Item 10

Travis County Commissioners Court Agenda Request

Meeting Date: 06/18/2013, 9:00 AM, Voting Session
Prepared By/Phone Number: Alan Miller, Planning and Budget, 854-9726
Elected/Appointed Official/Dept. Head: Leslie Browder, County Executive Planning and Budget
Commissioners Court Sponsor: Judge Samuel T. Biscoe

Review and approve requests regarding grant programs, applications, contracts and related special budgets, and permissions to continue:

A. New application to the Department of Defense for a $4,183,575 million federal grant to provide resources for an Email by Mail Ballot Creation, Encryption, Verification and Audit Project that will enable the County Clerk's Office to program and develop software for a proposed new STAR-Vote system. The potential cost of the new voting system is $8,233,850, which would leave a unfunded request of $4,050,275 if the grant was funded as requested;
B. New application to the Department of Defense for an Electronic Transmission of Ballot Portal request for Elections grant proposal in the County Clerk's Office a $19,950 grant to enhance the existing software in the County Clerk's Office; and
C. Contract with Texas Parks and Wildlife Department for Transportation and Natural Resources to construct a boat ramp at Pace Bend Park.

BACKGROUND/SUMMARY OF REQUEST AND ATTACHMENTS:

Item A is a proposal from the County Clerk to seek programming for a new voter system. Please see PBO memo for more detail.

Item B is a small request to the same funding source as Item A to enhance the ballot-by-mail system in the existing voter registration software.

Item C is a contract to construct a boat ramp in Pace Bend Park.

STAFF RECOMMENDATIONS:

PBO recommends approval.

ISSUES AND OPPORTUNITIES:

Additional information is provided on the grant summary sheets.

FISCAL IMPACT AND SOURCE OF FUNDING:

Please see PBO memo on item A.

Item B has no match requirement.
Item C has a match met by LCRA CIP Funds.

REQUIRED AUTHORIZATIONS:

Planning and Budget Office	Leslie Browder
County Judge's Office	David Salazar

TRAVIS COUNTY

6/18/2013

GRANT APPLICATIONS, CONTRACTS AND PERMISSIONS TO CONTINUE
FY 2013

The following list represents those actions required by the Commissioners Court for departments to apply for, accept, or continue to operate grant programs. This regular agenda item contains this summary sheet, as well as backup material that is attached for clarification.

	Dept.	Grant Title	Grant Period	Grant Award	County Cost Share	County Contribution	In-Kind Contribution	Program Total	FTEs	PBO Notes	Auditor's Assessment	Page #
Application												
A	120	Verifying UOCAVA Ballot Inclusion in Election Results	09/01/13 - 11/30/14	$4,183,575	$0	$0	$0	$0	1.00	R	EC	10
B	120	Electronic Transmission of Ballot Portal	09/01/13 - 11/30/14	$19,950	$0	$0	$0	$0	-	R	MC	70
** Amended from original.*												
Contracts												
C	149	Fire Mitigation Assistance Grant-Hodde Lane Fire #2957	09/04/11	$20,951	$0	$0	$0	$20,951	-	R	S	95

PBO Notes:

R - PBO recommends approval

NR - PBO does not recommend approval

D - PBO recommends item be discussed

County Auditor's Complexity Assessment measuring Impact to their Office's Resources/Workload

S - Simple

MC - Moderately Complex

C - Complex

EC - Extremely Complex

FY 2013 Grant Summary Report
Grant Applications approved by Commissioners Court

The following is a list of grants for which application has been submitted since October 1, 2012, and the notification of award has not yet been received.

Dept	Name of Grant	Grant Term	Grant Award	County Cost Share	County Contribution	In-Kind Contribution	Program Total	FTEs	Approval Date
117	Southeast Travis County Historical Survey	10/01/12 - 09/30/14	$7,500	$0	$6,000	$1,500	$15,000	-	10/30/2012
119	Underage Drinking Prevention Program	10/01/13 - 09/30/14	$161,204	$0	$35,951	$55,000	$252,155	3.00	11/6/2012
124	Formula Grant- Indigent Defense Grants Program	10/01/12 - 09/30/13	$441,998	$0	$0	$0	$441,998	-	11/27/2012
145	Juvenile Probation Pre-Doctoral Psychology Internship Program	7/1/13- 6/30/14	$34,306	$0	$0	$0	$34,306	-	12/4/2012
145	Juvenile Treatment Drug Court	9/30/2013- 9/29/2014	$199,970	$0	$0	$0	$199,970	-	1/8/2013
145	Juvenile Accountability Block Grant (JABG) Local Assessment Center	09/01/13 - 08/31/14	$61,334	$6,814	$0	$0	$68,148	-	1/22/2013
158	Coming of Age (CNCS)	04/01/13 - 03/31/14	$50,495	$324,753	$0	$0	$375,248	6.80	1/22/2013
147	Emergency Management Performace Grant	10/01/12 - 09/30/13	$71,221	$71,221	$0	$0	$142,442	-	2/5/2013
137	TCSO Child Abuse Victim Services Personnel	09/01/13 - 08/31/14	$23,092	$0	$34,639	$0	$57,731	1.00	2/5/2013
137	TxDOT Impared Driving Mobilization	03/1/13 - 09/30/13	$16,906	$5,684	$0	$0	$22,590	-	2/5/2013
124	Travis County Veterans' Court	09/01/13 - 08/31/14	$233,124	$0	$0	$0	$233,124	2.00	2/19/2013
124	Veterans Commission Grant	07/01/13 - 06/30/14	$49,470	$0	$0	$0	$49,470	-	2/19/2013
139	Travis County Adult Probation DWI Court	09/01/13 - 08/31/14	$228,460	$0	$0	$0	$228,460	4.00	2/19/2013
145	The Eagle Soars: An Educational and Career Development Program	09/01/13 - 08/31/14	$115,955	$0	$0	$0	$115,955	-	2/19/2013
145	Enhancing Services for Victims of Crime	09/01/13 - 08/31/14	$62,886	$15,722	$0	$0	$78,608	1.00	2/19/2013
145	Drug Court & In-Home Family Services	09/01/13 - 08/31/14	$181,000	$20,111	$0	$0	$201,111	0.23	2/19/2013

Dept	Name of Grant	Grant Term	Grant Award	County Cost Share	County Contribution	In-Kind Contribution	Program Total	FTEs	Approval Date
142	Drug Diversion Court	09/01/13 - 08/31/14	$155,838	$0	$0	$0	$155,838	2.00	2/19/2013
122	Family Drug Treatment Court	09/01/13 - 08/31/14	$143,438	$0	$0	$0	$143,438	1.00	2/26/2013
119	Family Violence Accelerated Prosecution Program	09/01/13 - 08/31/14	$84,954	$34,053	$0	$17,088	$136,095	1.77	2/26/2013
145	Trauma Informed Assessment and Response program	09/01/13 - 08/31/14	$193,808	$0	$0	$0	$193,808	0.50	2/26/2013
158	Parenting in Recovery II*	09/30/12 - 09/29/13	$625,747	$0	$268,195	$0	$893,942	1.00	2/26/2013
145	IMPACT: Investing in Minds to Prepare for A Career in Technology	10/1/13 - 09/30/14	$416,327	$0	$0	$0	$416,327	1.00	3/5/2013
137	K9s4COPs	04/01/13 - 09/30/13	$12,000	$0	$0	$0	$12,000	-	3/26/2013
145	Leadership Academy	10/01/13 - 09/30/14	$143,665	$47,888	$0	$0	$191,553	1.75	3/26/2013
158	Basic Transportation Needs Fund (Bus Pass Program)	09/01/13 - 08/31/14	$5,790	$0	$0	$0	$5,790	-	4/9/2013
145	FRESH Youth (Finding Regionally Sourced Food for High-Risk Youth)	11/01/13 - 10/31/14	$45,000	$15,000	$0	$0	$60,000	-	4/16/2013
157	NEH Preservation Assistance for Smaller Institutions	05/01/14 - 08/01/14	$6,000	$0	$0	$0	$6,000	-	4/16/2013
137	State Criminal Alien Assistance Program - SCAAP 13	07/01/11 - 06/30/12	$40,568,231	$0	$0	$0	$40,568,231	-	4/16/2013
137	SCATTIF Sheriff's Combined Auto Theft Task Force	09/01/13 - 08/31/14	$1,001,869	$134,184	$258,235	$0	$1,394,288	12.00	4/30/2013
145	Taking the Smart Path: Enhancing Assessment and Training to Address Youths' Needs	10/01/13 - 09/30/16	$644,987	$0	$0	$0	$644,987	-	4/30/2013
119	Other Victim Assistance Grant	09/01/13 - 08/31/15	$84,000	$0	$28,129	$0	$112,129	1.00	5/7/2013
123	Victim Coordinator and Liaison Grant	09/01/13 - 08/31/15	$84,000	$0	$0	$0	$84,000	-	5/14/2013
147	FY13 Homeland Security Grant Program / State Homeland Security Program (SHSP)-HAZmat ID	10/01/13 - 11/30/14	$22,500	$0	$0	$0	$22,500	-	5/21/2013

Dept	Name of Grant	Grant Term	Grant Award	County Cost Share	County Contribution	In-Kind Contribution	Program Total	FTEs	Approval Date
147	FY13 Homeland Security Grant Program / State Homeland Security Program (SHSP)-GASID	10/01/13 - 11/30/14	$9,500	$0	$0	$0	$9,500	-	5/21/2013
158	AmeriCorps	08/01/13 - 07/31/14	$298,671	$500,191	$0	$0	$798,862	31.00	5/21/2013
158	Parenting in Recovery II	09/30/13 - 09/29/14	$481,000	$259,000	$0	$0	$740,000	2.00	5/28/2013
145	National School Lunch/Breakfast Program & USDA School Commodity Program	09/30/13 - 09/29/14	$307,204	$0	$0	$0	$307,204	-	6/4/2013
145	The Eagle Soars: An Educational and Career Development Program*	09/01/13 - 08/31/14	$115,955	$0	$0	$0	$115,955	-	6/11/2013
			$47,389,405	$1,434,621	$631,149	$73,588	$49,528,763	73.05	

*Amended from original agreement.

FY 2013 Grant Summary Report
Grants Approved by Commissioners Court

The following is a list of grants that have been received by Travis County since October 1, 2012.

Dept	Name of Grant	Grant Term	Grant Award	County Cost Share	County Contribution	In-Kind Contribution	Program Total	FTEs	Approval Date
145	Travis County Eagle Resource Project	09/01/12 08/31/13	$29,930	$0	$0	$0	$29,930	-	10/2/2012
145	Trama Informed Assessment and Response Program	09/01/12 08/31/13	$192,666	$0	$0	$0	$192,666	0.50	10/2/2012
137	Sheriff's Office Command and Support Vessel*	9/1/12- 3/31/13	$250,000	$0	$0	$0	$250,000	-	10/16/2012
139	Travis County Adult Probation DWI Court	9/1/2012- 8/31/2013	$229,112	$0	$0	$0	$229,112	4.00	10/16/2012
147	Emergency Management Performance Grant	10/01/11 - 03/31/13	$71,221	$71,221	$0	$0	$142,442	-	10/16/2012
119	Family Violence Protection Team*	10/1/2010 03/31/2012	$699,507	$168,239	$0	$0	$867,746	4.50	10/23/2012
122	Family Drug Treatment Court	09/01/12 - 08/31/13	$137,388	$0	$0	$0	$137,388	1.00	10/23/2012
145	Drug Court & In-Home Family Services	09/01/12 - 08/31/13	$66,428	$7,381	$0	$0	$73,809	0.09	10/23/2012
158	Comprehensive Energy Assistance Grant*	01/01/12 - 12/31/12	$4,546,172	$0	$0	$0	$4,546,172	-	10/23/2012
158	Low Income Home Energy Assistance Program (LIHEAP) Weatherization Program	04/01/12 - 03/31/13	$817,334	$0	$0	$0	$817,334	-	10/23/2012
124	Travis County Veterans' Court	09/01/12 - 08/31/13	$186,000	$0	$0	$0	$186,000	2.00	10/30/2012
142	Drug Diversion Court	09/01/12 - 08/31/12	$132,585	$0	$0	$0	$132,585	1.00	10/30/2012
158	Parenting in Recovery II	09/30/12 - 09/29/13	$500,000	$0	$214,286	$0	$714,286	2.00	11/6/2012
158	Targeted Low Income Weatherization Program (TLIWP)	10/01/12 - 12/31/12	$42,061	$0	$0	$0	$42,061	-	11/6/2012
158	Seniors and Volunteers for Childhood Immunization (SVCI)	09/01/12 - 08/31/13	$8,845	$0	$0	$0	$8,845	0.14	11/20/2012
158	Coming of age (DADS)	09/01/12 - 08/31/13	$24,484	$24,484	$0	$0	$48,968	-	11/20/2012

Dept	Name of Grant	Grant Term	Grant Award	County Cost Share	County Contribution	In-Kind Contribution	Program Total	FTEs	Approval Date
158	DOE Weatherization Program	04/01/12 - 03/31/13	$60,471	$0	$0	$0	$60,471	-	11/20/2012
158	Atmos Energy Share the Warmth	11/01/12 - 10/31/13	$13,188	$0	$0	$0	$13,188	-	11/20/2012
139	Travis County Adult Probation DWI Court	09/30/12 - 09/29/13	$206,515	$0	$0	$0	$206,515	2.85	11/27/2012
137	State Criminal Alien Assistance Program-SCAAP 12	07/01/10 - 06/30/11	$492,999	$0	$0	$0	$492,999	-	11/27/2012
147	"Remembering When" Scholarship	12/02/12 11/01/13	$4,000	$0	$0	$0	$4,000	-	11/27/2012
158	Comprehensive Energy Assistance Program (CEAP)*	1/1/12-12/31/12	$4,546,172	$0	$0	$0	$4,546,172	4.00	12/4/2012
145	National School Lunch/Breakfast Program*	7/1/12-6/30/13	$217,219	$0	$0	$0	$217,219	-	12/4/2012
158	Title IV-E Child Welfare Services	10/01/12 - 09/30/13	$36,488	$81,190	$0	$0	$117,678	-	12/11/2012
137	2012 Byrne Justice Assistance Grant	10/01/12 - 09/30/15	$86,000	$0	$0	$0	$86,000	-	12/18/2012
158	2012 Phase 30 Emergency Food and Shelter Program	04/01/12 - 03/31/13	$25,000	$0	$0	$0	$25,000	-	12/18/2012
140	Safe Havens: Supervised Visitation and Safe Exchange program*	10/1/10-9/30/13	$400,000	$0	$0	$0	$400,000	-	12/28/2012
145	Juvenile Front End Therapeutic Services Program*	09/01/11-08/31/12	$17,617	$0	$0	$0	$17,617	-	1/22/2013
145	Residental Substance Abuse Treatment Program*	10/01/11 - 09/30/12	$132,063	$47,512	$0	$0	$179,575	1.00	1/22/2013
145	Eagle Resource Project*	09/01/11-08/31/12	$34,628	$0	$0	$0	$34,628	-	1/22/2013
137	Sheriff's Office Command & Support Vessel*	09/01/12 - 06/30/13	$250,000	$0	$0	$0	$250,000	-	1/29/2013
137	2010 UASI-Tactical Response Vehicle*	08/01/2010 - 07/31/12	$475,000	$0	$0	$0	$475,000	-	2/12/2013
147	2010 HSGP _ Travis County Haz. Mat. Detection and Decontamination Equipment and Related Maintenance*	08/01/2010 - 07/31/12	$39,938	$0	$0	$0	$39,938	-	2/12/2013

Dept	Name of Grant	Grant Term	Grant Award	County Cost Share	County Contribution	In-Kind Contribution	Program Total	FTEs	Approval Date
155	Justice Reinvestment Inititiave	03/01/13 - 02/28/15	$300,000	$0	$0	$0	$300,000	-	2/19/2013
147	2010 UASI Chemical Biological Radiological Nuclear Explosive (CBRNE) Strike Team Coordinator*	08/01/10 - 12/31/12	$250,000	$0	$0	$0	$250,000	1.00	2/26/2013
155	Justice Reinvestment Initiative (Arnold Foundation)	03/01/13 - 02/28/15	$69,012	$0	$0	$0	$69,012	-	2/26/2013
159	Capital Area Trauma Regional Advisory Council	05/01/12 - 08/31/13	$10,101	$0	$0	$0	$10,101	-	2/26/2013
158	Targeted Low Income Weatherization Program	03/01/13 - 11/30/13	$54,850	$0	$0	$0	$54,850		4/9/2013
158	DOE Weatherization Assistance Program	04/01/12 - 03/31/13	$60,471	$0	$0	$0	$60,471	-	4/9/2013
145	Juvenile Probation Pre-Doctoral Psychology Internship Program	07/01/13 - 06/30/14	$35,000	$0	$0	$0	$35,000	0.65	4/16/2013
158	Basic Transportation Needs Fund Bus Pass Program	09/01/12 - 08/31/13	$5,790	$0	$0	$0	$5,790	-	4/16/2013
158	Coming of Age (CNCS)	04/01/13 - 03/31/14	$16,832	$309,604	$15,149	$0	$341,585	6.00	4/23/2013
145	A Culture of Excellence: Enhancing Organizational Capacity to Exceed PREA Standards	04/01/13 - 03/31/14	$100,000	$0	$0	$0	$100,000	-	4/30/2013
158	Comprehensive Energy Assistance Program	01/01/13 - 12/31/13	$2,637,219	$0	$0	$0	$2,637,219	4.00	4/30/2013
158	AmeriCorps*	08/01/12 - 07/31/13	$291,671	$487,203	$0	$0	$778,874	31.00	5/21/2013
149	CAMPO Surface Transportation Program-Metropolitan Mobility; Blake-Manor Shared Use Path	05/21/13 - until complete	$2,208,400	$651,715	$0	$145,866	$3,005,981	-	5/21/2013
147	Fire Mitigation Assistance Grant- Perdernales Fire #2959	09/04/11	$306,990	$0	$0	$0	$306,990	-	5/28/2013
147	Fire Mitigation Assistance Grant- Steiner Ranch Fire #2960	09/04/11	$204,379	$0	$0	$0	$204,379	-	5/28/2013
158	Comprehensive Energy Assistance Program #58120001710	04/01/13 - 07/31/13	$1,263,589	$0	$0	$0	$1,263,589	-	5/28/2013

Dept	Name of Grant	Grant Term	Grant Award	County Cost Share	County Contribution	In-Kind Contribution	Program Total	FTEs	Approval Date
149	Fire Mitigation Assistance Grant- Hodde Lane Fire #2957	09/04/11	$20,951	$0	$0	$0	$20,951	-	6/11/2013
*Amended from original agreement.			$14,971,031	$400,027	$214,286	$0	$15,585,344	23.08	

FY 2013 Grants Summary Report

Permission to Continue

Dept	Name of Grant	Grant Term per Application	Amount requested for PTC: Personnel Cost	Operating Transfer	Total Request	Filled FTEs	PTC Expiration Date	Cm. Ct. PTC Approval Date	Cm. Ct. Contract Approval Date	Has the General Fund been Reimbursed?
137	Child Abuse Victim Services Personnel**	9/1/12-8/31/13	$8,920	$0	$8,920	1.00	10/31/2012	8/14/2012	N/A	Yes
119	Family Violence Accelerated Prosecution Program	9/1/12-8/31/13	$12,620	$0	$12,620	1.00	10/31/2012	8/21/2012	N/A	Yes
122	Family Drug Treatment Court	09/01/12 - 08/31/13	$10,922	$0	$10,922	1.00	10/31/2012	8/28/2012	N/A	No
124	Travis County Veterans Court	09/01/12 - 08/31/13	$25,630	$0	$25,630	2.00	10/31/2012	8/28/2012	N/A	Yes
142	Drug Diversion Court	09/01/12 - 08/31/13	$10,144	$0	$10,144	1.00	10/31/2012	8/28/2012	N/A	Yes
145	Juvenile Accountability Block Grant- Local Assessment Center	09/01/12 - 08/31/13	$13,747	$0	$13,747	1.00	11/30/2012	8/28/2012	N/A	Yes
145	Residental Substance Abuse Treatment Program	10/01/12 09/30/13	$15,046	$0	$15,046	1.00	12/31/2012	8/28/2012	N/A	Yes
158	Parenting in Recovery (PIR) FY 12	09/30/12 - 09/29/13	$94,630	$0	$94,630	-	12/31/2012	9/25/2012	N/A	Yes
158	Parenting in Recovery (PIR) FY 13	09/30/12 - 09/29/13	$84,756	$0	$84,756	-	12/31/2012	10/2/2012	N/A	Yes
158	Comprehensive Energy Assistance Program	1/1/2013- 12/31/2013	$29,196	$200,000	$229,196	4.00	3/31/2013	1/8/2013	N/A	No
158	Low Income Home Emergy Program	04/01/13 - 03/31/14	$0	$100,000	$100,000	-	6/30/2013	4/2/2013	N/A	No
158	Comprehensive Energy Assistance Program**	1/1/2013- 12/31/2013	$29,196	$300,000	$329,196	4.00	6/30/2013	4/2/2013	N/A	No
	Totals		$334,807	$600,000	$934,807	16.00				

TRAVIS COUNTY

FY 13 GRANT SUMMARY SHEET

Check One:	Application Approval: ☑ Contract Approval: ☐	Permission to Continue: ☐ Status Report: ☐
Check One:	Original: ☑	Amendment: ☐
Check One:	New Grant: ☑	Continuation Grant: ☐
Department/Division:	Travis County Clerk - Elections Division	
Contact Person/Title:	Susan Bell/Deputy County Clerk	
Phone Number:	x49587	

Grant Title:	Verifying UOCAVA Ballot Inclusion in Election Results	
Grant Period:	From: Oct 1, 2013	To: Mar 31, 2015
Fund Source:	Federal: ☑ State: ☐	Local: ☐
Grantor:	Department of Defense	
Will County provide grant funds to a sub-recipient?	Yes: ☐	No: ☑
Are the grant funds pass-through from another agency? If yes, list originating agency below.	Yes: ☐	No: ☑
Originating Grantor:		

Budget Categories	Grant Funds	County Cost Share	***Budgeted County Contribution #595010 (Cash Match)***	In-Kind	**TOTAL**
Personnel:	$ 176,514	$ 0	$ 0	$ 0	$ 176,514
Operating:	$ 4,007,061	$ 0	$ 0	$ 0	$ 4,007,061
Capital Equipment:	$ 0	$ 0	$ 0	$ 0	$ 0
Indirect Costs:	$ 0	$ 0	$ 0	$ 0	$ 0
Totals:	$ 4,183,575	$ 0	$ 0	$ 0	$ 4,183,575
FTEs:	1.00	0.00	0.00	0.00	1.00

Permission to Continue Information					
Funding Source (Cost Center)	Personnel Cost	Operating Cost	Estimated Total	Filled FTE	PTC Expiration Date
	$ 0	$ 0	$ 0	0.00	

Department	Review	Staff Initials	Comments
County Auditor	☐		Currently under review
County Attorney	☐		Currently under review

Performance Measures					
#	Measure	Actual FY 11 Measure	Projected FY 12 Measure	Projected FY 13 Measure	Projected FY 14 Measure
+ -	Applicable Departmental Measures				
1.	Number of Federal postcard applications received	N/A	950	3122	900
2.	Number of email ballots sent	N/A	587	2360	810
3.					
+ -	Measures for the Grant				
1.	Number of Federal postcard applications received	N/A	950	3122	900
	Outcome Impact Description				
2.	Number of email ballots sent	N/A	587	2360	810
	Outcome Impact Description				
3.	Number of email ballots accessed	N/A	N/A	N/A	N/A
	Outcome Impact Description				

PBO Recommendation:

See PBO memo for more information.

1. Brief Narrative - Summary of Grant: What is the goal of the program? How does the grant fit into the current activities of the department? Is the grant starting a new program, or is it enhancing an existing one?

This project focuses on the ballot building, marking, printing, verifying, counting, and auditing processes of an electronically transmitted ballot by mail for UOCAVA voters (military, overseas, and their spouses; and U.S. citizens residing outside the United States and its territories). Through the use of an online application, we can address the issues of encryption, hash codes, security, ballot anonymity, and ballot remake which gives the voter the opportunity to verify that not only their vote is counted, but counted correctly. This program would dovetail with our online ballot transmission proposal in that when a voter is emailed a link to their ballot through the EZAcess application, the link would take them to the ballot building program which would generate their ballot, allow the voter to mark their ballot, and print the ballot for return to the county.

$146,699 is requested to support a Project Manger position from grant funds. The position will be a grade 30, step 3 for the grant period of 1.49 years. The position will be supported by grant funds of 73.3%. The County will seek additional outside funding to offset the balance of the cost of the postion.

2. Departmental Resource Commitment: What are the long term County funding requirements of the grant?

The software developed will not require future licensing fees, but it will need to be maintained and updated as necessary.

3. County Commitment to the Grant: Is a county match required? If so, how does the department propose to fund the grant match? Please explain.

There is no grant match for the project.

4. Does the grant program have an indirect cost allocation, in accordance with the grant rules? If not, please explain why not.

Due to the amount of this grant request, we believe we have a higher chance of obtaining federal funding if we do not add in an indirect cost allocation.

5. County Commitment to the Program Upon Termination of the Grant: Will the program end upon termination of the grant funding: Yes or No? If No, what is the proposed funding mechanism: (1) Request additional funding or (2) Use departmental resources. If (2), provide details about what internal resources are to be provided and what other programs will be discontinued as a result.

No, the program will continue as the purpose is to replace our existing voting system. The funding mechanism is to be determined after we receive grant notification. We will request additional funding.

6. If this is a new program, please provide information why the County should expand into this area.

Not a new program, but a replacement for our current election voting system.

7. Please explain how this program will affect your current operations. Please tie the performance measures for this program back to the critical performance measures for your department or office.

The program will allow email voters the ability to mark their ballots before printing, reduce the number of remake errors, the ability to receive a receipt which will verify that their vote counted and was part of the official tally and supply substantial evidence that their vote was correctly recorded.

PLANNING AND BUDGET OFFICE
TRAVIS COUNTY, TEXAS

314 W. 11th Street
P.O. Box 1748
Austin, Texas 78767

MEMORANDUM

TO: Commissioners Court

FROM: Alan Miller, Budget Analyst

DATE: June 8, 2013

RE: Grant application to the United States Department of Defense developed by the County Clerk to fund the development of software to support a new voting system.

The County Clerk is proactively seeking funding to support the development of software necessary to implement a new voting system incorporating design ideas and concepts envisioned by the Travis County Clerk's Election Study Group. The findings of the Elections Study Group were presented to the Court on October 19, 2010. I have included the motion that was approved at the end of this memorandum. Also, the County Clerk submitted a budget request in FY 2013, indicating that a new voting system would likely be presented for funding in FY 2014/ FY 2015.

The County Clerk has estimated a one-time cost of $8,233,850 that was included as an FY 14 budget request for the software and hardware costs of the proposed new system. A grant from the U.S. Department of Defense (DoD) to improve the system by which members of the armed forces and oversea voters absentee vote may be available to reduce the potential cost to Travis County for the new system. The request to the DoD totals $4,183,575 and would substantially reduce the potential cost to the County from $8,233,850 to $4,050,275 should a new system and grant be approved.

The County Clerk has submitted the proposal for discussion and with the intent to implement the new system by November, 2015. The County Clerk's request consists of two major parts:

$5,733,850 for Software Development: This will cover the development and testing of software for the new voting system. The project includes the development of 59 self-contained functional elements and data interfaces as well as project management, administrative, and academic consultant costs. This includes two development contractors – one for general development and one specializing in complex cryptography. Additionally, $590,000 is included in the programming costs for a contractor specializing in secure software engineering. A contingency factor has been included for elements considered to be a high risk of cost or time over runs.

$2,500,000 for Hardware Costs: Hardware costs include approximately 3,000 computer tablets, 2,500 printers, 600 bar code scanners, 500 ballot boxes, and other associated peripherals.

This grant would reduce the need for Software development by up to $4,183,575, to an estimated $1,550,275 in software and $2,500,000 for a total cost of $4,050,275.

As part of the continuing discussion of this proposal, PBO recommends the development of estimated ongoing costs to maintain and modify the system annually and to replace the hardware purchased to support the new system and what the expected lifespan of the new system.

Due to the very tight application deadline of the grant, the County Clerk has not had the time for the more formal budget presentation that was envisioned as part of the FY 2014 budget process. However the submission of the grant application does not obligate the Court toward any specific funding requirement, there is no County Match or commitment to fund the system beyond what is supplied through the grant. PBO notes that the funds available from the grant opportunity total $10,000,000 for the whole Country.

Given the potential source of funding to assist with this project PBO recommends approval of the grant application. However, independent of the grant process, PBO recommends the department continue with the current plans to present the project more formally to Commissioners Court.

Additional Background:

When current voting system was purchased starting in FY 2001, the cost of the equipment was $4,802,759.64 of which $4,330,238.42 was purchased either with grants or federal program income. Unfortunately Federal funding from the Help America Vote Act is no longer available. It is unlikely similar additional grant dollars will be appropriated to help offset replacement system costs outside of the opportunity discussed here.

The need for a new voter system and the findings of the Election Study Group were presented to Court on October 19, 2010 at which time the following motion was approved:

Motion by Judge Biscoe **and seconded by** Commissioner Eckhardt:

- Accept and approve the study group's report and recommendations, which includes move to a paper ballot system with electronic tally as soon as possible.
- Implement this after the 2012 Presidential Election for the reason stated by the study group.
- Continue to use the current system.
- Add vote centers as soon as possible with no adverse impact on polling precincts, so at the appropriate time we'll review that.
- The County Clerk continue to write and refine voting system specifications, that that be completed as soon as possible.
- Commissioners Court be kept informed, and let us express our full appreciation to all members of the study group.

A Friendly Amendment to the previous Motion was offered by Commissioner Eckhardt that the paper ballot be verified sooner than 2012.
Acceptance of the Friendly Amendment was made by Judge Biscoe.

Cc: Leslie Browder, Jessica Rio, Travis Gatlin, PBO
Dana DeBeauvoir, County Clerk
Susan Bell, County Clerk's Office

Verifying UOCAVA Ballot Inclusion in Election Results

Online Blank Ballot Delivery within STAR-Vote

Technical Proposal

Catalog of Federal Domestic Assistance Number: **12.219**

BAA number: **H98210-13-BAA-0001**

Applicant: **Travis County, Texas**

Administrative Contact:

Dana DeBeauvoir
Travis County Clerk
Travis County Elections Division
5501 Airport Boulevard, Austin, TX 78751
Phone: +1 (512) 854-9188
E-Mail: Dana.DeBeauvoir@co.travis.tx.us

Technical Contact:

Bryce Eakin
Technical Lead
30-61 43rd St., Astoria, NY 11103
Phone: +1 (713) 703-8242
E-mail: Bryce.Eakin@outlook.com

Specific subcontractors not yet determined.

Proposed Term: **October 1st, 2013 through March 31st, 2015**, with continued reporting through November, 2018.

Table of Contents

1. Technical Approach and Justification

Executive Summary

Travis County, Texas, is currently in the early stages of developing a paradigm-shifting direct recording electronic (DRE) voting system called STAR-Vote. STAR-Vote represents a revolution in election technology, enabling evidenced-based elections where each election outcome is verified, validated, and transparent.

With STAR-Vote, we set out design a new kind of voting system: A voting system that combines the speed, reliability, and accessibility of electronic voting with the confidence of a paper ballot. A voting system both designed to be the most secure available – and created with such strong processes and controls that you don't have to trust the software to trust the election outcome. A voting system designed to make elections secure, transparent, auditable, and reliable to an extent never before deemed possible – and to do it using off the shelf hardware, keeping maintenance and replacement costs lower than ever before.

This document proposes that by providing a STAR-Vote ballot to UOCAVA covered voters electronically, we can allow these voters to receive many of the benefits that STAR-Vote promises to voters in polling locations, including:

- The ability to make their selections on a computer (through a web interface, via mouse, touch-screen, or other input device) with accessibility features and clear notification of undervotes, resulting in an improvement in ballot marking accuracy and ease of use;
- The ability for the voter to receive a 'receipt' containing a 15-20 digit alphanumeric code unique to their ballot and which **permits them to verify, virtually beyond doubt, that their vote was recorded and is part of the official tally;**
- Substantial evidence that the voter's selections, as indicated on the paper ballot they mail in, were correctly recorded for use in the official tally;

Our proposal makes use of STAR-Vote's unique architecture to provide the above features to UOCAVA covered voters without any electronic transmission of the voter's selections.

To support the development of this system, Travis County requests grant funding of $4,183,575. The expected term of this project is October 1st, 2013 through March 31st, 2015, with monitoring and reporting of data on UOCAVA voting improvements through the 2018 congressional election.

Finally, it is the purpose of Travis County to release STAR-Vote's complete software base as a managed open source project once completed, so as to ensure continued innovation around this exciting new platform and encourage its wide adoption.

Due to cost and concerns about mission creep, we had previously intended to leave enhanced UOCAVA features to a later software revision – however, with FVAP support, we can ensure that these features are delivered as a first-class component of STAR-Vote, with the potential to reach as many uniformed and overseas voters as possible.

Goals and Objectives

STAR-Vote Background

History and Purpose

STAR-Vote emerged as a collaboration between Travis County Elections Division and several leading researchers[1] in the areas of elections system design, security, audit, and human factors. With its initial design conceived in early 2012 and iteratively refined to the present, it has come through many hurdles and now, we believe, has sufficient momentum and clarity to be brought into active development.

STAR-Vote attempts to provide numerous benefits to modern elections, including:

- **Security through software independence** – neither software bugs, nor malicious code should alter an election outcome without detection and, whenever possible, correction.
- **Verifiability** – every stage of the system should be verifiable, from the recording of votes on individual machines, to the tallying process, through to post-election audits.
- **Transparency** – in every aspect of an election in which interested members of the public would wish to independently audit the results or process, and in which that may be achieved without risking voter privacy, provide the means for them to do so.
- **Meaningful audits** – design the system from the ground up to support meaningful, risk-limiting audits which can provide statistical guarantees that if a result is reported incorrectly, we will catch and correct it through a manual recount with no less than a selected probability. Provide complete, detailed privacy-retaining audit trails to aid forensic investigation of irregularities.
- **Reliability** – fault tolerance is built in at every stage of the process, data is redundantly recorded throughout, and no one person or entity should be able to compromise the integrity or privacy of the election. At worst, errors should not be able to undetectably alter an election outcome, at best they should be correctable.

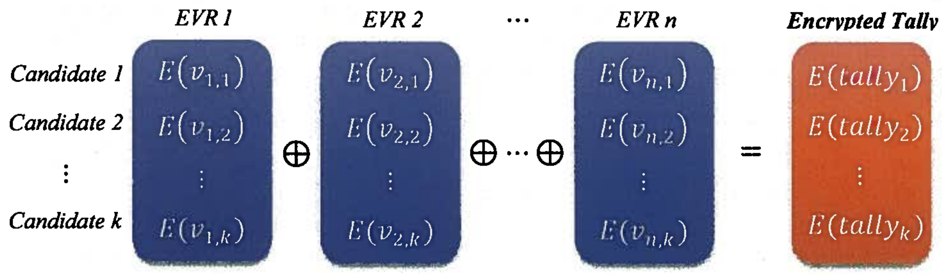
We rely on a number of advanced technologies to address these goals.

Technological Background

Homomorphic Encryption – Votes, stored in Electronic Vote Records (EVRs), are encrypted using an additively homomorphic, commitment consistent encryption scheme, most likely Exponential El Gamal for this initial implementation. Roughly speaking, an additively homomorphic encryption algorithm is one that lets you take two encrypted numbers and 'add' them into an encryption of the sum of the two numbers.

[1] Josh Benaloh, *Microsoft Research*
Michael D. Byrne, *Rice University*
Philip Kortum, *Rice University*
Neal McBurnett, *ElectionAudits*
Olivier Pereira, *Université catholique de Louvain*
Philip B. Stark, *University of California, Berkeley*
Dan S. Wallach, *Rice University*

Each EVR contains a slot for an encrypted vote (0 or 1) for each candidate / option for which that voter is authorized to cast a vote. Because of the additive homomorphic property, this means that given a set of EVRs with encrypted votes of 0 or 1 for each candidate / option on their ballots, it is possible to homomorphically add all their encrypted votes and arrive at a valid encryption of the tally for each candidate / option without ever decrypting individuals' votes and therefore endangering their privacy. Here is an illustration of this principle:



This has two important effects – 1) we can calculate an encrypted tally and decrypt that without having to trust anyone or any piece of software with individuals' plain-text votes; 2) we can **publicly release the EVRs** enabling anyone to calculate a valid encrypted vote tally.

Commitment Consistency – This second property of the selected encryption system means that given that you have an encryption of *n*, $E_k(n)$, if another party claims that they are able to decrypt $E_k(n)$ and that its decryption is *n*, they can provide additional information in the form of a non-interactive, zero-knowledge (NIZK) proof that $E_k(n)$ is a valid encryption of *n*, and can do so with mathematical certainty, without providing the decryption key. Thus, we have made it possible for members of the public to **independently verify** the complete set of EVRs which were included in the tally, and **verify that the published tally corresponds to the sum of these votes**.

When a voter finishes voting in a polling location, or remotely as an absentee voter in our proposed system, they receive a receipt[2] with a 15-20 digit alphanumeric code on it. This code is the cryptographic hash (for a selected and public cryptographic hash function, most likely SHA1) of the EVR containing their votes. When the election is complete, and the complete set of EVRs is published, it is therefore possible for interested members of the public to independently calculate the cryptographic hash of every EVR which has been proven to have been counted in the final tally. Any voter can look up his hash on one of these published lists (one will be provided by Travis County in the proposed software with a web interface) and, if found, **verify with high confidence that his ballot has not been tampered with, and was included in the final tally.**

This is the essence of what we want to make possible for the UOCAVA voter community.

Threshold Public Key Encryption – There is one final technology that is key to ensuring the relative privacy of voters once their votes are received, and that is Threshold Public Key Encryption. Threshold public key encryption allows you to have *n* individuals generate separate private / public key pairs (as would be used in traditional asymmetric key encryption), and from their public keys

[2] The term 'receipt' will not be used in the final system due to undesirable connotations.

calculate a combined threshold public key for a selected threshold k (where $k \leq n$), which may be used to encrypt data such that in order to decrypt that data, at least k of the original private keys must be available.

What this gains us is that we can create a public key with which all vote data will be encrypted which requires multiple individuals to be present in order to decrypt it. We propose that these *Election Trustees* would be composed of multiple individuals with differing interests (party representatives, members of the local Election Board, etc.) so as to minimize the likelihood of collusion. Then, in order to decrypt any votes, at least the threshold number of Trustees must be present and take part in the process. Under such a system **it becomes nearly impossible for a single individual, or even an entire election office to violate the privacy of voters via their electronically stored votes.**

Full STAR-Vote, including polling-location software and audit involves a number of additional features which are beyond the scope of what is necessary to provide our proposed functions for UOCAVA voters. The complete STAR-Vote system is outlined in a paper currently submitted for publication in the USENIX Journal of Election Technology and Systems (JETS), a working draft of which is attached to this proposal. Please refer to this paper for a more complete walkthrough of STAR-Vote including elements not related to the features we seek to provide UOCAVA

Fully functional reference implementations of the requisite software to provide the various independent verifications described above will be created as part of this project and released under a suitable open source license for the public's unlimited use.

What this enables for UOCAVA voters

Each UOCAVA voter who is registered for absentee voting, and who has provided a valid e-mail address (these are already collected as part of registration by Travis County) will be sent a digitally signed e-mail once their ballot is available. This e-mail will contain a link to a web application which provides the exact same user interface that would be shown to voters in a polling location on the DRE voting machines. The voter will be able to make their selections via standard input devices (mouse or keyboard) or via touch if accessing the web application from a touch-enabled device, and a browser that supports touch events. The precise design of the ballot display is a subject of ongoing discussions, but each race will be presented sequentially and independently, and the presentation will be compliant with the latest draft revision of the Voluntary Voting System Guidelines (VVSG), currently the 1.1 (2007) revision, with regard to the interface of a Voter Editable Ballot Device – Visual (VEBD-V).

When the voter has completed his selections, he will be presented with a summary screen which allows him to alter any race's selection as he likes, and when complete, to create his ballot. Upon clicking "I'm Done", the web application will use a random seed provided electronically by Travis County to encrypt the voter's selections and create an Electronic Vote Record (EVR) in precisely the same manner as a STAR-Vote terminal would in an actual polling location, but excluding any hash chain or machine identifier. It then calculates the cryptographic hash of that EVR, and discards the EVR and the voter's selections. The hash is presented to the voter as 15-20 alphanumeric characters along with instructions on how this may be used to verify that their vote was received and included in the final tally. This information may also be e-mailed to the voter (pending further security / privacy analysis), along with instructions for how to notify Travis County if the voter believes their online ballot was completed fraudulently. During this process, certain Non-Vote Encoding Cryptographic Primitives (NVECPs) may be exchanged between the voter's computer and Travis County servers to improve the strength of the guarantees attached.

The page also provides instructions to the voter regarding how to print his ballot and mail it in. At the bottom of the page is a button that says "Print or Save Ballot", which loads a PDF file (to ensure fidelity) generated by the web application containing all of the voter's selections in a format compatible with the printed ballot records used by STAR-Vote in polling locations. The voter's selections will be printed in plain text for easy review, in an OCR-friendly font for reliable scanning. There may be a small amount of additional data as required to enable perfect reconstruction of the EVR, however this data will in no way tie the ballot back to the specific voter or endanger the privacy of his ballot.

Once Travis County receives the paper ballot, each page will be scanned using optical character recognition (OCR) technology to reconstruct the voter's selections. From this, and the additional data on the pages, as well as the random seed known by Travis County to be associated with the ballot identifier on the paper ballot, a perfect reconstruction of the EVR can be achieved, and added to the public record of all EVRs included in the final tally. The hash of this EVR will only match the hash the voter received if every selection is correctly read from the paper, and since the voter can check the paper ballot before sending it in, if the hashes match, this serves as substantial evidence that the voter's ballot has been recorded and recorded correctly.

Once the election has taken place, a tally will be released including, as described above, information sufficient to prove that independently calculated homomorphic sums of publicly released cast EVRs correspond to the tally provided. This enables virtual certainty that specific EVRs were counted in that tally. If the hash of one of those EVRs corresponds to the hash provided to the UOCAVA voter, they have independently verified their ballot was included in the final tally.

Travis County will provide as part of the hash lookup web site an indication that the ballot was counted, but the point is that the voter need not trust Travis County, and can prove himself, or with the aid of an interested 3rd party, that his ballot was counted. More importantly, this functionality is provided without increasing the risk that the voter's privacy may be violated.

Estimated reduction of failure rates

Voter Registration / Absentee Ballot Request

This proposal does not attempt to address failures in voter registration or absentee ballot requests.

Blank Absentee Ballot Delivery

Travis County currently has in development a system which, for registered by-mail and UOCAVA voters who have provided a valid e-mail address, would electronically deliver a link to a PDF version of their ballot to be printed and manually marked. The proposed system will build on and improve upon this by providing a computerized ballot, rather than a PDF to be printed and manually marked.

Absentee Ballot Marking

Our goal is a complete elimination of overvotes, a reduction of ½ in unintentional undervotes, and a statistically significant reduction in the rate of vote errors (voting for a different candidate than intended).

The academic evidence regarding error rates in sequential Direct Recording Electronic (DRE) voting systems vs. hand-marked paper 'bubble' ballots is mixed. The available data indicates (Everett, et al., 2008) that, at least in the laboratory, there is no statistically significant difference in error rates between these two methods.

However, computer marked ballots provide a guarantee that certain types of errors will be completely avoided – most visibly, accidental overvotes. Additionally, there is a possibility of reducing unintentional undervotes substantially by, on the summary screen, clearly separating and highlighting races in which the individual has made no selection. Furthermore, we hypothesize that the additional visual richness and clarity which may be offered by a computerized interface promises to make erroneous votes more obvious, in particular when the individual intends to vote mostly for candidates of a single party (for states in which party display is permitted).

The problem in demonstrating this reduction is that it is not measurable during elections, due to the fact that the only true method of judging error rates requires first knowing the voter's intent. Therefore, we propose to coordinate with faculty at Rice University, and will have them conduct an independent analysis of our system's relative performance as compared to the existing hand-marked paper once we reach the necessary milestone.

Absentee Ballot Tabulation

Compared to human-marked ballots, reading intent from printed ballots is far less error prone. As evidenced by the drama around hand-marked ballots in close elections, stray marks, non-enforcement of proper vote alteration, and other problems, systematically bias the ability of computers, and even humans, to correctly judge the intent of the voter.

Our process not only removes human error or questions of intent from the process of tabulation, it fundamentally improves confidence in the tabulation by making it possible for the voter to independently verify that his ballot has been included in the final tally.

Absentee Ballot Return Verification

STAR-Vote offers a strict improvement in verification over existing solutions as the voter can now not only see that his ballot has been received, but verify that it has been recorded accurately and added to the final tally with very high certainty.

Impact / Improving Other Jurisdictions

In the 2012 General Election, Travis County serviced 3,122 FPCA applications. However, a number of counties have indicated interest in making use of STAR-Vote, specifically Williamson, Bexar and Dallas Counties in Texas, and Los Angeles County in California. Bexar and Los Angeles Counties are two of the five counties with the most UOCAVA voters in the nation. While these jurisdictions are not actively participating in development at this time, each has indicated a desire to evaluate and potentially adopt STAR-Vote as it approaches realization.

For the initial release of STAR-Vote we are focusing on Texas and Travis County requirements to avoid mission creep and reduce time to market. However, we will explicitly be including support out of the gate for an additional voter registration system – Votec – and have received a commitment from Votec to collaborate with us to ensure compatibility. Votec is currently used by 29 counties in Texas, including Bexar, Dallas, and Williamson counties.

Additionally, STAR-Vote will be open source, is engineered to be standards-based so as to minimize the cost of integration with different voter registration and election management systems, and is designed to rely as much as possible on off-the-shelf (COTS) hardware, substantially reducing the costs and risks of adoption (See Budget Proposal, ROI for further discussion).

Security Measures and Threat Model

There are generally four attack types we consider with regard to UOCAVA voters with STAR-Vote: privacy, integrity, confidence, and availability / denial of service attacks.

Privacy Attacks

As with all by-mail voting, there are limitations on the degree to which we can thwart voters who willingly compromise their own privacy. However, there are some new risks that must be addressed when dealing with computerized voting.

Proving votes to a coercer – We want to limit the voter's ability to prove that he voted a specific way. We do this by ensuring that the hash provided is never directly connected with the printed ballot (not in the same e-mail, not visible on the same screens, not included on the ballot, etc.) so that a voter could provide a printout with what a coercer wants to see alongside a hash of a different ballot. Second, we do not provide all the information necessary to reconstruct the hash or decrypt the related EVR's contents on the paper ballot – the random seed used to initialize the votes' encryption is retained as a secret known only to Travis County.

Middleman – In any internet communication there is the risk of interception or modification of the data being transmitted. To thwart such attacks, all communication between the voter's computer and Travis County servers will be performed using standard HTTPS secure communication.

Eavesdropping – There is a risk that malware on the computer can "eavesdrop" on the user's selections. One of the technologies we rely on in polling locations to provide confidence that machines are not malware-infected are Trusted Platform Modules (TPMs), which enable trusted boot. Since virtually every laptop computer sold in the last decade has a TPM, we are exploring ways to leverage this poll-site protection for UOCAVA voters. This is an area of active research.

Attack on the publicly released encrypted ballots – Part of our system involves publishing a public version of the EVRs for use in independent homomorphic tallying and verification. If our selected encryption, El Gamal, is broken, or someone successfully eavesdrops on the random seeds used for various voters' encryptions, it would be possible to extract the voter's selections from this public commitment. However, it is not a requirement of our design that we publish the full cyphertext. There are algorithms which would allow all the same properties to be gleaned without divulging full cyphertexts, thus defeating such attacks – in particular the algorithm PPAT1 (Cuvelier, Peters, & Pereira, 2012). However, we deem it technically infeasible at this time to attempt a practical, in-browser implementation of such algorithms, and as such leave them for future revisions.

Integrity Attacks

Attacks on proper vote recording – The voter has the ability to review the paper ballot – since votes are recorded from this plain-text, and voters may alter/reprint their votes as necessary, this attack is easily thwarted.

Error or willful fraud by election officials – By enabling independent public audit of the data used in tallying the election, and enabling the voter to verify that his hash matches the hash of a ballot included in that tally, voters now have the ability to test whether their votes were recorded and included correctly. It is not clear at this time precisely how to best ensure that the hash provided to the voter may be court-admissible in the circumstance that the hash is not found in the public record – this is an area of active research.

Publishing of false EVRs calculated to match the voter's hash – This is theoretically possible given what has been described thus far, through brute force selection of random data in the encrypted vote slots of the EVRs. However, all EVRs contain non-interactive, zero-knowledge (NIZK) proofs sufficient to demonstrate that every vote is either 1 or 0, and that the EVR is well-formed. As such, the probability of successfully constructing a valid EVR with a given hash is infinitesimal.

Confidence attacks

Providing a false hash – It is conceivable that a clever attacker could introduce malicious code such that the hash that is provided to the voter is incorrect. It could be a hash that would lead the voter to believe his vote was not cast when it was. It could similarly be a valid hash, simply not related to his particular ballot. This is why we say that finding the voter's hash in the public audit trail is strong evidence (though not proof) of correctness, while not finding it is only evidence that something went wrong somewhere in the process. We believe this attack can be thwarted, or at least its threat minimized, through the exchange of certain Non-Vote Encoding Cryptographic Primitives (NVECPs) between the voter's computer and Travis County servers, though the precise form this will take is an area of active research.

Availability / Denial of Service Attacks

Server-side – Attacks on IT infrastructure designed to limit access are a well-known problem, with well-established solutions outside the scope of this specific proposal.

Client-side – Attacks which aim to prevent a computer or a group of computers from using this system may be thwarted by using a different computer, downloading and printing the physical ballot to fill out and mail in, or by requesting a physical ballot by mail.

Unforeseen Attacks

We propose to engage the services of a "red team" – a company which would be involved at every step of development and whose purpose would be to find ways to break the system. As they identify additional attack vectors we will continue to make use of the researchers behind this project to ensure that the final product is as robust to as large a range of threat models as possible. We propose to allocate a pro-rata portion of the red team's budget to this grant request.

2. Schedule and Milestones

Travis County will follow all county procedures with regards to procurement during this process, which means the release of a RFP and the opening of a bidding process and negotiation whenever a vendor is required. With this in mind, our schedule is as follows:

- October 1st, 2013:
  - Project Manager hired and trained.
- October 15th, 2013:
  - STAR-Vote RFP released, bidding process for primary software contractor opened.
  - RFP / Bidding process opened for "Red Team"
  - Vetting process underway for a capable crypto subcontractor.
- January 15th, 2014 – RFP closed; review process and discussions begin.
- March 1st, 2014 – Request "best and final offers"
- March 15th, 2014 – Vendors selected and contracts finalized.
- **Milestone** – April 1st, 2014 – Careful system design begins as a collaboration between the primary vendor and the "Red Team", ensuring that the vendor engages in good, modular system design, engineered from the beginning for security. A complete object model is laid out, with well specified interfaces and standards-derived data formats. Crypto-relevant interfaces are finalized and shared between primary contractor and crypto specialists.
- April 1st, 2014 – Initial design meeting
- April 8th, 2014 – Preliminary design review
- April 22nd, 2014 – Critical design review
- **Milestone** – May 1st, 2014 – Software development begins in parallel by both the primary contractor and the crypto subcontractor. Each works through the discreet subcomponent lists in the order specified in Appendix A, or some variant agreed to with the contractor(s).
- **Milestone** – June 4th, 2014 – the Auditorium Network software layer will be complete, enabling reliably replicated, logged messages between all Auditorium-enabled devices on a physical network. This forms the backbone of all networked computer interaction in STAR-Vote.
- **Major Milestone** – June 25th, 2014 – the ballot display and interaction software subcomponent should be complete, enabling a demo of on-screen ballot interaction. This may be sufficient to begin usability testing in tandem with Rice University.
- **Milestone** – July 17th, 2014 – the proprietary Ballot Box Scanner hardware is functional and tested.
- **Major Milestone** – August 28th, 2014 – we should be able to demonstrate the creation of a threshold public key, homomorphic encryption of data using that key, homomorphic addition of that data, and the subsequent joint decryption of that sums via linked computers (or software) over an Auditorium layer network. This represents the first major technological hurdle in enabling the core functionality of STAR-Vote.
- **Milestone** – August 26th, 2014 – homomorphic encryption successfully ported to JavaScript, the first major hurdle in enabling UOCAVA-related features.

- **Major Milestone** – November 27th, 2014 – Creation and validation of NIZK proof systems complete and tested. Second major cryptographic milestone.
- **Major Milestone** – December 12th, 2014 – All in-polling-location systems complete. Demonstration of complete in-polling-location setup and process now possible.
- **Major Milestone** – December 23rd, 2014 – All systems requiring the specialist crypto contractor are complete and tested.
- **Major Milestone** – December 24th, 2014 – All in-county election certification software complete and tested.
- **Development Completion** – February 26th, 2015 – Primary development and testing of all software components complete.
- **Final Integration Testing Complete** – March 26th, 2015 – Fully integrated system stress tested using end-to-end election scenarios.
- **Major Milestone** – April 6th, 2015 – Full demonstration small-scale mock election run by primary vendor, from data collection through to tallying and internal / public audit. Includes multiple simulated polling locations, demonstration of redundancy to hardware, power, and other failures, and accessibility usage.
- **Milestone** – May 1st, 2015 – Relevant portions of the completed system submitted to Texas Secretary of State's office for certification.
- **Milestone** – May 15th, 2015 – Travis County begins internal testing, development of procedures, and training for the new system.
- **Major Milestone** – November 3rd, 2015 – Travis County uses STAR-Vote in its first election with limited deployment in polling locations only (UOCAVA voters are not included in non-Federal elections), in parallel to existing systems.
- **Major Milestone** – November 8th, 2016 – Travis County uses STAR-Vote for the 2016 Presidential Election, with full deployment of UOCAVA voter capabilities, providing the best demonstration of its maturity as a viable large-scale election system, and of its potential to enfranchise UOCAVA voters.

A prioritized breakdown of the expected schedule for development by functional subcomponent may be found in Appendix A.

3. Management Approach

Strategic Goals

- Improving ease, transparency, verifiability, and credibility of voting for UOCAVA voters and the general population.
- Enabling evidence-based elections, which allow us to move away from certifying hardware or software, and toward verifying each election outcome.
- Changing the landscape of elections from a siloed, proprietary hardware/software model, to an open, standards-based hardware/software model with vendors acting as integrators.
- Democratizing the electoral process by allowing ordinary people to validate the propriety of the process.

Project Management

Team

Travis County Clerk's Office

The Elections office at Travis County boasts an extraordinarily stable team, having had many of the same personnel through their past 3 voting technologies, spanning back to the late 80s. The Travis County Clerk, Dana DeBeauvoir, has held the office continually since 1986 enabling an extraordinary base of expertise to form in election systems, management, and logistics. Their knowledge has been essential in enabling the design of a system which both meets the lofty goals of its designers, and yet meets the practical requirements of an Elections office.

Furthermore, this consistency has allowed Dana and her staff to develop deep ties with key players throughout the elections industry, in the Texas legislature, and in the Texas Secretary of State's Office. These contacts have been crucial in clearing the way for STAR-Vote to proceed, and will help ensure that those legislative or regulatory hurdles which remain to be resolved do not interrupt the STAR-Vote project.

Technical Lead

Bryce Eakin, CFA, MBA, is acting as technical lead on this project, and has thus far been responsible for project management duties as well. Bryce has received a B.A. in both Computer Science and Economics from Rice University, as well as a M.B.A. from Oxford University. Additionally, he studied voting systems and graduate-level computer security during his undergraduate education. He additionally has direct experience designing and developing mission-critical software for the investments industry. His combined backgrounds in business, software engineering, practical software development, and computer security uniquely position him to effectively bridge the perspectives of the individuals on the academic design team, while focusing on the practical design details of the STAR-Vote system.

His primary duty is to ensure that a concrete set of practical requirements are constructed which provide the detail necessary to ensure that this complex and technically challenging system is implemented correctly, without unduly restricting opportunities for vendor ingenuity during the bidding process. During development, he will act as the technical specialist overseeing implementation, ensuring venders are properly interpreting and approaching design requirements, and acting as the liaison with the academic design team with which he has been working closely.

Project Manager / Financial Specialist

Once it is clear that funding has been secured and we are approaching release of our RFP to solicit contractors for development, we will hire an individual with experience managing subcontracted IT projects who will oversee processes and vendor management. They will be responsible for monitoring process metrics, identifying bottlenecks or threats to the development schedule, and resolving them in tandem with the Technical Lead and academic design team.

All supplies, reimbursements, information on allowable expenses and auditing reports will be managed by the PM/FS. All of this information will be collected and included in at least four semi-annual financial reports.

External Resources

Microsoft

We have opened a dialog with Microsoft's Research and e-Government groups regarding what we are trying to accomplish and have received a very positive response. To date, Microsoft Research has funded a $25,000 grant to Rice University for constructing a proof-of-concept of elements of the STAR-Vote system, and has committed to an ongoing collaboration with Travis County where appropriate. To be clear, no funding from this grant would finance work performed by Microsoft. However, given their government experience and extensive cross-disciplinary expertise including platform security, cryptography, and elections-related systems, we consider this a key relationship in helping us ensure that the STAR-Vote project is an unqualified success.

The Academic Design Team

We have a commitment from the original team behind STAR-Vote to continue to provide support on an ongoing basis, without cost, due to their enthusiasm at seeing their vision realized. It is important to emphasize that this team is not comprised simply of the individuals behind this particular design's implementation, but includes the people who originally conceived of many of the technologies we attempt to leverage. Their breadth and depth of expertise have been, and will continue to be, an unparalleled asset in ensuring our requirements and processes are meaningful and appropriate, and in helping us discover and resolve design problems and vulnerabilities.

PROCESS

Current Status

In designing STAR-Vote as a joint project involving both the academic design team and Travis County Elections personnel, we have effectively completed the Analysis phase of software development, and are currently in the Design phase. We are in the process of developing and iteratively refining our system requirements, with a targeted RFP release on October 15th, 2013.

Vendor Vetting and Selection

Given the technical complexity of the project, we will leave the RFP open no less than 60 days, and no more than 90 days, depending on vendor feedback as we approach the RFP release. Prior to releasing the RFP, we will hold a pre-RFP conference with potential bidders to explain the system, get feedback on timelines, and encourage the forming of coalitions of vendors with complementary expertise.

Our proposed contract, including the fact that all software produced will become the exclusive property of Travis County, will be part of this RFP to ensure all proposals respect our intended structure.

Proposals will be reviewed by a review board consisting of Travis County staff and members of the academic design team. To ensure that quality, rather than cost, is the primary factor in this analysis, budgets will be obscured from the initial round of reviews. Each proposal will be scored by each member of the review board according to a well-defined rubric disclosed in the RFP. Each proposal's score will be the average of the individual scores it receives. The top scoring few proposers will then be invited to give one or more presentations, meetings with each will ensue, and scores may be adjusted based on those meetings. Once Travis County is satisfied that it understands fully the top proposals, it will send out a request for "best and final offers" from the selected vendors. The final bids received will be evaluated, and a vendor group selected.

It is our intent to review proposals from coalitions which propose to manage the entire project, as well as from individual contractors which believe they fit into either the general contractor, specialist crypto contractor, or "red team" roles, and make judgments regarding the best combined group.

Design Phase

Once a vendor coalition is selected, it is crucial that the requirements be well understood, and directly translate into both object model design and testing at all levels. As such, we have scheduled a month for outlining the software design and testing strategy. Our initial design meeting will be April 1st, 2014, with preliminary design review scheduled for April 8th, 2014, and a critical design review scheduled for April 22nd, 2014. Team leaders from the primary contractor, as well as both members of the red team, and at least the team leader from the specialist crypto team will be present at each design meeting. During this month, our Technical Specialist, Bryce Eakin, will be physically available to the primary contractor to assist in developing a model consistent with the requirements and goals of the project.

Testing is to be heavily emphasized throughout the process. We will not prescribe what particular development management technique a vendor should adopt (scrum / waterfall / etc.) as advocating a development technique counter to the culture of a development team generally leads to confusion, loss of morale, and reduced productivity. As a result, we will instead review the vendors' development management techniques as part of the proposal review process. However, we will require two types of testing regardless of management philosophy: unit testing, and integration testing.

Unit testing – we require that, at a minimum, every functional unit within each module has tests designed to ensure that that functional module accepts inputs / provides outputs in accordance with design requirements, and that it provides an error in well-defined unexpected states (for example, a function which should only receive positive numbers receiving a negative number). In general, contracts should be designed to avoid the possibility of invalid input (by way of static, compile-time checks) where possible, but this is not a reasonable general design requirement.

Integration testing – We require separated and planned integration testing in no less than the following areas:

- **The combined cryptographic system** – Includes all the elements necessary to generate a threshold public key, homomorphically encrypt numeric data with that key, homomorphically add the encrypted data, and decrypt the sum in a distributed manner with the original private keys.
- **The combined NIZK Proof system** – Includes all the elements which create or validate NIZK proofs as used inside of Electronic Vote Records (EVRs) or as used to provide proof that a published election result corresponds to an independently calculated encrypted tally.
- **Polling location systems** – Involves running a simulated election within a single mock polling location, ensuring proper interaction between all systems and tolerance to various error states.
- **Complete System Testing & QA** – End-to-end testing of the integrated components, including in-polling-location systems, UOCAVA remote voting, etc., to ensure proper interoperability of all components and identify and correct communication or interface errors.

These tests will be outlined during this design phase to ensure that the engineers have a clear set of functional goals to work toward.

The design will most likely be based around the functional sub-components which have been identified as part of this proposal. Vendors will be encouraged to consider alternate ways of modularizing the project for the sake of encouraging creativity, however we expect the final software to closely mirror those elements outlined here.

Cryptography systems will be designed with the goal of meeting Federal Information Processing Standards 140 series (FIPS-140) requirements with regards to cryptography.

Development

During development, the Project Manager and Technical Specialist will have a conversation with each team lead in the primary contractor and specialist crypto contractor at the end of each week to get a brief update on the team's status, and any problems they have encountered. Twice per month, there will be a formal review of the current status of development. At the first of these meetings each month, a copy of the most recent codebase will be provided 2 days in advance to be reviewed for clarity, style, maintainability, and robustness. Checks will focus on newly developed areas, and areas which have been highlighted as problems in prior code reviews.

The "red team" will have access to the updated full codebase from both the primary contractor and the crypto specialists daily as it was checked in to version control the night before. They will have constant access to the contractors, and be included in all design-related meetings. The day prior to, or the day of bi-monthly reviews, the red team will give a brief report on their opinion regarding the state of the code, of the new work implemented in the prior two weeks, and of any problems they believe should be addressed. Should the red team believe they have encountered a fundamental vulnerability embedded into the system design, they will be responsible for immediately contacting the Project Manager or Technical Specialist such that it can be investigated in tandem with the academic design team. The red team will be directly involved in all integration testing. The specific access and requirements of the red team during development may change after discussions with such contractors have been completed.

At the end of each week, data will be provided to the Project Manager from the primary and crypto contractors, broken out by module (or team, as appropriate), including the total logical source lines of code (SLOC), percent of tests passing, percent of total interfaces implemented, and overtime hours worked that week. These data will inform the metrics described below for early detection of development problems.

User Interface Prototyping

Any voter-facing user interface (UI) elements (in polling locations, web-apps, or websites to be provided by the county) must involve a prototyping process with the opportunity for Travis County personnel and members of the academic design team to review layouts, presentation, interaction models, etc. to prior to heavy development of these components. These UI elements must additionally be designed using separation of presentation and code-behind to enable straightforward alterations to UI presentation at minimal cost post-development.

Performance Metrics

Our basic principal is that if you can't measure it, you can't manage it. We attempt here to capture a good set of leading indicators of the state of development, without putting undue burden on the development teams to churn out performance metrics. The metrics we have selected are:

Number of deadlines missed – This is a fairly straightforward indicator that either the schedule is too aggressive for the resources available, or that there is a problem in the development team. Either way, a rising number of deadlines missed generally warrants investigation.

Overtime hours – A proper development schedule with sufficient resources provided to the developers for their task should not result in a large number of overtime hours. If the number of overtime hours is large, or in particular if it appears to be rising, an investigation is warranted as it could be an early sign that the project is falling behind.

Logical SLOC – by itself, the number of source lines of code is not interesting. However, if the total SLOC seems to be slowing in tandem with an increasing number of missed deadlines, there may be a bottleneck, or a resource or scheduling problem that is leading to reduced development efficiency.

% Tests Passing by module – provides an automated view into the quality of each module relative to its interface currently.

Each integration testing suite will involve both a preliminary review, once Q&A has gotten underway and the initial opinion of the team leader is available. It will additionally involve a critical review when the team leader believes that the integrated software meets its tests.

RISKS AND MITIGATION

Time Overruns

We have taken care to build in slack into our schedule, however in any project, missing deadlines is possible. What is important is to understand why. Time overruns can be a symptom of a variety of problems:

Insufficient Staff

While it is always possible that a project's schedule is simply too aggressive for the number of developers involved, it is important to remember Brooks' law: "adding manpower to a late software project makes it later". This is particularly true when you are late in a development cycle.

The key to realizing that the team is too small is to detect it early, and to adjust timelines when new personnel are added to give the dev team temporary slack to train and integrate the new individual(s). The most reliable early signal that there may be insufficient staff for the deadlines is consistent use of overtime. While this can also be a sign of other time overrun problems, consistent or rising use of overtime always bears investigation as a properly paced project should not require substantial overtime by its developers. Of course a rising number of missed deadlines is also an indication, but generally a fairly late one.

Scheduling / Resource Problems

There are times when overruns are caused by scheduling conflicts or resource problems which result in development bottleneck – essentially, developers waiting for deliverables from elsewhere before being able to proceed. This can often be uncovered anecdotally, but is also visible as a reduction in the rate of growth of logical source lines of code (SLOC) at the same time that the number of missed deadlines is rising. This combination implies that something is preventing the code from getting written to meet the deadlines, and schedule re-prioritization, additional resources, or other actions may be necessary to remove the bottleneck.

Bad Team Leadership

Inevitably, productivity is a function of the quality of leadership and resulting morale the team experiences. This particular problem is more difficult to tease out of metrics than most, and must generally be anecdotally confirmed after the number of missed deadlines starts rising. This particular problem is more aptly controlled for proactively by maintaining communication with team leader(s), and managing them to identify those with a risk of demoralizing their team. At that point actions can be taken to address the problem with the team lead directly, or, if necessary, to reorganize teams to be managed more effectively.

Others
There are many others, but they key is to follow metrics that indicate that something is wrong – generally the relationship between logical SLOC, missed deadlines, and overtime – and look for the patterns discussed above, or any notable change from past behavior (once established). This does not always indicate a problem, but it always indicates that an investigation is warranted.

Mission Creep

Mission creep is, without question, one of the primary causes of IT project failures, delays, and cost overruns. We have taken great lengths to limit the scope for mission creep, including explicitly not engaging with other counties to form a coalition to build STAR-Vote. Each additional partner, while providing resources, would also have specific requirements and desires, and would want to be involved in the planning and review process, adding overhead, reducing clarity, and making the project progressively harder to manage. In the interest of maximizing the chance of finishing the project on budget, and ensuring its completion within our proposed schedule, we will continue to engage potential partners only on an advisory basis.

Furthermore, the scope of the project has already been solidified, with clear technical goals and deliverables established. Barring a revelation that the existing design bears a fundamental, and heretofore unrecognized flaw, we will direct any new elements we decide we might want to see within STAR-Vote to a queue of items to consider in a follow-on project.

Implementation Problems

One of the key risks in this particular project is that we rely on more than one technology which has never been implemented for practical use in a commercial system, and which are sufficiently complex that there are probably no more than 100 individuals in the world qualified to implement them. As a result, it is conceivable that one of these technologies could prove much more difficult to implement or test than expected, or even impossible to reliably implement.

There is no way to ensure that this will not be the case – however, we can ensure that if it will be the case it will be caught quickly so that it can be addressed and, if necessary, decisions about the viability of the project can be made relatively early into the process. To facilitate this, we have systematically preferred subcomponents with higher project risk for early implementation. Additionally, on all elements, we will require both weekly updates on progress of the current component and notification when initial implementation is complete, when % of tests passed reaches 50% and 90%, and when the component is deemed "tested and complete".

Metrics used to monitor this will include days slippage relative to projection (for completion, or for sub-milestones for which we will be receiving notification), percent of interfaces implemented, and percent of automated tests passing for each subcomponent. These metrics will be updated weekly, to balance the need for timely information with a desire not to weigh down development unduly.

Legislative and Regulatory Hurdles

We have made every effort to design STAR-Vote to meet current Texas election law. However, there are specific areas where we have chosen to depart from existing statutes in order to enable the desirable properties heretofore described. The Secretary of State's office has been briefed on our system, and is aware that some exemptions may be needed. While we have received no guarantees about their actions, and expect none, they have not indicated that anything we are attempting is unreasonable, and have encouraged us to continue with development. Furthermore, we have a letter from a member of the Texas Legislature attesting that key members of the Legislature are aware of what we are attempting, and voicing their support for our project.

While we are confident that any legislative or regulatory hurdles can be overcome, if necessary we can modify STAR-Vote in ways that, while reducing the efficacy of some aspect of the system, ultimately leave it nearly intact.

Specific hurdles include:

- Under present law, a voter may not leave the polling location with a marked ballot. Our ballot spoilage procedure for auditing an individual voting station includes leaving the polling location with a marked (though not cast) ballot. Without that element, the individual audit of voting stations is somewhat less meaningful or robust, but it does not directly interfere with the operation of any part of the system.
- Current certification standards are antiquated, counter-productive, costly, and relatively meaningless. Our system, while certainly drastically exceeding the security required for certification, does not meet some of the specific requirements currently in existence due to the fact that it runs on COTS hardware. We are optimistic that the Secretary of State's office will be amenable to certifying just the software, provided that it runs on hardware with certain properties (such as a firmware TPM, and in which any microphone / camera / Wi-Fi / Bluetooth devices have been physically disabled). However, should this not be the case the simplest solution is to certify a specific piece of hardware along with the software. It would potentially cause problems down the line as product cycles render that hardware no longer available, but it would allow for initial deployment while the situation is improved. Ideally, of course, we could convince the Secretary of State's office of the superiority of evidence-based elections and their claim to enable certification of each election outcome, rather than of the software which produces it, but this is likely a longer term goal.
- Traditional definitions of the "ballot" or a "recount" no longer apply – neither our paper record, nor the electronic record are strictly speaking "the ballot". Instead, each is merely independent evidence of voter intent (except in the case of UOCAVA voters, for whom the paper record is the only reliable evidence of voter intent). As such, our process does not have a well-defined "ballot" for a recount, and rather, should a given paper record and its associated electronic record disagree, it's time to do forensic analysis, or call lawyers. Similarly, because there is no clear "ballot", what is a recount? Once you do a risk limiting audit to confirm that the paper matches the electronic records, is a "recount" simply a recalculation of the original tally? Do we have to manually tally paper (a process prone to human error) when we have statistically verified that the electronic records are identical? These are not questions for which there are, necessarily, correct answers, however they do represent areas in which our design runs at odds with existing election law.

4. Current and Pending Project Proposal Submissions

Electronic Ballot Transmission Portal

Travis County concurrently is submitting a grant proposal to fund an augmentation to their existing voter registration software to enable the generation of e-mails to UOCAVA voters containing a link to their PDF ballot. This proposal would build on that technology if funded.

Source and amount of funding: $19,950; EASE 2.0 Grant / CFDA 12.219 / H98210-13-BAA-001

Percentage effort devoted to each project: Project fully handled by external vendor on contract.

Identity of Prime Applicant: Travis County, TX

Subcontractors: Easy Access, Inc.

Technical Contact:

Gail Fisher
Elections Division Director Succession
Travis County Elections Division
5501 Airport Blvd., Austin, TX 78751
512-854-7967
Gail.Fisher@co.travis.tx.us

Period of Performance: September 1, 2013 – November 30, 2014

Award period / amount including indirect costs, etc.: No indirect costs, 100% contractor.

Relation to this proposal: Under our existing conception, the STAR-Vote e-mail facility will use this project as the tie-in module for contacting UOCAVA personnel with an e-mailed link to their ballot. Were this module not available, a portion of its functions would have to be added to the STAR-Vote project to meet its goals for these voters.

5. Works Cited

Cuvelier, E., Peters, T., & Pereira, O. (2012). Election verifiability or ballot privacy: Do we need to choose. *SecVote, Dagstuhl*.

Everett, S. P., Greene, K. K., Byrne, M. D., Wallach, D. S., Derr, K., Sandler, D., & Torous, T. (2008). Electronic voting machines versus traditional methods: Improved preference, similar performance. *Human Factors in Computing Systems: Proceedings of CHI 2008* (pp. 883-892). New York: ACM.

6. Appendices

Appendix A. DETAILED ESTIMATED DEVELOPMENT SCHEDULE

Subcomponent	*Risk*	*Centrality*	*Budgeted Man-Days in Dev*	*Budgeted Man-Days in QA*	*Start Development*	*Completed Component*
			Crypto-Specialist Sub-Contractor Schedule			
Homomorphic Encryption	4	4	29.4	49.0	May 1, 2014	May 28, 2014
Distributed Threshold Key Creation	4	4	24.5	44.1	May 28, 2014	June 20, 2014
Distributed Threshold decryption	4	4	29.4	73.5	June 20, 2014	July 28, 2014
Homomorphic Summation	1	4	14.7	29.4	July 28, 2014	August 12, 2014
Combined Crypto System Testing & QA	-	-	-	49.0	August 12, 2014	August 28, 2014
EVR NIZK Proof Creation	4	4	29.4	58.8	August 28, 2014	September 29, 2014
Creation of Decryption NIZK Proof	2	4	34.3	44.1	September 29, 2014	October 27, 2014
NIZK Proof Validation	2	4	30.6	36.8	October 27, 2014	November 19, 2014
Combined NIZK Proof System Testing & QA	-	-	-	24.5	November 19, 2014	November 27, 2014
Unverified Distributed Mix	1	4	33.1	40.3	November 27, 2014	December 23, 2014
			Primary Contractor Schedule			
Object Model & Testing Design			220.0	-	April 1, 2014	May 1, 2014
Data Format: EVR	1	4	3.3	4.4	May 1, 2014	May 1, 2014
Data Format: PEVR	1	4	2.2	2.9	May 1, 2014	May 2, 2014
Data Format: Election Definition	0	4	2.0	2.9	May 2, 2014	May 2, 2014
Data Format: Election Results	0	4	2.9	4.4	May 2, 2014	May 5, 2014
Data Format: Ballot Style	0	2	2.0	2.5	May 5, 2014	May 5, 2014
Data Format: Hash->status mapping	0	2	2.0	2.0	May 5, 2014	May 6, 2014
Data Format: PEVR -> Plaintext mapping	0	2	1.0	1.1	May 6, 2014	May 6, 2014
Data Format: Plaintext vote/hash pairs	0	2	1.0	1.0	May 6, 2014	May 6, 2014
Data Format: Public Audit Data	0	2	2.9	3.3	May 6, 2014	May 7, 2014
Data Format: Raw Election	0	2	5.9	6.6	May 7, 2014	May 8, 2014
Object Interface Implementation	0	2	20.0	10.0	May 8, 2014	May 13, 2014
Crypto Hash	0	4	2.0	2.9	May 13, 2014	May 14, 2014
Limited Linux Distro	1	2	44.1	49.0	May 14, 2014	May 27, 2014
Asymmetric key generation	0	3	1.0	1.3	May 27, 2014	May 27, 2014
Asymmetric Key Encryption	0	2	1.0	1.2	May 27, 2014	May 27, 2014
Certification Authority	0	2	1.0	1.2	May 27, 2014	May 28, 2014
Certification Authority Creation	0	2	1.0	1.2	May 28, 2014	May 28, 2014
Digital Signatures	0	2	1.0	1.2	May 28, 2014	May 28, 2014
Auditorium Network / Logging Layer	1	4	22.1	29.4	May 28, 2014	June 4, 2014
Printed Ballot Rendering Engine	1	4	19.6	24.5	June 4, 2014	June 11, 2014
Thermal Printer Control	0	1	3.9	4.4	June 11, 2014	June 11, 2014
Ballot Display and Interaction	1	4	34.9	59.6	June 11, 2014	June 25, 2014
High Speed Ballot-Style Scanner	1	2	11.0	12.3	June 25, 2014	June 27, 2014
Ballot Box Hardware	2	1	73.5	66.2	June 27, 2014	July 17, 2014
Crypto Hash (JS)	0	2	4.0	5.0	July 17, 2014	July 18, 2014
UI: RLA Support Software	1	3	55.7	75.0	July 18, 2014	August 6, 2014

Detailed Estimated Development Schedule (continued)

Subcomponent	Risk	Centrality	Budgeted Man-Days in Dev	Budgeted Man-Days in QA	Start Development	Completed Component
Primary Contractor Schedule						
UI: Ballot Design	0	1	26.5	29.8	August 6, 2014	August 14, 2014
Ballot Reader	1	0	4.9	4.9	August 14, 2014	August 15, 2014
Ballot Box Hardware Control	1	1	11.0	11.0	August 15, 2014	August 19, 2014
Homomorphic Encryption (JS)	1	2	20.0	30.0	August 19, 2014	August 26, 2014
UI: Voting Station	1	3	59.6	72.8	August 26, 2014	September 12, 2014
UI: OS Hash tool	0	3	20.6	28.3	September 12, 2014	September 19, 2014
UI: Tabulator	1	2	44.7	53.9	September 19, 2014	October 3, 2014
EVR NIZK Proof Creation (JS)	1	2	15.0	15.0	October 3, 2014	October 8, 2014
UI: UOCAVA in-browser web app	1	2	50.6	80.0	October 8, 2014	October 27, 2014
GIS Data Input	0	0	10.0	4.9	October 27, 2014	October 29, 2014
Text-To-Speech	0	0	9.8	9.8	October 29, 2014	October 30, 2014
UI: By-Mail Ballot Scanner	0	2	27.0	45.0	October 30, 2014	November 11, 2014
OCR	0	1	20.0	22.5	November 11, 2014	November 17, 2014
UI: ED Creation	0	1	20.6	23.2	November 17, 2014	November 21, 2014
UI: PL Hardware Init	0	1	19.6	14.7	November 21, 2014	November 27, 2014
UI: BCS	1	1	54.6	54.6	November 27, 2014	December 12, 2014
Trustee UI	1	1	29.4	49.6	December 12, 2014	December 24, 2014
UI: Election DC Control	1	0	49.6	44.1	December 24, 2014	January 6, 2015
UI: Election DC Entities	1	0	59.6	53.0	January 6, 2015	January 21, 2015
"Bed Sheet" Rendering Engine	0	0	29.4	29.4	January 21, 2015	January 29, 2015
UI: Ballot Box	0	0	14.7	14.7	January 29, 2015	February 3, 2015
UI: Hash Lookup	0	0	26.5	26.5	February 3, 2015	February 10, 2015
UI: Ballot System	0	0	41.2	41.2	February 10, 2015	February 23, 2015
UI: Public Audit Prep	0	0	14.7	14.7	February 23, 2015	February 26, 2015
Complete System Testing and QA	-	-	-	200.0	February 26, 2015	March 26, 2015

VERIFYING UOCAVA BALLOT INCLUSION IN ELECTION RESULTS

ONLINE BLANK BALLOT DELIVERY WITHIN STAR-VOTE

BUDGET PROPOSAL

Catalog of Federal Domestic Assistance Number: **12.219**

BAA number: **H98210-13-BAA-0001**

Applicant: **Travis County, Texas**

Administrative Contact:

Dana DeBeauvoir
Travis County Clerk
Travis County Elections Division
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Technical Contact:

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Technical Lead
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Specific subcontractors not yet determined.

Proposed Term: **October 1st, 2013 through March 31st, 2015**, with continued reporting through November, 2018.

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1. Overview

Executive Summary

Travis County seeks $4,183,575 in grant funding to support the development of the core elements of the STAR-Vote architecture which are required to enable the features described in our Technical Proposal, as well as the extensions to STAR-Vote required to enable these features for UOCAVA voters. The requested grant represents 73.0% of the project's anticipated costs.

The STAR-Vote project may be effectively broken down into 17 high-level systems, comprised of 61 self-contained functional elements, data interfaces, and integration test suites. Of these 61, 14 are unrelated to providing UOCAVA voters our promised features, and a further 3 are made more complex by supporting non-UOCAVA voters. As such, our grant request excludes the 14 unrelated components, and proposes to fund only a portion of the 3 with tangential requirements. The remaining 44 components we propose to fully fund via this grant, along with a portion of initial object model design. Indirect costs are allocated between the county and this grant in proportion to the relative burden of direct costs.

These budgets have been calculated based on the full project budget outlined below – each discussion is in terms of full project costs, with breakdowns of its proposed contributions from the EASE grant program and from Travis County.

Notably, we demonstrate that, even without grant funding, developing and deploying STAR-Vote is slightly financially superior over 10-years to investing in an existing DRE system for Travis County. More importantly, for other counties wishing to adopt STAR-Vote upon its completion, the ROI for adopting STAR-Vote will be extraordinary compared to the existing options in the marketplace, making it virtually assured that the UOCAVA features this grant will make possible will not stop at the borders of Travis County.

Methodology, Limitations, and Key Assumptions

Given our intent to contract the majority of the work out to a primary contractor, a subcontractor specializing in cryptography, and a second direct contractor for our "red team", most of our costs will be passed through from those contractors. However, due to the stage of development of the STAR-Vote project, we have been restricted from soliciting specific bids or estimates from vendors regarding the cost of most elements of STAR-Vote.

As such, cost estimates for subcomponents which represent relatively mainstream software engineering tasks have been derived from county experience and conversations with contacts in the IT consulting industry – budgets are based around a cost of $1,000 per programmer per day before overhead, and based on a reasonable assessment of the time involved. Cost estimates for elements of a more complex nature which will require specialized sub-contractors have been estimated in the same manner, with the assumption that the cost per programmer per day before overhead will be double, or $2,000.

Key assumptions/estimates in the budget calculations are as follows:

Parameter	Assumed Value
Cost for 1 man-day of programming time	$1,000
Cost for 1 man-day of advanced crypto programming time	$2,000
Cost for an academic study of the usability and accuracy of STAR	$100,000
"Red-team" cost per person per year	$200,000
Project Manager cost per year	$100,000
Contractor administration, overhead, and markup	25%

In order to take into account the variable confidence in labor estimates, each subcomponent was assigned a project risk value. Those assessed with the highest risk have been budgeted with up to a 50% cushion relative to their mean expected development time. Those with the lowest risk are budgeted to complete at expectation, with linear interpolation in between. These choices were made in an attempt to limit the probability or scope of cost overruns as a result of certain advanced technical elements proving more complex to implement or test than initially expected.

Testing / QA time estimates have been made individually in good faith according to the importance of the proper running of that element in tandem with its technical complexity, with the knowledge that testing is not truly a separate activity, and must be integrated into the development process throughout. However, for budgeting purposes it is more straightforward to estimate implementation times, and then derive likely QA time based on that value.

All user interfaces were development-time estimated based on 3 man-days average initial coding time per page (with 3 pages added to the page estimate for each UI element to account for navigation and unforeseen additions), plus an equivalent time in Quality Assurance testing and bug-correction, systematically adjusted for importance and complexity.

For simplicity, we include software "business logic" which is not separable for use as a modular, self-contained, sub-component as part of the various "UI" subcomponents. This does not imply a software development practice of co-mingling user interface and business logic, but rather reflects the typical proportionality of user interface complexity and business logic complexity. It would have been imprudent to further subdivide already self-contained software modules for purposes of budgeting or scheduling. Software development practices are addressed in our Technical Proposal, Section 3 – Management Approach.

2. Project Breakdown

BUDGET SUMMARY

			EASE Grant Proposed Budget		
	Full Project Budget	*Not EASE Grant Relevant*	*Total Grant Budget*	*STAR-Vote Core*	*UOCAVA Specific*
Budgeted Development Labor in Man-Days	*2,570.0*	*1,046.8*	*1,523.2*	*1,040.6*	*482.6*
@ $1,000 / Man-Day	$ 2,570,000	$ 1,046,801	$ 1,523,199	$ 1,040,643	$ 482,555
Budgeted Specialist Labor in Man-Days	*675.3*	*0.0*	*675.3*	*623.6*	*51.7*
@ $2,000 / Man-Day	$ 1,350,560	$ -	$ 1,350,560	$ 1,247,102	$ 103,458
Direct Labor Cost	$ 3,920,560	$ 1,046,801	$ 2,873,759	$ 2,287,746	$ 586,013
Overhead & Administrative @ 25%	$ 980,140	$ 261,700	$ 718,440	$ 571,936	$ 146,503
Plus Testing Equipment	$ 40,000	$ 30,000	$ 10,000	$ 10,000	$ -
	$ 1,020,140	$ 291,700	$ 728,440	$ 581,936	$ 146,503
Development Contractors Total Cost	$ 4,940,700	$ 1,338,501	$ 3,602,198	$ 2,869,682	$ 732,516
Estimated development time to completion in years (See Appendix A for detailed schedule)					0.99
2-Man "Red Team at $200k / person / yr	$ 394,444	$ 105,318	$ 289,127	$ 230,168	$ 58,958
Plus Overhead & Administrative @ 25%	$ 98,611	$ 26,329	$ 72,282	$ 57,542	$ 14,740
Red-Team Contractor Total Cost	$ 493,056	$ 131,647	$ 361,408	$ 287,710	$ 73,698
Estimated Total Project Management Length in years (See Technical Proposal for explanation)					1.49
Project Manager	$ 200,094	$ 53,426	$ 146,669	$ 116,760	$ 29,908
Plus Academic Work	$ 100,000	$ 26,700	$ 73,300	$ 58,353	$ 14,947
PM & Academic Costs	$ 300,094	$ 80,126	$ 219,968	$ 175,113	$ 44,856
Total Budget	$ 5,733,850	$ 1,550,275	$ 4,183,575	$ 3,332,505	$ 851,070

DETAILED BREAKDOWN OF BUDGET ESTIMATES

Subcomponent	*Risk*	*Centrality*	*UI Pages*	*Budgeted Man-Days in Dev*	*Budgeted Man-Days in QA*	*Regular =1, Specialist =2*	*Total Cost*	*STAR-Vote Core*	*UOCAVA Specific*	*Non-UOCAVA*
"Bed Sheet" Rendering Engine	0	0	n/a	29.4	29.4	1	$ 58,839	○	○	●
Asymmetric Key Encryption	0	2	n/a	1.0	1.2	1	$ 2,206	●	○	○
Asymmetric key generation	0	3	n/a	1.0	1.3	1	$ 2,329	●	○	○
Auditorium Network / Logging Layer	1	4	n/a	22.1	29.4	1	$ 51,484	◑	○	◑
Ballot Box Hardware	2	1	n/a	73.5	66.2	1	$139,742	○	○	●
Ballot Box Hardware Control	1	1	n/a	11.0	11.0	1	$ 22,064	○	○	●
Ballot Display and Interaction	1	4	6	34.9	59.6	1	$ 94,485	●	○	○
Ballot Reader	1	0	n/a	4.9	4.9	1	$ 9,806	○	○	●
Certification Authority	0	2	n/a	1.0	1.2	1	$ 2,206	●	○	○
Certification Authority Creation	0	2	n/a	1.0	1.2	1	$ 2,206	●	○	○
Combined Crypto System Testing & QA	-	-		0.0	49.0	2	$ 98,064	◕	◔	○
Combined NIZK Proof System Testing & QA	-	-		0.0	24.5	2	$ 49,032	◕	◔	○
Complete System Testing and QA	-	-		0.0	200.0	1	$200,000	◔	◔	◑
Creation of Decryption NIZK Proof	2	4	n/a	34.3	44.1	2	$156,903	●	○	○
Crypto Hash	0	4	n/a	2.0	2.9	1	$ 4,903	●	○	○
Crypto Hash (JS)	0	2	n/a	4.0	5.0	1	$ 9,000	○	●	○
Data Format: Ballot Style	0	2	n/a	2.0	2.5	1	$ 4,413	●	○	○
Data Format: Election Definition	0	4	n/a	2.0	2.9	1	$ 4,903	●	○	○
Data Format: Election Results	0	4	n/a	2.9	4.4	1	$ 7,355	●	○	○
Data Format: EVR	1	4	n/a	3.3	4.4	1	$ 7,723	●	○	○
Data Format: Hash->status mapping	0	2	n/a	2.0	2.0	1	$ 3,923	●	○	○
Data Format: PEVR	1	4	n/a	2.2	2.9	1	$ 5,148	●	○	○
Data Format: PEVR -> Plaintext mapping	0	2	n/a	1.0	1.1	1	$ 2,084	○	○	●
Data Format: Plaintext vote/hash pairs	0	2	n/a	1.0	1.0	1	$ 1,961	●	○	○
Data Format: Public Audit Data	0	2	n/a	2.9	3.3	1	$ 6,252	◕	◔	○
Data Format: Raw Election	0	2	n/a	5.9	6.6	1	$ 12,503	○	○	●
Digital Signatures	0	2	n/a	1.0	1.2	1	$ 2,206	●	○	○
Distributed Threshold decryption	4	4	n/a	29.4	73.5	2	$205,935	●	○	○
Distributed Threshold Key Creation	4	4	n/a	24.5	44.1	2	$137,290	●	○	○
EVR NIZK Proof Creation	4	4	n/a	29.4	58.8	2	$176,516	◕	◔	○
EVR NIZK Proof Creation (JS)	1	2	n/a	15.0	15.0	1	$ 30,000	○	●	○
GIS Data Input	0	0	n/a	10.0	4.9	1	$ 14,903	○	◔	◕
High Speed Ballot-Style Scanner	1	2	n/a	11.0	12.3	1	$ 23,290	●	○	○
Homomorphic Encryption	4	4	n/a	29.4	49.0	2	$156,903	◕	◔	○
Homomorphic Encryption (JS)	1	2	n/a	20.0	30.0	1	$ 50,000	○	●	○
Homomorphic Summation	1	4	n/a	14.7	29.4	2	$ 88,258	◕	◔	○
Limited Linux Distro	1	2	n/a	44.1	49.0	1	$ 93,161	●	○	○
NIZK Proof Validation	2	4	n/a	30.6	36.8	2	$134,838	●	○	○
Object Interface Implementation	0	2	n/a	20.0	10.0	1	$ 30,000	◑	◔	◔
Object Model & Testing Design				220.0	0.0	1	$220,000	◔	◔	◑
OCR	0	1	n/a	20.0	22.5	1	$ 42,500	○	●	○

Subcomponent	Risk	Centrality	UI Pages	Budgeted Man-Days in Dev	Budgeted Man-Days in QA	Regular =1, Specialist =2	Total Cost	STAR-Vote Core	UOCAVA Specific	Non-UOCAVA
Printed Ballot Rendering Engine	1	4	n/a	19.6	24.5	1	$ 44,129	●	○	○
Text-To-Speech	0	0	n/a	9.8	9.8	1	$ 19,613	○	○	●
Thermal Printer Control	0	1	n/a	3.9	4.4	1	$ 8,335	○	○	●
Trustee UI	1	1	7	29.4	49.6	1	$ 79,064	●	○	○
UI: Ballot Box	0	0	2	14.7	14.7	1	$ 29,419	○	○	●
UI: Ballot Design	0	1	6	26.5	29.8	1	$ 56,264	●	○	○
UI: Ballot System	0	0	11	41.2	41.2	1	$ 82,374	◑	◑	○
UI: BCS	1	1	8	54.6	54.6	1	$109,219	○	○	●
UI: By-Mail Ballot Scanner	0	2	6	27.0	45.0	1	$ 72,000	○	●	○
UI: ED Creation	0	1	4	20.6	23.2	1	$ 43,761	●	○	○
UI: Election DC Control	1	0	7	49.6	44.1	1	$ 93,774	○	○	●
UI: Election DC Entities	1	0	9	59.6	53.0	1	$112,529	○	○	●
UI: Hash Lookup	0	0	6	26.5	26.5	1	$ 52,955	●	○	○
UI: OS Hash tool	0	3	4	20.6	28.3	1	$ 48,910	●	○	○
UI: PL Hardware Init	0	1	4	19.6	14.7	1	$ 34,322	○	○	●
UI: Public Audit Prep	0	0	2	14.7	14.7	1	$ 29,419	●	○	○
UI: RLA Support Software	1	3	8	55.7	75.0	1	$130,688	◕	◔	○
UI: Tabulator	1	2	6	44.7	53.9	1	$ 98,616	●	○	○
UI: UOCAVA in-browser web app	1	2	7	50.6	80.0	1	$130,625	○	●	○
UI: Voting Station	1	3	9	59.6	72.8	1	$132,387	○	○	●
Unverified Distributed Mix	1	4	n/a	33.1	40.3	2	$146,821	●	○	○

Project Manager & Academic Costs

Academic costs listed refer to the expected cost of having Rice University perform a usability and accuracy study comparing STAR-Vote to existing hand-marked paper for purposes of reporting on expected improvements for UOCAVA voters. This is a preliminary estimate based on conversations with Rice University.

The Project Manager is budgeted as a full-time employee, with an annual salary of $104,124.80 based on the prevailing rate for an applicable grade employee at Travis County. Benefits and taxes will cost an additional $30,518.20 per year, for a total cost of $134,643.00 annually. The total project management length applicable to this grant is 1.49 years, for a total PM cost of $200,094.

We exclude the Technical Specialist from this project's budget as he is an existing employee of Travis County.

Breakout of Budget by Quarter

Total Project	Direct Labor Cost	Admin & Overhead	Testing Equipment	Red Team Incl. A&O	PM & Tech Sp.	Academic Consult.	Total
Q4 2013	$ -	$ -	$ -	$ -	$ 33,661	$ -	**$ 33,661**
Q1 2014	$ -	$ -	$ -	$ -	$ 33,661	$ 20,000	**$ 53,661**
Q2 2014	$ 1,018,961	$ 254,740	$ -	$ 125,000	$ 33,661	$ -	**$ 1,432,362**
Q3 2014	$ 1,175,808	$ 293,952	$ -	$ 125,000	$ 33,661	$ 60,000	**$ 1,688,420**
Q4 2014	$ 1,121,185	$ 280,296	$ 10,000	$ 125,000	$ 33,661	$ 10,000	**$ 1,580,142**
Q1 2015	$ 604,607	$ 151,152	$ 30,000	$ 118,056	$ 31,791	$ 10,000	**$ 945,605**
Total	$ 3,920,560	$ 980,140	$ 40,000	$ 493,056	$ 200,094	$ 100,000	**$ 5,733,850**

Proposed FVAP EASE Grant Budget	Direct Labor Cost	Admin & Overhead	Testing Equipment	Red Team Incl. A&O	PM & Tech Sp.	Academic Consult.	Total
Q4 2013	$ -	$ -	$ -	$ -	$ 24,673	$ -	**$ 24,673**
Q1 2014	$ -	$ -	$ -	$ -	$ 24,673	$ 14,660	**$ 39,333**
Q2 2014	$ 746,895	$ 186,724	$ -	$ 91,625	$ 24,673	$ -	**$ 1,049,917**
Q3 2014	$ 861,863	$ 215,466	$ -	$ 91,625	$ 24,673	$ 43,980	**$ 1,237,607**
Q4 2014	$ 821,825	$ 205,456	$ 2,500	$ 91,625	$ 24,673	$ 7,330	**$ 1,153,409**
Q1 2015	$ 443,175	$ 110,794	$ 7,500	$ 86,534	$ 23,302	$ 7,330	**$ 678,636**
Total	$ 2,873,759	$ 718,440	$ 10,000	$ 361,408	$ 146,669	$ 73,300	**$ 4,183,575**

Figure 1. Total Budget and Proposed Grant Budget, by category, by calendar quarter.

3. ROI Analysis

There are two views to take when approaching the ROI for STAR-Vote: that of Travis County which, at present, bears full development costs, and that of alternate counties in Texas (such as Bexar and Dallas) for which there should be no, or very low, development costs to deploy STAR-Vote once it has been created.

Note that all calculations are based on opportunity cost relative to a representative current-market Direct Recording Electronic voting system and assume a county the same size as Travis.

TRAVIS COUNTY

Assumptions:

- Either STAR-Vote or a different system will be adopted in Year 1
- Travis county uses roughly 2500 voting / ballot control devices
- STAR-Vote, using COTS hardware will cost roughly $2.5 Million to deploy
- STAR-Vote hardware will require 5% replacement each year (due to failure) plus rollover of ¼ of hardware every 5 years
- Existing systems would cost roughly $6.0 Million to purchase and deploy
- Existing systems would cost roughly $250,000 per year for a service contract, plus replacing ¼ of systems every 5 years
- Voting / ballot control devices cost $1000 for COTS (STAR-Vote), and $3,500 for current standard DRE.

	STAR-Vote	Market DRE
2014	$ 4,754,584	$ 250,000
2015	$ 3,445,605	$ 6,000,000
2016	$ 125,000	$ 250,000
2017	$ 125,000	$ 250,000
2018	$ 125,000	$ 250,000
2019	$ 125,000	$ 250,000
2020	$ 625,000	$ 2,437,500
2021	$ 125,000	$ 250,000
2022	$ 125,000	$ 250,000
2023	$ 125,000	$ 250,000

Figure 2. 10-year cash flow comparison for Travis County.

The prevailing investment-grade municipal interest rate at the time of this writing on June 9, 2013 was 2.19%, implying a 10-year net present value (NPV) of STAR-Vote of -$9,251,562.55, compared to a NPV of -$9,609,376.46 for the market DRE – implying a preference for STAR-Vote of $357,813.91 in net present value. The cumulative IRR of the STAR-Vote project cash flows net of opportunity cost (the market DRE) is 4.68% implying, on a purely financial basis, that the project should be undertaken even if Travis County bore the entire financing cost. Furthermore, we anticipate this IRR to be unique and stable due to the uniform sign of cash flows net of opportunity cost after year 0. The return on investment over 10 years, net of opportunity cost, is a cumulative 7.60%, implying a compound annual ROI of 0.74%.

These numbers are not particularly strong on the surface – however, they become truly extraordinary when it is realized that **it is more cost effective over 10 years for Travis County to develop its own voting system and deploy it than to continue to buy into the existing vendor model.**

OTHER TEXAS COUNTIES

Fundamentally, the costs to other counties of comparable size will be similar **except** that there will much more limited up front development costs. To make this as realistic as possible, we will assume the other county has some local requirements, an unusual voter registration system, or some other incompatibility that requires $500,000 in up front development. This is well above what we anticipate most Texas counties would encounter, but we prefer to make conservative assumptions for this demonstration.

	STAR-Vote	Market DRE
Year 0	$ 500,000	$ 250,000
Year 1	$ 2,500,000	$ 6,000,000
Year 2	$ 125,000	$ 250,000
Year 3	$ 125,000	$ 250,000
Year 4	$ 125,000	$ 250,000
Year 5	$ 125,000	$ 250,000
Year 6	$ 625,000	$ 2,437,500
Year 7	$ 125,000	$ 250,000
Year 8	$ 125,000	$ 250,000
Year 9	$ 125,000	$ 250,000

Figure 3. 10-year cash flow comparison for other Texas counties.

Again, using the prevailing investment-grade municipal interest rate of 2.19% as our discount rate, we calculate a 10-year net present value of -$4,182,647.62 for STAR-Vote, and -$9,609,376.46 for the market DRE, implying an opportunity cost net present value of $5,426,728.84 over 10 years. The cumulative opportunity-cost ROI over 10-years is 131.94%, or 8.78% annually, with an astounding 30.24% compound annual IRR.

IMPLICATIONS

As the numbers bear out, this project will create a new voting system with a massive cost advantage over existing DRE systems once its development is complete. COTS hardware prices, no vendor service contracts, and the ability to change to alternate hardware without completely replacing the voting system offer impressive flexibility and cost savings relative to the traditional vendor lock-in model in Elections. While there are additional marginal costs (such as paper purchase, handling, and storage) and marginal gains (reliably cheaper audits, likely falling future hardware prices), the simple ROI models presented here provide a result of such magnitude that we can reasonably discard any such incremental changes. From a financial perspective there is simply no competition – and having UOCAVA-relevant features built in from the start will help make sure that as this system grows, UOCAVA voters will see their experience improve in parallel.

NON-FINANCIAL ROI

The area in which we expect the greatest improvement for UOCAVA voters from implementing the STAR-Vote project is in the confidence with which UOCAVA voters participate in the democratic process. From the current, relatively opaque system, which can leave voters feeling disenfranchised, we will transition to a transparent, empowering process which provides voters confidence that their vote has not only been received, but tallied. Furthermore, the academic literature consistently shows that voters self-report substantially higher levels of satisfaction with the voting process when using computerized ballots.

We hope to capture some data regarding improvements in voter enfranchisement and sentiment through anonymous feedback in the form of a survey to be e-mailed to voters after each election during the reporting period. While we have no prior data to use as a control, some data can still be gleaned from asking the voter about the improvement relative to their prior experiences. Our goal is a consistent and statistically significant increase in the confidence of UOCAVA voters that their vote was correctly received and tallied, as well as a consistent and statistically significant increase in UOCAVA voter self-reported satisfaction. This anonymous survey will also assist in providing a feedback channel to ensure we know places where there are problems or room for improvement.

Additionally, we will monitor changes in UOCAVA voter participation, with an eye toward validating the hypothesis that improved voter enfranchisement will lead to greater voter participation. Unfortunately there is no precedent for the type of system we are trying to create, so any prediction in this arena would be speculative, however normal data collection regarding UOCAVA voter ballot requests and returns should begin to provide insight into this question after the 2016 general election.

STAR-Vote: A Secure, Transparent, Auditable, and Reliable Voting System

authors hidden for blind review

STAR-Vote is a collaboration between a number of academics and the elections office of a large county that currently uses a DRE voting system and previously used an optical scan voting system. STAR-Vote represents a rare opportunity for a variety of sophisticated technologies, such as end-to-end cryptography and risk limiting audits, to be designed into a new voting system, from scratch, with a variety of real world constraints, such as election-day vote centers that must support thousands of ballot styles and run all day in the event of a power failure. This manuscript describes the current design of STAR-Vote which is now largely settled and whose development will soon begin.

1. INTRODUCTION

A decade ago, DRE voting systems promised to improve many aspects of voting. By having a computer mediating the user's voting experience, they could ostensibly improve usability through summary screens and a variety of accessibility features including enlarged text, audio output, and specialized input devices. They also promised to improve the life of the election administrator, yielding quick, accurate tallies without any of the ambiguities that come along with hand-marked paper ballots. And, of course, they were promised to be secure and reliable, tested and certified. In practice, much of this was wishful thinking.

Many current DRE voting systems experienced their biggest sales volume after the failures of punch card voting systems in Florida in the 2000 presidential election. The subsequent Help America Vote Act provided a one-time injection of funds that made these purchases possible. Now, a decade later, these machines are near the end of their service lifetimes.

Last year, the election administration office of a large county whose current DRE systems are approaching end-of-life concluded that no system on the market—DRE or optical scan—meets their needs. This county, an early adopter of DREs, prefers to avoid hand-marked paper ballots because they open the door to ambiguous voter intent, a source of frustration in its previous centrally-tabulated optical scan system. They didn't want to go back.

The county's needs and preferences impose several significant constraints on the design of STAR-Vote:

DRE-style UI. Hand-marked ballots are not to be used, for the reason above. DRE-style systems were also preferred for their ability to offer facilities for disabled voters.

Printed paper ballot summaries. While the DRE-style UI was desired for entering selections, printed ballots were desired for their security benefits, verifiability by voters, and redundancy against failures in the electronic system. In order to save on paper and paper management, the county wished to only print a list of each voter's selections, analogous to the summary screens on many current-generation DRE systems.

All-day battery life. Power failures happen. Current-generation DRE systems have batteries that can last for hours. The new system must also be able to operate for hours without external power.

Early voting and election-day vote centers. This county supports two weeks of early voting, where any voter may vote in any of more than 20 locations. Also, on Election Day, any voter may go to any local polling place. Voters report loving this flexibility.

COTS hardware. Current DRE systems are surprisingly expensive. The county wants to use commercially available, off-the-shelf equipment, whenever possible, to reduce costs and shorten upgrade cycles. That is, "office equipment" rather than "election equipment" should be used where possible.

Long ballots. While voters in many countries only select a candidate for member of parliament, in the U.S., voters regularly face 100 or more contests for federal, state, and

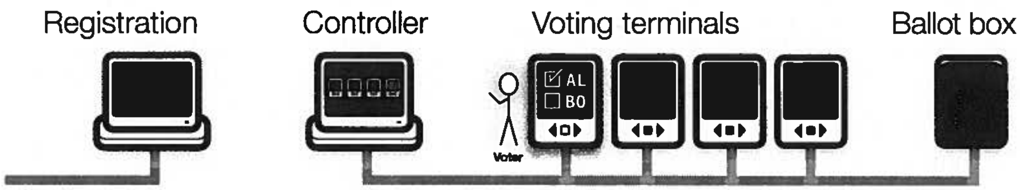

Fig. 1. The design of the STAR-Vote system. The voter registration system (left) is connected to the Internet but not to the internal LAN. Voters move left to right. First, the voter's registration is validated, and a thermal printout indicates the proper ballot style. This moves to the controller, which scans it and issues the voter a PIN, again printed on thermal paper. The voter proceeds to any open voting terminal, enters the PIN, and is given the proper ballot style. The ballot summary is printed, and deposited into the ballot box (right).

regional offices; judges; propositions; and constitutional amendments. STAR-Vote must support very long ballots.

These constraints interact in surprising ways. Even if the county did not have a strong preference for a DRE-like UI, pre-printed paper ballots are inefficient for vote centers, which may need to support hundreds or thousands of distinct ballot styles. Likewise, the requirement to run all-day on battery backup eliminates the possibility of using laser printers, which consume too much power.[1]

We were charged with using the latest advances in human factors, end-to-end cryptography, and statistical auditing techniques, while keeping costs down and satisfying many challenging constraints. We want to generate quick, verifiable tallies when the election is over, yet incorporate a variety of audit mechanisms (some voter-verifiable, others facilitated by auditors with additional privileges).

We were notably not required to worry about Federal and State certification. Of course, for STAR-Vote to go into production, these challenges need to be addressed, but at least for now, our focus has been on designing the best possible voting system given these constraints.

2. VOTER FLOW

Figure 1 shows how STAR-Vote works from the perspective of a voter. The STAR-Vote voting system bears a resemblance to the Hart InterCivic eSlate system and to VoteBox [Sandler et al. 2008], in that the voting machines are networked together, simplifying the movement of data. Like eSlate, our design contains a networked group of voting machines that share a common judge's station with a computer like Hart InterCivic's "Judge Booth Controller" (JBC) that manages everything.

(1) *Registration (pollbook).* The first step for the voter is to check-in with a poll worker. This is where voter registration is verified and the voter's precinct and ballot style are determined. The registration system, via cellular modem, notifies a centralized database of the voter's change in status, to eliminate any risk of double-voting.
The registration system will use a thermal label printer to generate a sticker with the voter's name, precinct and ballot style indicated. The precinct and ballot style are also indicated with a 1-D barcode. This sticker goes into a poll book which the voter signs, providing a backup to the online database. The barcode can also be read by an off-the-shelf scanner connected to the controller. This represents the only data flow from the outside world into the internal voting network, and helps avoid data entry errors that

[1]A laser printer may consume as much as 1000 watts while printing. A reasonably good UPS, weighing 26 kg, can provide that much power for only ten minutes. Since a printer must warm up for each page when printed one-off (perhaps 10 seconds per page), the battery might be exhausted by printing as few as 60 ballots.

might come from human transcription. Nothing in the barcode is secret nor is it unique to the voter. Consequently, the flow of this information does not compromise the voter's privacy, so long as the voter is not the only voter with the same precinct and ballot style to vote at that polling location.
Provisional voters will be indicated with a suitable prefix to their precinct code, allowing the voting system to suitably distinguish their ballots from regular ones. (Provisional votes are cast by voters who, for whatever reason, do not appear in the voter registration database, and believe this to be in error. They are only tabulated after the voter's registration status is verified, typically not until at least a few days after the end of voting.)

(2) *Controller.* The controller scans the barcode on the sticker to identify the voter's precinct and ballot style. The controller then prints a 5-digit code, unique for the remainder of the election in this polling place. Holding this printout, the voter can then approach any open voting terminal, enter the code, and be presented with the correct ballot style. (There will probably need to be a special alternative for ADA compliance as not all voters can see or handle paper. One possible solution is that a poll worker could enter the relevant code, then depart before the voter begins voting.)
There are only ever a small number of 5-digit codes active at any one time, reducing the odds of a voter successfully guessing an active code and casting multiple ballots. We note that there will be no record binding the 5-digit code to the voter, helping ensure voter anonymity. We also note that these codes reduce the attack surface, relative to other voting systems that use smartcards or other active electronic devices to initialize a voting machine for each voter.

(3) *Voting terminals.* The voter makes selections with the GUI (for sighted voters) or auditory UI (for non-sighted voters). There is a review screen (or the auditory equivalent) so that the voter can confirm all selections before producing a paper record.

(4) *Print.* When the voter has finished making selections, the voting terminal prints two (possibly joined) items: (1) a paper ballot which includes a human-readable summary of the voter's selections and a random (non-sequential) serial number, and (2) a take-home receipt that identifies the voting terminal used, the time of the vote, and a short (16-20 character) hash code that serves as a commitment to the vote but does not reveal its contents.[2] The voting terminal also sends data about the vote and receipt to the judge's station. (See Section 6 for the exact cryptographic design.)

(5) *Review printed record.* The voter may then review the printed record to confirm the indicated selections. There will be at least one offline station available that can scan the paper record and read it back to the voter for those who cannot visually read the paper record.

(6) *Option: Cast or challenge/spoil.* After reviewing the ballot, the voter has a choice: Cast the ballot or spoil it. A voter might spoil the ballot because of an error (or change of heart) or because the voter wishes to challenge the voting terminal, demanding it to show that the voter's selections were correctly recorded and committed to. This process represents a novel variant on Benaloh challenges [Benaloh 2006; 2007]; rather than asking the voter a "cast or challenge" question, the voter either deposits the ballot in the box or not. This represents a potentially significant usability gain over prior variants of the Benaloh challenge.
The two procedures are described below. Note also that there is a special procedure for provisional ballots.
Regardless, the voter may keep the take-home paper receipt. We note that most thermal printers include a cutting device that leaves a small paper connection between the two

[2]A secondary hash code with as many as 16-20 additional characters may be included for additional assurance.

sides of the cut. It is therefore a simple matter for the voting terminal to print a single sheet that the voter can easily separate into the ballot summary and the take-home receipt. We also note that "privacy sleeves" (i.e., simple paper folders) can protect the privacy of these printed ballots as voters carry them from the voting machine either to the ballot box to be cast, or to the judge's station to be spoiled.

(a) *Ballot box: cast ballot.* A voter who wishes to cast the ballot takes the paper ballot summary to the ballot box. The ballot box has a simple scanner that can read the serial number from the ballot (the serial number might also be represented as a one-dimensional barcode for reliability) and communicate this to the controller, allowing the controller to keep a record of which ballots have found their way to the ballot box, and thus, which ballots should be tabulated. *An electronic ballot record is not considered complete and should not be included in the tally unless and until its corresponding paper ballot summary has been deposited in the balot box.*

(b) *Spoil ballot.* If the paper record is to be spoiled, the voter returns to a poll worker. The ballot serial number is scanned so that the controller can record that the ballot is to be spoiled. This informs the controller that the corresponding encrypted ballot record should not be included in contest results. Instead, it should be decrypted and published as such after the election is over. The original printed paper ballot thus corresponds to a *commitment* by the voting machine, before it ever "knew" it might be challenged. If the voting machine cannot produce a suitable proof that the ballot encryption matches the plaintext, then it has been caught cheating. Voters who don't care about verification can simply restart the process. For voters who may feel uncomfortable with this process, as it might reveal their intent to a poll worker, we note that voters could deliberately spoil ballots that misstate their true intent. We note that dedicated election monitors could be allowed to use voting machines, producing printed ballots that they would be forbidden from placing in the ballot box, but which would be spoiled and then the corresponding ciphertext would be decrypted. In effect, election monitors can conduct *parallel testing in the field* on any voting machine at any time during the live election.

(c) *Provisional ballot.* In the case of a provisional ballot, the voter must return the ballot to a poll worker. The voter can choose to spoil the balot and re-vote or to cast the ballot provisionally by having it placed — under an identifying seal – into a distinct provisional ballot box. The voter may retain the receipt to see if the ballot ends up being counted. Because the ballot box is connected to the controller over the LAN, it can also query the controller as to whether the ballot is provisional. In the event that a voter accidentally puts a provisional ballot into the ballot box, the scanner can detect this and reject the pages. (Provisional ballots need to go into dedicated envelopes that are processed after the voting has ended.)

(7) *At home (optional): Voter checks crypto.* The encrypted votes will be posted on a public "bulletin board" (i.e., a web site maintained by the county). The voter receipt corresponds to a cryptographic hash of the encrypted vote. A voter should be able to easily verify that this vote is present on the bulletin board. If a voter spoiled a ballot, that should also be visible on the bulletin board together with its decrypted selections. This allows independent observers to know which ballots to include in the tally and allows independent verifiers to check that all spoiled ballots are correctly decrypted. Individual voters can check, without any mathematics, that the decryptions of their own spoiled ballots match their expectations.

While this process is more cumbersome than a traditional DRE voting system, it has several advantages. By having the paper elements, this system not only benefits from sophisticated end-to-end cryptographic techniques (described in Section 6), it also can be audited post-election, by hand, using a risk-limiting audit (see Section 5). Voters also have the confidence that comes from holding, verifying, and casting a tangible record of their votes, whether or not they trust the computers.

3. DESIGN

From the perspective of voters, the process of registration and poll-station sign-in is unchanged from current practice. Once authorized, voters proceed to a voting terminal where they use a rich interface that prevents overvotes, warns of undervotes, and supports alternative input/output media for disabled and impaired voters. The printed ballot summary and the corresponding electronic ballot record both include a variety of cryptographic features, which we now describe.

3.1. Crypto Overview

From the perspective of election officials, the first new element in the election regimen is to generate the cryptographic keys. A set of election trustees is designated as key holders and a threshold number is fixed. The functional effect is that if there are n election trustees and the threshold value is k, then any k of the n trustees can complete the election, even if the remaining $n-k$ are unavailable. This threshold mechanism provides robustness while preventing any fewer than k of the trustees from performing election functions that might compromise voter privacy. Threshold cryptosystems are straightforward extensions of traditional public-key cryptosystems [Desmedt and Frankel 1989].

The trustees each generate a key pair consisting of a private key and a public key; they publish their public keys. A standard public procedure is then used to compute a single public key from the n trustee public keys such that decryptions can be performed by any k of the trustees. This single election public key K is published and provided to all voting terminals together with all necessary ballot style information to be used in the election. A start value z_0, which is unpredictable and unique to the election, is also chosen and distributed to each voting terminal for reasons discussed below.

During the election, voters use voting terminals to make their selections. Once selections are completed, the voting terminal produces paper printouts of two items. The first is the paper ballot summary which consists of the selections made by the voter and also includes a random (non-sequential) serial number. The second is a receipt that consists of an identification number for the voting terminal, the date and time of the vote, and a short hash of the encryption of the voter's selections together with the previous hash value. Specifically, if the voter's selections are denoted by v, the i^{th} hash value produced by a particular voting terminal m in an election is computed as

$$z_i = H(E_K(v), m, z_{i-1})$$

where H denotes the hash function and E denotes encryption.

The voting terminal should retain both the encrypted ballots and the current hash value. At the conclusion of the election (if not sooner), the encrypted ballots should be posted on a publicly-accessible web page and digitally signed by the election office using a simple signature key (not the key generated by the trustees). The posting of each encrypted ballot should also include a non-interactive zero-knowledge (NIZK) proof that the ballot is well-formed. Once they receive their ballot summaries and take-home receipts, voters may either deposit their ballot summaries into a ballot box or take them to a poll-worker and have them spoiled. Ballot summaries deposited in a ballot box have their serial numbers scanned and recorded. The electronically stored encrypted vote is not considered complete (and not included in the tally) unless and until its corresponding serial number has been recorded in the ballot box.

Any electronically stored encrypted ballots for which no corresponding serial number has been scanned and recorded are deemed spoiled. The published election record should include all spoiled ballots as well as all cast ballots, but for each spoiled ballot the published record should also include a verifiable decryption of the ballot's contents. Voters should be able to easily look up digitally-signed records for any receipts they hold and verify their presence and, for spoiled receipts, the ballot contents.

A voter who takes a completed paper ballot summary to a poll worker can request that the poll worker spoil the ballot and give the voter an opportunity to re-vote. The poll worker marks both the take-home receipt and the paper ballot summary as spoiled (including removing or marking the serial number so that it will not be recorded if subsequently placed in the ballot box) and returns the spoiled ballot summary to the voter.

Upon completion of the election, the election office homomorphically combines the cast ballots into an aggregate encryption of the election tally (this can be as simple as a multiplication of the public encrypted ballots). At least k of the election trustees then each perform their share of the decryption of the aggregate as well as individual decryptions of each of the spoiled ballots. The trustees also post data necessary to allow observers to verify the accuracy of the decryptions.

A privacy-preserving risk-limiting audit is then performed by randomly selecting paper ballot summaries and matching each selected ballot with a corresponding encrypted ballot to demonstrate the correct matching and provide software-independent evidence of the outcome [Rivest and Wack 2006; Lindeman and Stark 2012; Stark and Wagner 2012].

3.2. Triple Assurance

Three lines of evidence are produced to support each election outcome [Stark and Wagner 2012]. The homomorphic tallying process proves that the announced tally corresponds to the posted encrypted ballot records. The ballot challenge and receipt checking processes allow voters to check that these encrypted ballot records correctly reflect their selections. The risk-limiting audit process provides an independent check that a hand count of the paper ballots matches the outcome which a hand count of the paper records would produce. In addition, the paper records remain available in case of systemic failure of the electronic records or if a manual count is ever desired. The paper and electronic records are conveyed to the local election office separately, providing additional physical security of the redundant audit trail.

The design of the election system ensures that all three of these checks should be perfectly consistent. There is sufficient information in the records so that if any discrepancies arise (for instance because of loss of some of the electronic or paper records), the discrepancies can be isolated to individual ballots that are mismatched or counted differently.

3.3. Software and Hardware Engineering

An important criteria for STAR-Vote is that it should leverage commodity components whenever feasible. This reduces cost and simplifies the ability for an election administrator to replace aging hardware by sourcing it from multiple vendors. While this paper isn't intended to cover certification issues, the separation of hardware and software allows for the possibility of *commercial off-the-shelf* (COTS) hardware, which *could* be subject to a lower bar for certification than the software.

Ideally, the voting terminals and the judge station could use identical hardware. In particular, we believe that a reasonable target might be "point of sale" terminals. These are used in restaurants worldwide. They are used in relatively demanding environments and, on the inside, are ordinary PCs, sometimes built from low-power laptop-class parts. The only missing hardware from a COTS point of sale terminal, relative to our needs for STAR-Vote, are a printer and a battery.

If you want a reliable, low-power printer, without having to worry about consumable ink or toner, there's only one choice: thermal printers. They come in a variety of widths, up to US Letter size. Thermal paper, particularly higher cost thermal paper, can last for years in an air-conditioned warehouse, although some experimentation would be required to see whether it can survive an un-air-conditioned trip in a hot car in the summer. Every shipping label from major online vendors like Amazon is printed thermally, lending some credence to its survivability in tough conditions.

Specifying a battery is more complicated. We could require that the voting terminal have an internal (and removable) battery, but this eliminates COTS point of sale terminals. Tablet computers come with built-in batteries that, at least in some cases, can last all day. Tablet computers have smaller screens than we might prefer, and we would have to worry about theft. Also, we would prefer to use wired networks, rather than the wireless networks built into most tablets. Perhaps the right answer is to specify a point of sale terminal with an external battery, and hope a vendor can do this without extensive customization.

For the software layer, we see no need for anything other than a commodity operating system, like Linux, which can be stripped of unessential features to reduce the attack surface. For example, we don't need a full-blown window system or 3D graphics pipeline. All we need are basic pre-rendered ballots, as in pVote [Yee et al. 2006; Yee 2007] or VoteBox [Sandler et al. 2008]. We would specify that the voting system software be engineered in a type-safe language like Java or C# (eliminating buffer overflow vulnerabilities, among other problems) and we would also specify that the software be engineered with *privilege separation* [Provos et al. 2003], running separate parts of the voting software as distinct applications, with distinct Unix user-ids, and with suitably reduced privileges. For example, the storage subsystem can maintain append-only storage for ballots. The voter-facing UI would then have no direct access to ballot storage, or the network, and could be "rebooted" for every voter. Consequently, a software compromise that impacts the UI application could impact at most one voter. A tablet that includes a Trusted Platform Module (TPM) can provide additional assurance that the correct software — and only the correct software — is running on the device.

A separation architecture like this also provides some degree of protection over sensitive cryptographic key materials, e.g., if we want every voting terminal to have a unique private key to compute digital signatures over ballots, then we must restrict the ability for compromised software to extract the private keys. DStar [Zeldovich et al. 2008], for example, used this technique to protect the key material in an SSL/TLS web server.

4. USABILITY

4.1. Design Considerations

In designing this reference voting system it was important to maximize the usability of the system within the framework of enhanced security and administrative expediency. The overall design of the system was strongly influenced by usability concerns. For example, a proposal was put forth to have all voters electronically review the paper record on a second station; this was rejected on usability grounds. ISO 9241 Part 11 [ISO] specifies the three metrics of usability as effectiveness, efficiency, and satisfaction, and these are the parameters we attempt to maximize in this design. Effectiveness of the system means that users should be able to reliably accomplish their task, as they see it. In voting, this means completing a ballot that correctly records the candidate selections of their choice, whether that be though individual candidate selection by race, straight party voting, or candidate write-ins. Efficiency measures the ability of a voter to complete the task with a minimum of effort, as measured through time on task or number of discrete operations required to complete a task. Efficiency is important because users want to complete the voting task quickly and voting officials are concerned about voter throughput. Reduced efficiency means longer lines for waiting voters, more time in the polling booth, and higher equipment costs for election officials. Satisfaction describes a user's subjective assessment of the overall experience. While satisfaction does not directly impact a voter's ability to cast a vote in the current election, it can have direct impact on their willingness to engage in the process of voting at all, so low satisfaction might disenfranchise voters even if they can cast their ballots effectively and efficiently. How does this design seek to maximize these usability metrics? For voting systems, the system must generally be assumed to be walk-up-and-use. Voting is an infrequent activity for most, so the system must be intuitive enough that little to no instruction is required to use. The system should minimize the cognitive load on voters, so that they can focus on making candidate selections and not on system navigation or operation. The system should also mitigate the kinds of error that humans are known to make, and support the easy identification and simple correction of those errors before the ballot is cast.

Why not paper?. Paper ballots (bubble ballots in particular) have many characteristics that make them highly usable [Everett et al. 2006; Byrne et al. 2007]. Users are familiar with paper, and most have had some experience with bubble-type item selection schemes. Voting for write-in candidates is simple and intuitive. Unlike electric voting machines, paper is nearly 100% reliable and is immune from issues of power interruption. Further, paper leaves an auditable trail, and wholesale tampering is extremely difficult. However, paper is not a perfect solution. Voters actually show higher satisfaction with electronic voting methods than they do with paper [Everett et al. 2008] and paper has significant weaknesses that computers can overcome more easily. First, the ambiguity that can be caused by partial marks leads to substantial problems in counting, recounting, and re-interpreting paper ballots. Second, voting by individuals with disabilities can be more easily accommodated using electronic voting methods (e.g., screen readers, jelly switches). Third, electronic voting can significantly aid in the reduction of error (e.g. undervotes, overvotes, stray marks) by the user in the voting process. Fourth, electronic voting can more easily support users whose first language is not English, since additional ballots for every possible language request do not have to be printed, distributed and maintained at every polling location. This advantage is also evident in early voting and vote center administration; rather than having to print, transport, secure, and administer every possible ballot for every precinct, the correct ballot can simply be displayed for each voter. Computers also facilitate sophisticated security and cryptography measures that are more difficult to implement in a pure paper format. Finally, administration of the ballots can be easier with electronic formats, since vote counting and transportation of the results are more efficient. We have taken a hybrid approach in this design, by using both paper and electronic voting methods in order to create a voting system that retains the benefits of each medium while minimizing their weaknesses.

Usability vs Security. Usability and security are often at odds with each other. Password design is a perfect example of this tension. A system that requires a user have a 32-character password with upper and lower case letters, digits, and symbols with no identifiable words embedded might be highly secure, but it would have significant usability issues. Further, security might actually be *compromised* since users are likely to write such a difficult password down and leave it in an insecure location (e.g., stuck to the computer monitor). For voting systems, we must strive for maximum usability while not sacrificing the security of the system (our security colleagues might argue that we need to maximize security while not sacrificing usability). In our implementation, many of the security mechanisms are invisible to the user. Those that are not invisible are designed in such a way that only those users who choose to exercise the enhanced security/verifiability of the voting process are required to navigate additional tasks (e.g., ballot challenge, post-voting verification).

Error reduction. The use of computers in combination with paper is anticipated to reduce errors committed by voters. Because voters will fill out the ballot on electronic voting terminals, certain classes of errors are completely eliminated. For example, it will be impossible to over vote or make stray ballot marks, as the interface will preclude the selection of more than a single candidate per race. Under voting will be minimized by employing sequential race presentation, forcing the voter to make a conscious choice to skip a race [Greene 2008]. Undervotes will also be highlighted in color on the review screen, providing further opportunity for users to correct accidental undervotes. This review screen will also employ a novel party identification marker (described below) that will allow a voter to easily discern the party for which they cast a vote in each race. The use of the paper ballot (printed when the voter signals completion) provides the voter with a final chance to review all choices before casting the final ballot.

4.2. User Interface Design Specification

The basic design for the UI is a standard touchscreen DRE with auditory interface for visually impaired voters and support for voter-supplied hardware controls for physical impairments (e.g., jelly switches).

The VVSG. The starting point for UI specifications is the 2007 version of the Voluntary Voting System Guidelines (VVSG). These guidelines specify many of the critical properties required for a high-quality voting system user interface, from simple visual properties such as font size and display contrast to more subtle properties such as ballot layout. They also require that interfaces meet certain usability benchmarks in terms of error rates and ballot completion time. We believe that no extant commercial voting UI meets these requirements, and that any new system that could meet them would be a marked improvement in terms of usability. That said, there are some additional requirements that we believe should be met.

Accessibility. While the VVSG includes many guidelines regarding accessibility, more recent research aimed at meeting the needs of visually-impaired voters [Piner and Byrne 2011] has produced some additional recommendations that should be followed. These include:

— The system should include an auditory interface than can be used alone or in conjunction with the visual interface.
— Speech rate (as well as volume) should be adjustable by the voter.
— In order to maximize intelligibility, a synthesized male voice should be used so that speed can be altered without changing pitch.
— Navigation should allow users to skip through sections of speech that are not important to them as well as allowing them to replay any parts they may have missed or not comprehended the first time.
— At the end of the voting process, a review of the ballot must be included, but should not be required for the voter.

Review Screens. Another area where the VVSG can be augmented concerns review screens. Voter detection of errors (or possible malfeasance) on review screens is poor [Everett 2007], but there is some evidence that UI manipulations can improve detection in some cases [Campbell and Byrne 2009a]. Thus, STAR-Vote requires the following in addition to the requirements listed in the VVSG:

— Full names of contests and candidates should be displayed on the review screen; that is, names should be text-wrapped rather than truncated. Party affiliation should also be displayed.
— Undervotes should be highlighted using an orange-colored background.
— Activating (that is, touching on the visual screen or selecting the relevant option in the auditory interface) should return the voter to the full UI for the selected contest.
— In addition to party affiliation in text form, graphic markings should be used to indicate the state of each race: voted Republican, voted Democratic, voted Green, etc.—with a distinctive graphic for "not voted" as well. These graphic markings (perhaps a donkey for the Democratic Party, an elephant for the Republican Party, etc.) should be highly

distinguishable from each other so that a rapid visual scan quickly reveals the state of each race.

Paper Record. The VVSG has few recommendations for the paper record. For usability, the paper record should meet VVSG guidelines for font size and should contain full names for office and candidate. To facilitate scanner-based retabulations, the font should be OCR-friendly. Contest names should be left-justified while candidate names should be right-justified to a margin that allows for printing of the same graphic symbols used in the review screen to facilitate rapid scanning of ballots for anomalies. Candidate names should not be placed on the same line of text as the contest name and a thin horizontal dividing line should appear between each office and the next in order to minimize possible visual confusion.

4.3. Issues that still need to be addressed

There are still several issues that need to be addressed in order to make the system have the highest usability. The first of these is straight party voting (SPV). SPV can be quite difficult for a voter to understand and accomplish without error, particularly if voters intend to cross-vote in one or more races [Campbell and Byrne 2009b]. Both paper and electronic methods suffer from these difficulties, and the optimum method of implementation will require additional research. Races in which voters are required to select more than one candidate (k of n races) also create some unique user difficulties, and solutions to those problems are not yet well understood.

5. AUDIT

The E2E feature of STAR-Vote enables individual voters to confirm that their votes were included in the tabulation, and that the encrypted votes were added correctly. The challenge feature, if used by enough voters, assures that the encryption was honest and that substantially all the votes are included in the tabulation. But there might not be many voters who challenge the system; the voters who do are hardly representative of the voting public; and some problems may go unnoticed. Moreover, the anonymized form of E2E used here does not allow a voter to confirm that *others'* ballots were included in the tabulation, only that those ballots that were included were included correctly.

The paper audit trail enables an entirely independent check that the votes were included and tabulated accurately, that the visible trace of voter intent as reflected in the ballot agrees with the encryption, and, importantly, that the winners reported by the voting system are the winners that a full hand count of the audit trail would reveal. The key is to perform a compliance audit to ensure that the audit trail of paper ballots is adequately intact to determine the outcomes, and then to perform a risk-limiting audit of the machine interpretation against a manual interpretation of the paper ballots. For the risk-limiting audit, STAR-Vote uses SOBA [Benaloh et al. 2011] with improvements given by [Lindeman and Stark 2012].

A risk-limiting audit guarantees a large minimum chance of a full hand count of the audit trail if the reported outcome (i.e., the set of winners) disagrees with the outcome that the full hand count would reveal. The full hand count then sets the record straight, correcting the outcome before it becomes official. Risk-limiting audits are widely considered best practice for election audits [Lindeman et al. 2008; Bretschneider et al. 2012].

The most efficient risk-limiting audits, ballot-level comparison audits, rely on comparing the machine interpretation of individual ballots (cast vote records or CVRs) against a hand interpretation of the same ballots [Stark 2010; Benaloh et al. 2011; Lindeman and Stark 2012]. Current federally certified voting systems do not report cast vote records, so they cannot be audited using the most efficient techniques [Lindeman and Stark 2012; Stark and

Wagner 2012]. This necessitates expensive work-arounds.[3] The preamble to conducting a ballot-level comparison audit using currently deployed voting systems can annihilate the efficiency advantage of ballot-level comparison audits [Stark and Wagner 2012].

A big advantage of STAR-Vote is that it records and stores individual cast vote records in a way that *can* be linked to the paper ballot each purports to represent, through encrypted identifiers of the ballot corresponding to each voter's selections, separately for each contest. This makes ballot-level comparison audits extremely simple and efficient. It also reduces the vulnerability of the audit to human error, such as accidental changes to the order of the physical ballots.[4]

A comparison audit can be thought of as consisting of two parts: Checking the addition of the data,[5] and randomly spot-checking the accuracy of the data added, to confirm that they are accurate enough for their tabulation to give the correct electoral outcome. The data are the votes as reported by the voting system. For the audit to be meaningful, the election official must commit to the vote data before the spot-checking begins. Moreover, for the public to verify readily that the reported votes sum to the reported contest totals, it helps to publish the individual reported votes. However, if these votes were published ballot by ballot, pattern voting could be used to signal voter identity, opening a communication channel that might enable widespread wholesale coercion [Rescorla 2009; Benaloh et al. 2011].

The SOBA risk-limiting protocol [Benaloh et al. 2011] solves both of these problems: It allows the election official to commit cryptographically and publicly to the vote data; it publishes the vote data in plain text but "unbundled" into separate contests so that pattern voting cannot be used to signal. Moreover, the computations that SOBA requires are extremely simple (they are simplified even further by [Lindeman and Stark 2012]). The simplicity increases transparency, because observers can confirm that the calculations were done correctly with a pencil and paper or a hand calculator.

The encrypted ballot/contest identifiers on the ballot that STAR-Vote produces allow the electronic cast vote records for each contest to be linked to the paper they purport to represent. This simplifies SOBA procedures because it eliminates the need to store ballots in a rigid order. Moreover, because the voting terminal generates both the electronic vote data and the paper ballot, the audit should find very few if any discrepancies between them.

But since voters and election workers will handle the ballots in transit from the voting terminal to the scanner to the audit, voters might make marks on their ballots. Depending on the rules in place for ascertaining voter intent from the ballot, those marks might be interpreted as expressing voter intent different from the machine-printed selections, in which case the SOBA audit might find discrepancies.

It could also happen that a ballot enters the ballot box but its serial number is not picked up, so the electronic vote data ends up in the "untallied but unspoiled" group. This should be detectable by a compliance audit [Benaloh et al. 2011; Lindeman and Stark 2012; Stark and Wagner 2012] as a mismatch between the number of recorded votes and the number of pieces of paper, providing an opportunity to resolve the problem before the audit begins.

[3]For instance, a *transitive audit* might require marking the ballots with unique identifiers or keeping them in a prescribed order, re-scanning all the ballots to make digital images, and processing those images with software that can construct CVRs from the images and associate the CVRs with the ballots. That software in turn needs to be programmed with the all the ballot definitions in the contest, which itself entails a great deal of error-prone handwork.

[4]For instance, we have seen groups of ballots dropped on the floor accidentally; even though none was lost, restoring them to their original order was impossible.

[5]This presupposes that the contest under audit is a plurality, majority, super-majority, or vote-for-k contest. The operation that must be checked to audit an instant-runoff contest is not addition, but the same principle applies.

If such cases remain and turn up in the audit sample, SOBA would count them as discrepancies and the sample might need to expand, either until there is strong evidence that the electoral outcomes are correct despite any errors the audit uncovers, or until there has been a complete hand count.

The random selection of ballots for the SOBA audit should involve public participation in generating many bits of entropy to seed a high-quality, public, pseudo-random number generator (PRNG), which is then used to select a sequence of ballots to inspect manually [Lindeman and Stark 2012]. (For instance, audit observers might roll 10-sided dice repeatedly to generate a 20-digit number.) Publishing the PRNG algorithm adds transparency by allowing observers to verify that the selection of ballots was fair.

6. THE CRYPTOGRAPHIC WORKFLOW

The core elements. STAR-Vote keeps an electronic record of all the votes encrypted with a threshold cryptosystem (so that decryption capabilities are distributed to protect voter privacy) that has an additive homomorphic property (to allow individual encrypted ballots to be combined into an aggregate encryption of the tally). The common exponential version of the Elgamal cryptosystem satisfies the required properties, even though stronger security is obtained by using PPATS encryption [Cuvelier et al. 2013], in particular against key manipulation errors by the trustees and long-term security. The encryption scheme comes with an extraction function Ext that, from a ciphertext, extracts a commitment on the encrypted value. In the case of Elgamal, this is be the ciphertext itself, while in the case of PPATS, it is a perfectly hiding homomorphic commitment.

Cryptographic key generation can be accomplished in one of two ways, depending on the availability of the election trustees and the desired amount of robustness. The preferred process offers general threshold key generation requires multiple rounds (see [Gennaro et al. 2007] for Elgamal and PPATS), but can be simplified into a single-round solution if redundancy is eliminated. At the end of the key generation procedure, the trustees each hold a private key share that does not contain any information on the full private key, and the unique public key K corresponding to those shares is published.

During the polling phase, the ballot marking devices encrypt the votes of each voter using the public key K. This encryption procedure is randomized in order to make sure that two votes for the same candidates result in ciphertexts that look independent to any observer.

A cryptographic hash value of the commitment extracted from each ciphertext (and of a few more data, as discussed below) is also computed, fingerprinting the ballot to a 256 bit string, an abridged form of which is provided to the voter in a human readable form as part of the take-home receipt. All the hashes and commitments are computed and posted on a publicly accessible web page, as soon as the polls are closed. This web page is digitally signed by the election office using a traditional signature key.

The posting of all the hashes gives all voters the ability to verify that their ballots have been recorded properly. The commitments can also be checked for consistency with the hashes and used to confirm the homomorphic aggregation of the individual ballots into a single encryption of the sum of the ballots, which constitutes an encryption of the election tallies.

At the end of the election, any set of trustees that achieve the pre-set quorum threshold use their respective private keys to decrypt the derived aggregate tally encryption. This procedure is simple and efficient and can be completed locally without interaction between the trustees. We note that the individual encrypted ballots, from which the aggregate encryption of the tallies is formed, are never individually decrypted. However, each spoiled ballot *is* individually decrypted using exactly the same process that is used to decrypt the aggregate tally encryption.

The elements we just described make the core of the workflow and are sufficient to compute an election tally while preserving the privacy of the votes. We now explain various

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ways in which this simple workflow is hardened in order to make sure that the tally is also correct. All the techniques that follow enable the verification of different aspects of the ballot preparation and casting.

Hardening encryption. Since the tally does not involve the decryption of any individual ballot, and since the audit procedure relies on the fact that all counted ballots are properly formed, it is crucial to make sure that all the encrypted ballots that are added correspond to valid votes. This is achieved by requiring the ballot marking devices to compute, together with the encryption of the votes, a non-interactive zero-knowledge (NIZK) proof that each ballot is well-formed. Such a proof guarantees that each ciphertext encrypts a valid vote and does not leak any other information about the content of the vote. As a side benefit, this proof can be designed to make the ballots non-malleable, which provides an easy technique to prevent the replay of old ballots (i.e., reject duplicates). Traditional sigma proofs provide the required security properties [Bernhard et al. 2012].

Hardening decryption. Making sure that the encrypted ballots are valid is not enough: we also need to make sure that the tally is correctly decrypted as a function of those encrypted ballots: otherwise, malicious trustees (or trustees using corrupted devices) could publish an outcome that does not correspond to these ballots. As a result, we require the trustees to provide evidence of the correctness of the decryption operations that they perform. This can also be accomplished with sigma proofs in the case of Elgamal or more simply by publishing commitment openings in the case of PPATS.

Hardening the timeline. The procedures described above prevent malfunctioning or corrupted voting terminals or trustees to falsify individual ballots or decryption operations.

The detection of manipulation of encrypted ballots can be more effective by linking ballots with each other, using hash chaining. For this purpose, each ballot marking device is seeded, at the beginning of the election, with a public start value z_0 that includes a unique identifier for the election. This unique identifier is chosen at random shortly before the election, either in a central way or by the poll workers themselves at the beginning of election day.

From this seed, all election events are chain hashed, with z_{i+1} being computed as a hash of z_i concatenated to the id of the machine on which the event happens and to the event content. Two such chains are maintained and properly separated. One is internal and contains the full election data, including the encryption of the votes, the casting time of each paper ballot, and information on machines being added or removed. The second is public and chains the commitment extracted from all encrypted votes, together with time and identifiers for the election and voting machine. The public hash is the one actually printed on the take-home receipt. When the polls close, the final value of the hash chains are digitally signed, and the public chain is made public together with all the information needed for its reconstruction.

As a result of this procedure, any removed ballot will invalidate the hash chain which is committed to at the close of the election and whose constituents appear on the voter take-home receipts.

Hardening the link between the paper and electronic election outcome. The voting terminals print human-readable versions of each ballot summary which can be inspected for correctness by voters. In addition to the cast or challenge procedure discussed above, we need to produce the data required for the risk-limiting audit described in Section 5.

To this purpose, we need to commit on a full electronic record including a 1-to-1 mapping and evidence that this electronic record leads to the announced outcome. This is achieved as follows.

(1) For each ballot, the ballot marking device selects a random ballot id sequence number *bid*. This *bid* is printed on the ballots as a barcode. Furthermore, for each race r to which

the voter participates, an encryption of $H(bid\|r)$ is also computed and appended to the encryption of the choices.
(2) At the end of the day, and before decryption of the tallies, the trustees (or their delegates) shuffle and rerandomize all encrypted votes, race by race. This shuffle does not need to be verifiable.
(3) When the trustees decrypt the homomorphically added votes, they also decrypt the output of this shuffle. For each race, this provides a list of elements of the form $H(bid\|r)$ and the corresponding cleartext choices.
(4) Now, auditors can sample the paper ballots, read the *bid* printed on them, recompute the value of $H(bid\|r)$ for all races present on the paper ballot, and compare to the electronic record (as well as check many other things, as prescribed for the risk-limiting audit).

The use of hashed *bid*'s has the important benefit of making sure that someone who does not know a *bid* value cannot, by looking at the electronic record, link the selections made for the different races on a single ballot, which protects from pattern voting attacks. There is no need for such a protection from someone who can access the paper ballots, since that person can already link all races just by looking at the paper.

The full cryptographic protocol. The resulting cryptographic workflow is as follows.

(1) The trustees jointly generate a threshold public key/private key encryption pair. The encryption key K is published.
(2) Each voting terminal is initialized with the ballot/election parameters, the public key K and seeds z_0^p and z_0^i that are computed by hashing all election parameters and a public random salt.
(3) When a voter completes the ballot marking process selection to product a ballot v, the voting terminal performs the following operations:
    (a) It selects a unique and unpredictable ballot identifier *bid*, as well as a unique (but possibly predictable) ballot casting identifier *bcid*.
    (b) It computes an encryption $c_v = E_K(v)$ of the vote, as well as a NIZK proof p_v that c_v is an encryption of a valid ballot. This proof is written to be verifiable from $Ext(c_v)$ only.
    (c) For each race $r_1, \ldots, r_n$ to which the voter takes part, it computes an encryption $c_{bid} = E_K(bid\|r_1)\| \cdots \|E_K(bid\|r_n)$.
    (d) It computes a public hash code $z_i^p = H(bcid\|Ext(c_v)\|p_v\|m\|z_{i-1}^p)$, where m is the voting terminal unique identifier, as well as an internal hash $z_i^i = H(bcid\|c_v\|p_v\|c_{bid}\|\|m\|z_{i-1}^i)$
    (e) It prints a paper ballot in two parts. The first contains v in a human readable format as well as c_{bid} and *bcid* in a robust machine readable format (e.g., as barcodes). The second is a voter take-home receipt that includes, the voting terminal identifier m, the date and time, and the hash code z_i^p (or a truncation thereof), all in a human-readable format.
    (f) It transmits $(bcid, c_v, p_v, c_{bid}, m, z_i^p, z_i^i)$ to the judge's station.
(4) When a ballot is cast, the ballot casting id *bcid* is scanned and sent to the judge's station. The judge's station then marks the associated ballot as cast and ready to be included in the tally. This information is also broadcast and added in the two hash chains.
(5) When the polls are closed, the tally is computed: the product of all cast encrypted votes is computed and verifiably decrypted, providing an election result.
(6) The data needed for the risk limiting audit is computed, as described above.

All the data included in the public hash chain are eventually digitally signed and published by the local authority. Those audit data are considered to be valid if the hash chain checks, if all cryptographic proofs check, that is, if the ballot validity proofs check, if the homomorphic aggregation of the committed votes is computed and opened correctly, and if all spoiled ballots are decrypted correctly.

Write-in votes. So far, we have not described how our cryptographic construction can support write-in voting. Support for write-in votes is required in Texas and many other states. To be general-purpose, STAR-Vote adopts the vector-ballot approach [Kiayias and Yung 2004], wherein there is a separate homomorphic counter for the write-in slot plus an encryption of the string in the write-in. If there are enough write-in votes to influence the election outcome, then the write-in slots, across the whole election, will be mixed and tallied (together with the corresponding counters).

We note that, at least in Texas, write-in candidates must be registered in advance. It's conceivable that we could simply allocate a separate homomorphic counter for each registered candidate and have the STAR-Vote terminal help the voter select the desired "write-in" candidate. Such an approach could have significant usability benefits but is expected to require some update of regulations.

7. COERCION

In designing STAR-Vote, we made several explicit decisions regarding how much to complicate the protocol and impede the voter experience in order to mitigate known coercion threats. Specifically, one known threat is that a voter is instructed to create a ballot in a particular way but to then execute a decision to cast or spoil the ballot according to some stimulus received after the ballot has been completed and the receipt has been generated. The stimulus could come, for example, from subtle motions by a coercer in the poll site, the vibration of a cell phone in silent mode, or some of the (unpredictable) data that is printed on the voter's receipt. Some prior protocols have required that the receipt, although committed to by the voting device, not be visible to the voter until after a cast or spoil decision has been made (perhaps by printing the receipt face down behind a glass barrier) and configuring poll sites so that voters cannot see or be seen by members of the public until after they have completed all steps. We could insist on similar measures here, but in an era where cell phones with video recording capabilities are ubiquitous and eyeglasses with embedded video cameras can easily be purchased, it seems unwise to *require* elaborate measures which mitigate some coercion threats but leave others unaddressed.

7.1. Chain Voting

A similar threat of "chain voting" is possible with this system wherein a voter early in the day is instructed to neither cast nor spoil a ballot but to instead leave the poll site with a printed ballot completed in a specified way. This completed ballot is delivered to a coercer who will then give this ballot to the next voter with instructions to cast the ballot and return with a new printed ballot—again completed as specified. Chain voting can be mitigated by instituting time-outs which automatically spoil ballots that have not been cast within a fixed period after their production and by attempting to prevent voters from leaving poll sites with printed ballots, but, beyond simple mitigations, we require no additional steps to make chain voting impossible.

(Traditional paper ballots sometimes include a perforated header section which includes a serial number. A poll worker keeps one copy of this number and verifies that the ballot a voter wishes to cast matches the expected serial number. If so, the serial number is then detached from the ballot and deposited in the box. STAR-Vote could support this, but we believe it would damage STAR-Vote's usability. The timeout mechanism seems like an adequate mitigation.)

We do, however, take measures to prevent wholesale coercion attacks such as those that may be enabled by pattern voting. For instance, The SOBA audit process is explicitly designed to prevent pattern-voting attacks; and the high assurances in the accuracy of the tally are acheived without ever publishing the full set of raw ballots.

An interesting concern is that our paper ballots have data on them to connect them to electronic ballot records from the voting terminals and judge's console. The very data that links a paper ballot to an electronic, encrypted ballot creates a potential vulnerability. Since some individual paper ballot summaries will be selected for post-election audit and made public at that time, we are careful to not include any data on the voter's take-home receipt which can be associated with the corresonding paper ballot summary.

7.2. Absentee and Provisional Ballots

There are several methods available for incorporating ballots which are not cast within the STAR-Vote system, such as absentee and provisional ballots. The simplest approach is to completely segregate votes and tallies, but this has several disadvantages, including a reduction in voter privacy and much lower assurance of the accuracy of the combined tally.

It may be possible to eliminate all "external" votes by providing electronic means for capturing provisional and remote ballots. However, for the initial design of the STAR-Vote system, we have chosen to avoid this complexity. Instead, we ask that voting officials receive external votes and enter them into the STAR-Vote system as a proxy for voters. While this still does not allow remote voters to audit their own ballots, the privacy-preserving risk-limiting audit step is still able to detect any substantive deviations between the paper records of external voters and their electronically recorded ballots. This provides more supporting evidence of the veracity of the outcome without reducing voter privacy.

8. CONCLUSIONS AND FUTURE WORK

In many ways, STAR-Vote is a straightforward evolution from existing commercial voting systems, like the Hart InterCivic eSlate, mixing in advanced cryptography, software engineering, usability, and auditing techniques from the research literature in a way that will go largely unnoticed by most voters, but that have huge impact on the reliability, accuracy, fraud-resistance, and transparency of elections. Due to space constraints, this document doesn't mention many pragmatic features that our election administration colleagues have specified based on their experience running prior elections. Clearly, we're long overdue for election systems engineered with all the knowledge we now have available.

STAR-Vote also opens the door to a variety of interesting future directions. For example, while STAR-Vote is intended to service any given county as an island unto itself, there's no reason why it cannot also support *remote voting*, where ballot definitions could be transmitted to a remote supervised kiosk, which securely returns the electronic and paper records. By virtue of STAR-Vote's cryptographic mechanisms, such a remote vote is really no different than a local provisional vote and can be resolved in a similar fashion, preserving the anonymity of the voter. (A variation on this idea was earlier proposed as the RemoteBox extension [Sandler and Wallach 2008] to VoteBox [Sandler et al. 2008].) This could have important ramifications for overseas and military voters with access to a suitable impromptu polling place, e.g., on a military base or in a consular office.

(We do not want to suggest that STAR-Vote would be suitable for *Internet* voting. Using computers of unknown provenance, with inevitable malware infections, and without any systematic way to prevent voter bribery or coercion, would be a foolhardy way to cast ballots.)

STAR-Vote anticipates the possibility that voting machine hardware might be nothing more than commodity computers running custom software. It remains unclear whether off-the-shelf computers can be procured to satisfy all the requirements of voting systems (e.g., long-term storage without necessarily having any climate control, or having enough battery life to last for a full day of usage), but perhaps such configurations might be possible.

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Austin Mayor's Committee for People with Disabilities

June 11, 2013

To Whom it May Concern:

I am writing on behalf of the Austin Mayor's Committee for People with Disabilities (AMCPD) to express support for the Travis County Elections Division's application for the *Effective Absentee Systems for Election 2.0 (EASE 2.0)* grant from the Federal Voting Assistance Program. We recognize the potential of Travis County's proposed STAR voting system to improve the voting experience of uniformed and overseas voters through electronic ballot delivery. We are confident in the ability of the STAR system to provide electronic ballots with accessible functionality using affordable off-the-shelf hardware and a secure voting process that delivers verifiable evidence that a remote voter's ballot has been tallied.

The AMCPD has a long-standing relationship with the Travis County Elections Division. AMCPD representatives have served on the past two Elections Study Groups responsible for identifying and selecting the County's current accessible voting system and developing specifications for STAR, our next generation voting system. Through this relationship, we have recognized Travis County's commitment to proactively meet the needs of voters with disabilities to independently participate in elections in an inclusive manner using the same voting system as all other voters. Travis County has both ensured the procurement and development of secure and accessible voting systems and effectively planned for accessibility throughout the entire election process.

The AMCPD is an advisory body to the city council and city manager regarding problems affecting persons with disabilities in the Austin area. The committee was established to encourage, assist, and enable persons with disabilities to participate in the social and economic life of the City; achieve maximum personal independence; become gainfully employed; and use and enjoy fully all public and private facilities available within the community. We regard equal access to the vote as an essential civil right for voters with disabilities and fully support the Travis County Election Division commitment to ensure this right for all voters in the most secure and cost effective manner.

Sincerely,

Jesus Lardizabal

Jesus Lardizabal, AMCPD Chair

AMCPD
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June 10, 2013

To Whom It May Concern,

On behalf of the Coalition of Texans with Disabilities (CTD), I am excited to strongly recommend the Travis County Elections Division for the Effective Absentee Systems for Election 2.0 (EASE 2.0) grant from the Federal Voting Assistance Program.

Travis County's proposed STAR-Vote system has the potential to be a quantum leap forward for voters with disabilities. Many of the issues that remain unsolved in the continuing rollout of the Help America Vote Act are addressed in STAR-Vote: accessibility, security, auditability and reliability. It would address the question of cost by using off-the-shelf technology. This is important because issues of the cost of proprietary voting software programming have been used in proposed legislation to exempt some elections from HAVA requirements.

CTD is a statewide cross-disability advocacy organization that is deeply involved in accessible voting, having served on the Texas Secretary of State's HAVA Implementation Committee, giving dozens of HAVA presentations, serving as a subject matter expert on issues surrounding voters with disabilities and more. Voting rights issues and practices are an extremely important part of the civic engagement to which all citizens must have free and easy access.

Our background has afforded us an opportunity to know or hear of many practices. We particularly note that Travis County has always included a person with a disability on its Election Study Group and frequently seeks out the disability perspective. This stands as a commitment to engaging the disability community as the County moves forward into an EASE 2.0 grant process.

For A Barrier Free Society,

Dennis Borel
Executive Director

TRAVIS COUNTY

FY 13 GRANT SUMMARY SHEET

Check One:	Application Approval: ☑ Contract Approval: ☐	Permission to Continue: ☐ Status Report: ☐
Check One:	Original: ☑	Amendment: ☐
Check One:	New Grant: ☑	Continuation Grant: ☐
Department/Division:	Travis County Clerk - Elections Division	
Contact Person/Title:	Gail Fisher/Election Special Projects	
Phone Number:	x47967	

Grant Title:	Electronic Transmission of Ballot Portal		
Grant Period:	From: Sep 1, 2013	To: Nov 30, 2014	
Fund Source:	Federal: ☑	State: ☐	Local: ☐
Grantor:	Department of Defense CFDA No. 12.219		
Will County provide grant funds to a sub-recipient?		Yes: ☐	No: ☑
Are the grant funds pass-through from another agency? If yes, list originating agency below.		Yes: ☐	No: ☑
Originating Grantor:			

Budget Categories	Grant Funds	County Cost Share	***Budgeted County Contribution #595010 (Cash Match)***	In-Kind	**TOTAL**
Personnel:	$ 0	$ 0	$ 0	$ 0	$ 0
Operating:	$ 19,950	$ 0	$ 0	$ 0	$ 19,950
Capital Equipment:	$ 0	$ 0	$ 0	$ 0	$ 0
Indirect Costs:	$ 0	$ 0	$ 0	$ 0	$ 0
Totals:	$ 19,950	$ 0	$ 0	$ 0	$ 19,950
FTEs:	0.00	0.00	0.00	0.00	0.00

Permission to Continue Information					
Funding Source (Cost Center)	Personnel Cost	Operating Cost	Estimated Total	Filled FTE	PTC Expiration Date
	$ 0	$ 0	$ 0	0.00	

Department	Review	Staff Initials	Comments
County Auditor	☐		Item under review
County Attorney	☐		Item under review

#	Measure	Actual FY 11 Measure	Projected FY 12 Measure	Projected FY 13 Measure	Projected FY 14 Measure
Performance Measures					
+ -	**Applicable Departmental Measures**				
1.	Number of Federal Postcard Applications eligible for eMail ballot by mail (FPCA)	N/A	950	3122	900
2.	Number of requested eMail ballots to UOCAV	N/A	587	2360	810
3.	Number of hours processing eMail ballots to FPAC	N/A	13	52	5
+ -	**Measures for the Grant**				
1.	Number of FPCA (Federal Postcard Applications)	N/A	950	3122	900
	Outcome Impact Description	This measurement is not expected to change			
2.	Number of requested eMail ballot forms for FPCA	N/A	587	2360	810
	Outcome Impact Description	The number of requested eMail ballots is expected to increase over time.			
3.	Number of hours processing eMail ballots	N/A	13	52	5
	Outcome Impact Description	Reduce number of hours necessary to process eMail requests.			

PBO Recommendation:

This is a smaller request from the County Clerk to the Department of Defense for the same opportunity as the Clerk's request for programming related to the new voting system. PBO has confirmed with the County Clerk that the grantor allows multiple applications from the same entity.
This grant is for $19,950 to have the vendor, Easy Access Inc, that maintains the Voter Registration system add additional functionality to the existing ballot-by-mail mail module of the system. This additional functionary will automatically electronically deliver a link to a PDF version of the voter's ballot which the voter can print, manually mark, and return by mail.

This match has no grant match requirements and does not obligate the County to continue any specified level of funding. PBO recommends approval of this request.

1. Brief Narrative - Summary of Grant: What is the goal of the program? How does the grant fit into the current activities of the department? Is the grant starting a new program, or is it enhancing an existing one?

The primary goal of this project is to increase efficiency in the processing of electronic ballot by mail submissions for UOCAVA (Uniformed and Overseas Citizen Absentee Voting Act) voters (military, overseas, and their spouses; and U.S. citizens residing outside the United States and its territories). This grant would be used for enhancements to the existing Ballot by Mail module of the Easy Access application which is used to verify and process ballot by mail applications of UOCAVA voters utilizing the Federal Postcard Application. It would replace the time-consuming, manual processing of UOCAVA applicants who request online ballot delivery with a stream-lined, efficient, electronic solution, and allow for immediate receipt of the ballot by the voter without delays inherent in manual systems.

2. Departmental Resource Commitment: What are the long term County funding requirements of the grant?

There are no long-term County funding requirements of the grant.

3. County Commitment to the Grant: Is a county match required? If so, how does the department propose to fund the grant match? Please explain.

No

4. Does the grant program have an indirect cost allocation, in accordance with the grant rules? If not, please explain why not.

No indirect cost allocation, grant request is under $50,000

5. County Commitment to the Program Upon Termination of the Grant: Will the program end upon termination of the grant funding: Yes or No? If No, what is the proposed funding mechanism: (1) Request additional funding or (2) Use departmental resources. If (2), provide details about what internal resources are to be provided and what other programs will be discontinued as a result.

No. There is no requirement for future funding mechanisms. This is an add on enhancement to an existing product.

6. If this is a new program, please provide information why the County should expand into this area.

The enhancement to the Easy Access application will allow for future growth of the UOCAVA electronic ballot transmission program for all Federal elections.

7. Please explain how this program will affect your current operations. Please tie the performance measures for this program back to the critical performance measures for your department or office.

Switching to a fully automated process for servicing voters who request electronic submission of ballots would yield a current savings of approximately 40 work hours per election. This savings of time could greatly aid the Ballot by Mail staff in complying with the mandates of the UOCAVA transmission deadline. When an election is programmed and the ballot is tested and certified, the Ballot by Mail staff has only one to two days to process the electronic transmission of these ballots to UOCAVA voters. Of the 4,379 UOCAVA voters eligible to vote in the Presidential Election of 2008, only 8 voters requested electronic ballot transmission. In 2012, the requests increased to 2,360 out of 3,122 voters eligible. This increase shows a dramatic shift to the use of electronic receipt of ballots by this demographic.

Technical Proposal

Catalog of Federal Domestic Assistance Number:
12.219

BAA number:
H98210-13-BAA-0001

Title of Proposal: Electronic Transmission of Ballot Portal

Identify of applicant
Travis County Texas – Office of the County Clerk

Contractor
Easy Access, Inc.

Technical Contact Name
Gail Fisher
PO Box 149325
Austin, TX 78751
512-854-9188
Gail.Fisher@co.travis.tx.us

Administrative/Business Contact
Dana DeBeauvoir
PO Box 149325
Austin, TX 78751
512-854-9188
Dana.DeBeauvoir@co.travis.tx.us

Proposed term
September 1, 2013 – November 30, 2014

Contents

Technical Approach and Justification

Executive Summary

Travis County is requesting funding for the implementation of enhancements to the ballot-by-mail software module used by the Travis County Clerk's Election Division. Travis County is continuously working to meet the challenges of serving our military and overseas voters to ensure they have every opportunity to participate in the election process. Timely and convenient access to the ballot is imperative to protecting these individuals right to vote. Therefore, our goals are to rapidly and efficiently provide these individuals a ballot, offer a convenient method of voting so ballots can be quickly returned, and give voters a means to track when their ballot has been received back to the Clerk's Office. The improvements we are requesting through this grant will further streamline the process and allow us to even more swiftly deliver ballots to these voters.

With this enhancement, we will be able to replace many of our manual procedures and instead, immediately and electronically send the UOCAVA voter an email with a link to an individualized web page. This page will contain a uniquely serialized ballot specific to the voter (in accordance with Texas Election Code Chapter 52) along with instructions and attachments for the return of the voted ballot. Private portals and digital signatures will ensure that his/her ballot is safely delivered and his/her anonymity protected. The voter will then be able to print and vote the ballot and return it by mail to the County.

In the Presidential Election of 2008, Travis County participated in a pilot project and provided 4,379 UOCAVA voters the opportunity to request a ballot by email. There were eight voters who participated in this program. This represented a .18% participation rate. By the 2012 Presidential Election, participation increased to 2,360, a participation rate of 75.6%. This dramatic increase shows the benefits of the email program and demonstrates why enhancements to this process are so important.

Easy Access Inc., a Texas Company, will develop these improvements and implement this new enhancement of the current ballot-by-mail module at an estimated cost of $19,950.

GOALS AND OBJECTIVES

The primary goal of this project is to provide the fastest most efficient delivery of electronically transmitted ballots to all UOCAVA voters. By extending functionality to an already-existing system in which UOCAVA voters are identified, their current information and eligibility verified, and the status of their ballots tracked, Travis County can provide the best service possible to this group of voters. This proposed enhancement will automatically electronically deliver a link to a PDF version of the voter's ballot which the voter can print, manually mark, and return by mail.

The vendor responsible for the current system is Easy Access Inc. This company originated and maintains the Voter Registration system for the Travis County Tax Office. The Travis County Clerk's ballot-by-mail application is a module of the Voter Registration system. Implementation of this enhancement will provide a long-term solution which will enable the County Clerk to prepare her Elections Division for growth of the UOCAVA program.

In 1995, the vendor Easy Access Inc., a Texas-based company, developed the Voter Registration database system for the Travis County Tax Assessor Collector. The Elections Division of the Travis County Clerk utilizes modules of this system for various voter verification, tracking, and identification processes. Easy Access Inc. continues to maintain the system and has created innovative customizations that have allowed the Elections Division to implement programs such as electronic poll books with real-time updates (1997), the use of barcoding for a wide spectrum of purposes (2001), and the formulation of ballot styles using geocoding to identify and import district information into our ballot programming utility (2002). Travis County began using these innovations long before these programs were introduced by other companies to the general market.

Current operations capture voter information, including an email address, and identify the voter as a standard or Federal Postcard Application (FPCA) by-mail voter. Enhancements would include the ability to identify and track:

- the number of FPCA's - the overall number of applications and a breakdown in each category by military, spouse or dependent, residing out of country and intending to return, out of country not intending to return, citizen granted military/overseas voting rights, emailed, emailed to voter in hostile territory, returned by email from hostile territory, faxed to voter in hostile territory, and returned by fax from hostile territory;
- the number of emailed FPCAs - the overall number of applicants and a breakdown in each category by military, spouse or dependent, residing out of country and intending to return, out of country not intending to return, citizen granted military/overseas voting rights.

Current operations dictate that an election worker creates an email for each UOCAVA voter using an email template. This template contains attachments with generic forms and information that are required by the State. The correct precinct and ballot style is identified by the system, and the election worker pulls a PDF image of that ballot and manually attaches it to the individual voter's email. The email is sent to the voter, and the date and time is manually recorded into the system. Improvements to the system would include:

- the ability to create an election specific record for the FPCA voter and roll groups of voters to a batch (working in batches allows for greater efficiency in generating administrative records for logging, tracking, and filing);
- the ability to automatically generate and transmit an email to the voter, attaching all required forms, including forms for Statement of Residence (SOR) and ID required, and specific instructions for each;
- the ability to generate a link in the body of the email which connects the voter to a personalized web page portal containing the ballot with the correct precinct and ballot style and instructions for accessing, voting, and returning the marked ballot;
- the ability, in accordance with Texas Election Code, to include a unique serial number on the ballot as the voter prints it;
- the ability to auto-populate necessary forms with the voter information include the Voter ID and barcode (this will reduce processing time when receiving, logging, and tracking returned ballots); and
- the ability to verify that the content of all electronic transmissions are correct.

Current operations entail creating PDF images of serialized ballots, storing those ballot images in a file, removing a unique, serialized ballot (as identified in the system by precinct and ballot style) from a file, and attaching the image to an email. By utilizing an email with a digital signature and a link to an individualized web-based page:

- the voter can establish that the email comes from an authentic source;
- the voter receives a unique portal for the retrieval of their ballot;
- the ballot is given a unique serial number at the time of printing that cannot be traced or associated to the voter by the County;
- the voter may access, print, and vote their ballot at their convenience; and
- the system provides a portal for access to a ballot that may evolve over time as ballot formats, voting system vendors, or voting system technologies change.

Managing timelines is very crucial to releasing ballots by mail on time. From the time ballot content is certified to the time it is tested, locked down, and ready for distribution, only one and a half to two days remain for the printing, processing, and mailing of ballots to comply with the 45-day MOVE deadline.

From the Presidential Election of 2008 to the Presidential Election of 2012, the number of FPCA voters requesting email ballots by mail increased from 8 (.18% of FPCA requestors) to 2,360 (75.6%). In the Presidential of 2012, it took 52 staff hours to process the 2,360 email ballot requests. In a process where time is of the essence and success depends upon the number of computer stations available to fulfill these requests, the UOCAVA email program slowed our processing down so much that it almost jeopardized our ability to process all by mail ballots on time in accordance with the MOVE Act.

Automating the process of electronic transmission of the ballot link, not only provides a significant administrative time savings, it allows for a more accurate and on-time delivery of the ballot to the UOCAVA voter. In addition, utilizing digital signatures provides protection to the voter from false emails from sources claiming to be Travis County.

Although improvements to the system can produce nominal savings of about $600 - $800 per election, greater benefits arise from the ability to more quickly and efficiently distribute ballots to all requestors in a timely manner. Additional cost savings can be realized by utilizing enhancements to a reliable, enterprise system already in use rather than purchasing a limited-use software application.

SCHEDULE AND MILESTONES

Travis County intends to follow county procedures for modification and Commissioners Court approval of the current contract with Easy Access Inc. Once approval is obtained, the County Clerk and her Elections Division expect:

From date of approval through September 30, 2013 – software development;

- October 1, 2013 - receipt of the software enhancement;
- October 1 through October 31, 2013 – software testing, mock election exercises, compilation of action items and corrections;
- November 1 through November 31, 2013 – continued testing and software corrections, procedures writing;
- December 1, 2013 – implementation;
- January 24, 2014 – 45-day-out MOVE Act deadline for March Primaries;
- March 4, 2014 – Primary Elections.
- May 2014 – Primary Runoff Elections.
- November 4, 2014 – November General Election.

Management Approach

Dana DeBeauvoir, the Travis County Clerk, and her Elections Division will manage the implementation of the project with Easy Access Inc. performing the programming enhancements. See Ms. DeBeauvoir's resume and Easy Access' biographical information.

Funds for the project will be used solely for the modification of the ballot by mail module.

Definition and formalization of strategic goals

Although Travis County has met all of the goals in delivering ballots by mail for federal elections in accordance with the MOVE Act, the accelerated interest in the program necessitates improvements in the current software application that enters and tracks applicants. The desired result is an enhancement that gives UOCAVA voters requesting email ballots (75.6% and rising during Presidential Election years) a reliable method to access and vote their ballots without delay.

As our voting technologies evolve, this enhancement, which will provide the voter with a safe portal for accessing their ballot, will support the changes in voting systems, ballot creation, ballot marking, and ballot return. This scalability will carry the County Clerk and her Elections Division forward as voting applications change and grow.

Because the current system already creates the information necessary for the voter to track the progress of their ballot through internet or telephone access, this enhancement will close the circle of efficiency and allow us to fully service the UOCAVA voter quickly and efficiently in the most cost effective manner.

Working in collaboration with a long-trusted vendor that has provided the Travis County Clerk and her Elections Division with innovative, sustainable solutions, keeps the office on the cutting edge of technology with a sharp focus on customer service and on time delivery. The County Clerk is also reaping cost benefits by adding functionality to an already existing software application rather than seeking out new software with limited use.

Analysis and measurement of current processes

Our current procedures for servicing FPCA email requestors utilizes a labor-intensive, manual process that occupies three of our five ballot by mail computers for a full two-day period if the ballot is certified, tested, locked down, and available for delivery on time. If there are any delays with making the ballot available for distribution, this process can involve the use of all resources as well as pulling resources from other areas of the Elections Division for the processing of paper ballots for on-time mail out.

Identification of processes and related elements

The workflow for processing a Travis County UOCAVA email requestor is as follows. The Travis County Election Division receives an FPCA voter application for an email ballot by mail. The applicant either has a record on file that is verified or a new applicant is entered into the Easy Access ballot by mail system. All information including email address is proofed, the time and date of receipt of the application is logged, and a barcoded label is printed for the applicant's yellow jacket (the in-house file containing the application, return ballot, and any hard copies of correspondence with the applicant). Once a batch of UOCAVA applicants is entered, an election worker runs and prints a report listing the applicant and their corresponding precinct and ballot style. An election worker pulls batches of serialized ballots from the ballot generation system and saves them to a PDF file. These ballots are moved to a CD and then transferred to a USB thumb drive to allow for removing unique serialized ballot to an individual's email. An election worker pulls up each UOCAVA email applicant separately, creates a new email, and affixes their email address, the body of the email and attachments, and instructions for using the attached materials. The worker then uses the printed report to identify the precinct and ballot style and manually moves the correct, serialized ballot from the USB thumb drive to the email. The email is sent to the voter. The voter prints and marks the ballot, prints and assembles the envelopes, and mails the ballot back to the County. Once the ballot is received by the Elections Division it is manually checked into the system which documents the time and date of receipt. The unopened ballot is placed into the yellow jacket along with the application and filed until it is opened during Early Voting Ballot Board. Once the Ballot Board convenes, board members verify signatures on the return envelope against the application signature. Once the signature is verified, the ballot, which is in a privacy envelope, is removed from the signed return envelope and is placed in a ballot box. Board members then remove the ballots from the box, open them, and prepare them for ballot remake. Members log and file the original remade ballots. Remade ballots are counted.

Identification of potential risks and mitigating strategies

Potential receipt of fraudulent emails claiming to be from Travis County is mitigated by the use of a Travis County digital signature.

Formalization of performance indicators

The compilation of reports tracks the following UOCAVA metrics: total number of voters, the total number of email requestors, the name of each requestor and the precinct and ballot style sent, the total number of sent ballots tracked by precinct and ballot style, the total number of ballots returned, and the total number of ballots returned by precinct and ballot style. Enhancements to the system will allow us to track each of these metrics by the categories listed in Goals and Objectives.

Justification for the modifications to existing processes

The current UOCAVA process for email requestors is an extremely time-consuming, labor-intensive process that does not use ballot by mail resources in a very effective manner. By fully automating the process, adding barcode technology to return envelopes, and creating more detail categories to voting tracking, ballot by email procedures can be turned into a model of efficiency and accuracy. These additions will provide the UOCAVA voter with an opportunity to receive their ballot swiftly and vote in a manner that fully protects their anonymity.

Projections of the effectiveness of modifications

To decrease the staff hours required to process the UOCAVA email applicants, to reduce handling errors, and to produce a ballot which is not traceable back to applicant.

Measurements of performance

Measurements of performance will include the number of UOCAVA requestors versus the number of requests for email ballots, the number of ballots downloaded, the number of ballots returned, and the number of hours to enter and send email ballots.

Current and Pending Project Proposal Submissions

No other funding has been requested in conjunction with this software enhancement. However, Travis County has applied for additional funding under CFDA 12.219, BAA number H98210-13-BAA-0001. Proposal title: Online Blank Ballot Delivery within STAR-VOTE. The STAR-VOTE system will be utilizing this proposal: Electronic Transmission of Ballot Portal for UOCAVA email ballot delivery.

Title:	Online Blank Ballot Delivery within STAR-Vote
Source:	CFDA 12.219 BAA # H98210-13-BAA-0001
Amount of Funding Requested:	$4,183,575
Percentage effort devoted to each project:	100% - not overlapping
Identify of Prime Applicant:	Travis County
List of Contractors:	Unknown at this time
Technical Contact:	Bryce Eakin, Technical Lead
	30-61 43rd St, Astoria, NY 11103
	Phone: 713-703-8242
	Email: Bryce.Eakin@outlook.com
Period of Performance:	October 1, 2013-November 30, 2018.
Portion of Time:	None, there is no overlap of personnel.
Award Period:	May 9, 2013 through June 24, 2013

Amount requested $4,183,575. There are no indirect costs allocated to the project. The number of person-months is 1.49 years.

Projects Related:	These two grant requests are related only to the degree that the STAR-Vote will use this software enhancement to deliver ballots by email.

Representation

The Applicant represents that is not a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

The Applicant represents that it is not a corporation that was convicted of a criminal violation under any Federal law within the preceding 24 months.

Appendix

PRINCIPAL INFORMATION

Travis County Clerk Dana DeBeauvoir
(Dana's last name is pronounced *day-buv-wah*)
E-mail Address: *dana.debeauvoir@co.travis.tx.us*

Biography

County Clerk Dana DeBeauvoir has always been inspired by public service. Her interest led her to obtain a Master's Degree from the LBJ School of Public Affairs and ultimately to run for public office. Since her election as County Clerk in 1986, Dana has devoted herself to bringing high ethical standards, effective and cost efficient management practices, the benefits of new technology, and high quality customer service to the office of the County Clerk. The Clerk's Office has a wide range of responsibilities including the conduct of elections; the filing and preservation of real property records; and the management of civil, probate, and misdemeanor court documents.

Dana's commitment to excellence in government has received nationwide acclaim. In 2009, Dana was named **Public Official of the Year** by the National Association of County Recorders, Election Officials and Clerks (NACRC). The National Association of Election Officials (Election Center) also awarded Dana with the **2009 Minute Man Award** for developing a security practice that is effective, inexpensive, and easy for election officials to adopt. In 2005, she was the national recipient of the Election Center's Best Practices Award for her work in using risk analysis to implement security measures for electronic voting systems. Travis County is also recognized across the country for its groundbreaking early voting program that is centered on customer-friendly polling locations in high-traffic retail locations.

Dana serves as a Texas Representative on the federal Election Commission Assistance Standards Board and as the Election Committee Chair for the National Association of County Recorders, Elections Officials, and Clerks.

Travis County voters have a passion for democracy, and Dana has been honored to share their enthusiasm with other parts of the world as an advisor and election observer for Bosnia, the Peoples Republic of Bangladesh, Kosovo, and the historic South Africa election that represented the end of apartheid.

Dana's most recent and ambitious project is to help lead a nationwide effort to revolutionize the design and standards of our nation's voting systems. Her efforts have brought together a collaboration of computer security experts, usability professionals, voter activists, and election administrators. Their common goal - to usher in new standards for secure, voter-friendly, and cost-efficient voting systems that combine the accuracy of electronic tallying with the accountability of a paper ballot.

Dana has brought innovation to the Clerk's Recording Division, which is responsible for receiving and maintaining a vast library of documents that includes real property transactions, business names, and marriage licenses. During her tenure, the once handwritten indexes and vulnerable cloth-bound books that hold some of the County's most precious and important documents are now preserved as digital or film images. Access to millions of these documents are now available online and our new *eRecording* program allows for the electronic filing of many documents. These programs save customers' time, reduce costs, and help the environment by decreasing the amount of paper and car trips to the office. To help prevent identify theft, the Clerk's Office implemented one of the nation's most aggressive redaction programs that blocks personal information (such as Social Security Numbers) from appearing on internet documents.

This Office also serves as Clerk of the Courts and manages the documents used in the County's probate, civil, and misdemeanor court proceedings. Dana has used technology and enhanced work flow measures to secure the safety of this large volume of records and has implemented new systems such as *eFiling* and document imaging to convert the cumbersome paper-laden process to one that utilizes electronically filed and retrieved documents. These new methods not only make it easier for defendants and their attorneys, prosecutors, and judges to quickly view and file information; but save the cost of storing and securing millions of pages of paper documents.

Dana DeBeauvoir is running for re-election in 2014, and with the voters' approval, will continue her efforts to protect the integrity and accessibility of the election process, to use effective and cost efficient practices and technology to manage real property and court documents, and to do her best to serve each and every citizen of Travis County.

Summary

Education

University of Texas at Arlington, Bachelor of Arts in Sociology and Social Work, 1979
Lyndon B. Johnson School of Public Affairs, Master of Public Affairs, 1981

Work Experience

1987 - Present	Travis County Clerk, Austin, Texas
1982 – 1985	Director of Property Tax Division, Travis County Tax Assessor/Collector

Professional and Community Service

Current	National Association of County Recorders, Election Officials, and Clerks – Member, Board of Directors and Election Committee Chair (2007-2012)
Current	Federal Election Assistance Commission, Board of Standards – Representative, Local Election Officials (since 2004)
Current	County and District Clerk's Association – Chair, Elections Legislative Committee (since 1995)

Current	***Election Center Postal Task Force for By-Mail Voting – Member (since 2005)***
Current	Judicial Conference on Information and Technology – Texas Supreme Court Appointee, Liaison (since 2003)
2008 – 2009	Travis County Combined Charities Campaign – Chair
2004 – 2008	Election Security Subcommittee, Institute of Electrical and Electronic Engineers (P1583) – Member
2003	Ad Hoc Committee on Future Technology, County and District Clerk's Association – Chair
2000	Certified Election/Registration Administrator, Election Center in Association with Auburn University – Graduate
1999	OSCE/United Nations/IFES Elections Advisor to Kosovo
1996	***OSCE/United Nations/IFES Elections Advisor to Bosnia***
1996	***LBJ School Seminar on Public Service, Krakow, Poland – Instructor***
1995	Election Secretariat, Peoples Republic of Bangladesh – Instructor
1994	United Nations Elections Observer for historic South Africa Election
1993	Paramount Producers Board, Paramount Theatre – President
1993	Leadership Austin – Graduate
1987	Austin Society for Public Administration – President

Awards and Honors

2009	Named Public Official of the Year by the National Association of County Recorders, Election Officials and Clerks (NACRC)
2009	Recipient of the National Association of Election Officials (Election Center) Minute Man Award
2007	Recipient of the Stephen F. Austin "Champions of the Republic Award" for Travis County
2006	Recipient of the Stephen F. Austin "Champions of the Republic Award" for Travis County
2005	Election Center/National Association of Election Officials Professional Practices Award
2004	Founder, YWCA Scholarship Program for Aspiring Public Servants
2002	LBJ School Alumni Association Distinguished Public Service Award
2002	Chairman's Commendation, Austin Mayor's Committee for People with Disabilities
1998	Savings Idea Contest Award, The Election Center and Utah Election Officials
1998	Community Collaboration Award, Chamber of Commerce/United Way/Citysearch.com
1995	Texas and Travis County Liberty Bell Awards, Young Lawyers Associations
1992	James W. McGrew Public Policy Research Award, Austin Society for Public Administration
1991	Administrator of the Year Award, Austin Society for Public Administration
1989	National Directors' Award for Excellence in Local Government from the International Association of Clerks, Recorders, Election Officials, and Treasurers (IACREOT)

Sample of Publications and Videos

"Method for Developing Security Procedures in a DRE Environment," Election Center Professional Practices Submission

"History of the Texas Constitution," Video, 2002

"Impact of Changing Technology on the Elections Process," Emerging Issues in State and Local Government, 1999

"Triumph Sooths Pain of Democracy, My Experience as a United Nation's Election Observer in South Africa," Austin American Statesman, July 2, 1994

"Some Texas Early Voting Experiences," Video and Booklet, 1993

"Motivation Without Money," Practical Supervision, June 15, 1991

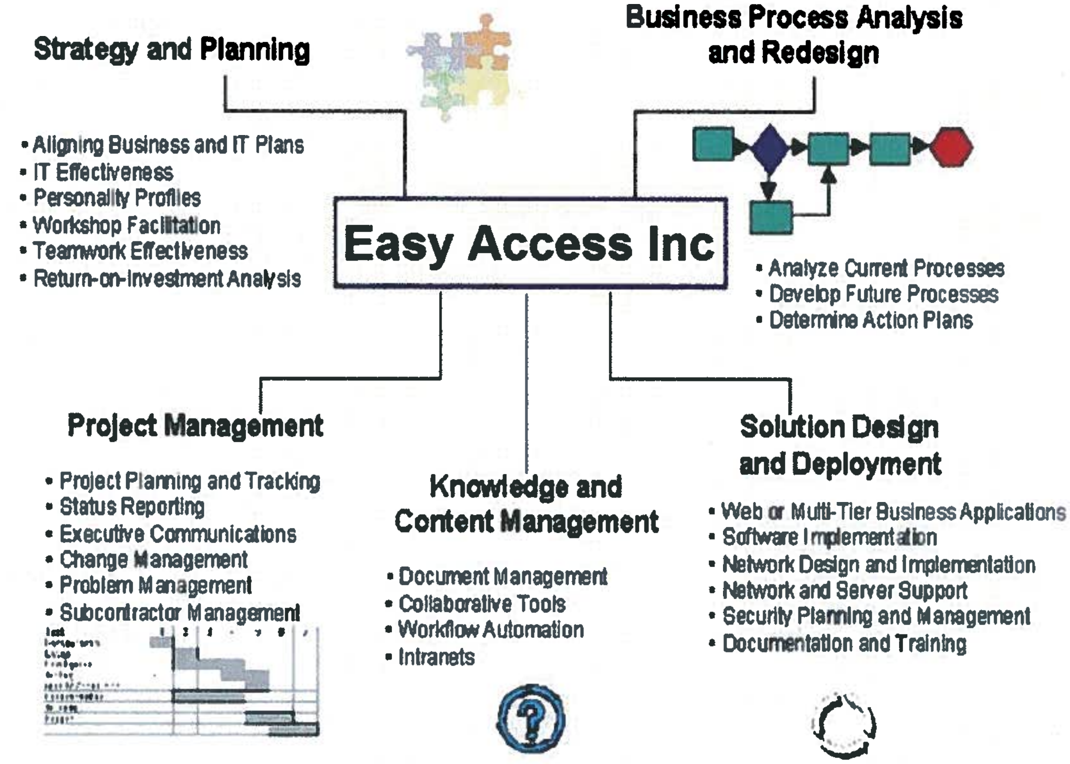
"Got to Vote," Video encouraging 18-24 years of age to vote

Hobbies and Interests

Skydiving (126 jumps – a perfect training ground for working in politics!), Quilting, White Water Rafting, Sailing, Bicycling, Construction and Remodeling Projects, Reading, and Singing

EASY ACCESS INC

Easy Access Inc. (EAI) is a management and information technology-development and consulting firm located in McAllen, TX with additional development resources in Fort Worth and San Antonio Texas. EAI has over thirty seven (37) years of developing and implementing application software for state & local government clients. EAI provides comprehensive expertise in strategic planning, business process reengineering, project management, subject matter specialization, and networking, all of which converge on unique application software implementations for the public sector.



EAI's professional expertise includes a broad range of subject matter specialists that range from voter registration/election management to that of property tax management. Beyond subject matter proficiency, EAI also possesses exceptional staff expertise in the crucial area of security for its application software. Nowhere is this level of security more evident than when one examines the application software solutions developed for Voter Registration and Election's Management.

In this realm of state and national government, EAI was one of the first in the Nation to have a voter registration and elections management system that fully complied with the Help America Vote Act (HAVA) of 2002. Moreover, EAI led in the development of voter registration and early voting and election day voting failsafe internal audits. These internal audits have been complemented by EAI's depth of knowledge in applying secure wireless technology. This wireless technology provides a very affordable means by which local government can easily bring the voter registration and election systems closer to the public, thus materially providing a means by which to enhance voter participation. In addition to an exceptionally well-proven voter registration and election management system, EAI was one of the first in the Nation to pioneer an election night reporting system that provides a synchronized rapid deployment of election night results to the general public. Furthermore, EAI was also one of the first in the Nation to incorporate the use of scannable, printed labels that are used on election day combination forms such that, when used in conjunction with EAI's embedded imaging technology, a large county can update voter records and close out an election in a few short hours after the polls close. Beyond EAI's professional expertise in the development of voter registration and election management software, EAI has also provided both on and off-site expertise in assisting governmental jurisdictions in the actual day-to-day management of an election.

When examining the breadth and depth of EAI application software, it becomes quickly obvious that beyond distinctive workflow enrichment, EAI applications are driven by the underlying goal of providing a total solution that is "Citizen Centric". Citizen Centric to EAI is the underlying development view point that a total solution in the public sector arena should have as its focus the ability to assist government in being as transparent as possible to the general public. Examples of this type of application software development are translated into publicly accessible web sites that allow the 'citizen/taxpayer' the ability to have access to the data that is related to their individual records. In these instances, citizens/taxpayers can gain unfettered access to information that relates to such things as property tax records, on-line payment of property tax obligations, rapid access to election results, voter participation data, access to voter registration forms, on-line payment of fines, and victim restitution for adult probation. Ultimately, this type of comprehensive application software design materially contributes to the goal of creating transparency, and this transparency will contribute to protecting the public's trust and thus promote the public's interest.

EAI is a total hardware, software and implementation services solution company that operates in jurisdictions throughout the United States.

Budget Proposal

Catalog of Federal Domestic Assistance Number:
12.219

BAA number:
H98210-13-BAA-0001

Title of Proposal: Electronic Transmission of Ballot Portal

Identify of applicant
Travis County Texas – Office of the County Clerk

Contractor
Easy Access, Inc.

Technical Contact Name
Gail Fisher
PO Box 149325
Austin, TX 78751
512-854-9188
Gail.Fisher@co.travis.tx.us

Administrative/Business Contact
Dana DeBeauvoir
PO Box 149325
Austin, TX 78751
512-854-9188
Dana.DeBeauvoir@co.travis.tx.us

Proposed term
September 1, 2013 – November 30, 2014

Contents

Budget Proposal

Travis County, Texas 2012 FYE CAFR

The above is the hyperlink to the most current Travis County Audited Financial Statements.

The cost of the enhancement is approximately $19,950 for consulting services.

Cost breakdown:

Estimated number of consultant hours to enhance existing software:	133
Consultant Hourly Rate	$ 150
Estimated Costs	$19,950

RETURN ON INVESTMENT

In the 2012 Presidential election, the County used 52 staff hours to email 2,360 ballots which represented about 75.6% of the FPCA population of 3,122. The cost of staff hours used to copy email addresses to a form, including employment taxes, was $633. With the software enhancement, we are hoping to reduce the number of hours to 16 or $193, a cost savings of $440.

For the contract period, there will be three federal elections therefore our savings will be $1,320.

ROI Calculation

$1,320-$19,950/$19,950 or -93.4%

The cost of the enhancement goes beyond the numerical value listed above. The County received 8 requests for email ballots in the Presidential Election of 2008. By the Presidential Election of 2012, the requests rose to 2,360. It is the hope of the County that these numbers will continue to grow until we will receive 100% email requests from UOCAVA voters in future years. The improvements we are requesting through this grant will further streamline our processes and allow us to even more swiftly and safely deliver ballots to these voters while protecting their anonymity.

SUBCONTRACTOR PROPOSAL

Easy Access Inc

4200-A N Bicentennial Dr
McAllen, Texas 78504
Phone: (956) 682-3466 -:- Fax: (956) 682-0906

Quote Number: 2729

Quotation Date: 06/10/13

Client:
Travis County Clerk
5501 Airport Blvd
Austin TX 78751
Ph: 512:854-9193
Attn: Gail Fisher

Ship To:
Travis County Clerk
5501 Airport Blvd
Austin TX 78751
Ph: 512:854-9193
Attn: Gail Fisher

This quotation is valid for a period of thirty (30) days unless modified in writing by Easy Access Inc.

ITEM	QTY	MODEL NUMBER	DESCRIPTION	$ UNIT PRICE	EXTENDED $ AMOUNT
			Modification to EZ-VOTE		
1.	121	Proc Hrs	Modification to 'Ballot by Mail' module	$150.00	$18,150.00
2.	12	Est OvrRun Hrs	Estimated Cost Over run hours for technical staff	$150.00	$1,800.00
			This is an estimation of the number of technical staff hours deemed necessary for Project of scope at this stage of the Project		

Sub Total	$ 19,950.00
Sales Tax	Not Applicable
Installation	Not Applicable
Freight	Not Applicable
Insurance	Not Applicable
Gross Amount	$ 19,950.00

Special Instructions:

Easy Access Inc :

Authorized Signature: *M. G. Braun Jr*

Typed Name: M.G. (Mike) Braun/rme Title: Special Projects Director Date: 06/10/13

As an authorized agent, I accept the items above and the General Terms & Conditions attached hereto or incorporated herein and hereby acknowledged.

Authorized Client Signature:

Typed Name: Title: Date:

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TRAVIS COUNTY

FY 13 GRANT SUMMARY SHEET

Check One:	Application Approval: ☐	Permission to Continue: ☐	
	Contract Approval: ☑	Status Report: ☐	
Check One:	Original: ☑	Amendment: ☐	
Check One:	New Grant: ☑	Continuation Grant: ☐	
Department/Division:	TNR/NREQ		
Contact Person/Title:	Mickey Roberts - Environmental Specialist Senior		
Phone Number:	512-854-6613		

Grant Title:	Pace Bend Low Water Boat Ramp		
Grant Period:	From: May 16, 2013	To: 9/30/2015	
Fund Source:	Federal: ☑	State: ☐	Local: ☐
Grantor:	Texas Parks and Wildlife Department		
Will County provide grant funds to a sub-recipient?	Yes: ☐	No: ☑	
Are the grant funds pass-through from another agency? If yes, list originating agency below.	Yes: ☑	No: ☐	
Originating Grantor:	Department of the Interior		

Budget Categories	Grant Funds	County Cost Share	***Budgeted County Contribution #595010 (Cash Match)***	In-Kind	**TOTAL**
Personnel:	$ 0	$ 0	$ 0	$ 0	$ 0
Operating:	$ 0	$ 0	$ 0	$ 0	$ 0
Capital Equipment:	$ 80,460	$ 0	$ 26,820	$ 0	$ 107,280
Indirect Costs:	$ 0	$ 0	$ 0	$ 0	$ 0
Totals:	$ 80,460	$ 0	$ 26,820	$ 0	$ 107,280
FTEs:	0.00	0.00	0.00	0.00	0.00

Permission to Continue Information					
Funding Source (Cost Center)	Personnel Cost	Operating Cost	Estimated Total	Filled FTE	PTC Expiration Date
	$ 0	$ 0	$ 0	0.00	

Department	Review	Staff Initials	Comments
County Auditor	☒	JC	
County Attorney	☒	MN	

Performance Measures					
#	Measure	Actual FY 11 Measure	Projected FY 12 Measure	Projected FY 13 Measure	Projected FY 14 Measure
+ -	Applicable Departmental Measures				
1.	Coordinate grants program for the TNR Parks Division, NREQ Division, and overall TNR Department, including grant and fund seeking and grant administration for parks, preserves, floodplain buyout, natural resource management projects, and improvement of air quality.				
2.					
3.					
+ -	Measures for the Grant				
1.	Secure grant funding and complete construction.	Submit application for grant to TPWD		Approve grant contract and begin bid process for construction	Complete Construction
	Outcome Impact Description				
2.					
	Outcome Impact Description				
3.					
	Outcome Impact Description				

PBO Recommendation:

This grant contract provides funds to build a one lane boat ramp in Pace Bend Park. The grant is a follow up to three grants that were previously applied for by the department to build additional boat ramps.

The grant requires a $26,820 County contribution that will be met through the allocation of existing LCRA-CIP funds. No additional funding is required.

PBO recommends approval of this Contract.

1. Brief Narrative - Summary of Grant: What is the goal of the program? How does the grant fit into the current activities of the department? Is the grant starting a new program, or is it enhancing an existing one?

In October 2011, an application was submitted to Texas Parks and Wildlife Department (TPWD) for a boat ramp and facilities at Dink Pearson Park. Due to severe drought conditions causing numerous ramp closures on Lake Travis, TPWD requested a substitute proposal to provide boating access at lower lake levels than was feasible for a ramp project at Dink Pearson Park. Pace Bend Park was selected by Parks staff as the best location to construct a low water ramp. Travis County Parks division operates a number of boat ramps on Lake Travis, all of which are closed at this time due to low water conditions.

2. Departmental Resource Commitment: What are the long term County funding requirements of the grant?

The grant requires that projects funded through this program must be operated and maintained for public park and recreation purposes for a minimum of 25 years. The County has already made this commitment through voter and Commissioners Court approval of the park project.

3. County Commitment to the Grant: Is a county match required? If so, how does the department propose to fund the grant match? Please explain.

The proposed grant requires a 25% match of $26,820. Matching funds will be provided through the LCRA-CIP account.

4. Does the grant program have an indirect cost allocation, in accordance with the grant rules? If not, please explain why not.

Indirect costs are not allowable under this program.

5. County Commitment to the Program Upon Termination of the Grant: Will the program end upon termination of the grant funding: Yes or No? If No, what is the proposed funding mechanism: (1) Request additional funding or (2) Use departmental resources. If (2), provide details about what internal resources are to be provided and what other programs will be discontinued as a result.

Park development will be completed upon termination of the grant contract. TNR Parks will assume long-term operation of the park and appropriate resources have been allocated through the County budget process.

6. If this is a new program, please provide information why the County should expand into this area.

This is not a new program. TNR Parks develops, operates, and maintains a county-wide parks system.

7. Please explain how this program will affect your current operations. Please tie the performance measures for this program back to the critical performance measures for your department or office.

This grant will improve boating access to Lake Travis during low water conditions, which have persisted due to prolonged and severe drought. Performance measures related to one of TNR's goals to "provide increasing and diverse recreation opportunities using public resources."

TRANSPORTATION AND NATURAL RESOURCES
STEVEN M. MANILLA, P.E., COUNTY EXECUTIVE

411 West 13th Street
Executive Office Building
PO Box 1748
Austin, Texas 78767
(512) 854-9383
FAX (512) 854-9436

June 11 2013
~~October 11, 2011~~

MEMORANDUM

TO: Members of the Commissioners' Court

Carol B. Joseph

FROM: Steven M. Manilla, P.E., County Executive, TNR

SUBJECT: Grant Contract - Pace Bend Park Low Water Boat Ramp

Posting: Consider and take appropriate action on a grant contract for development of a low water boat ramp at Pace Bend Park on Lake Travis.

Summary and Staff Recommendation: The contract provides $80,460 in grant funds to construct a low water boat ramp at Pace Bend park. Staff recommends approval.

Budgetary and Fiscal Impact: The grant requires a 25% cash match to receive funding. Sponsor match will be provided through voter approved bond funding or the LCRA Capital Improvement Project (CIP) fund.

Background: In October 2011, an application was submitted to Texas Parks and Wildlife Department (TPWD) for a boat ramp and facilities at Dink Pearson Park. Due to severe drought conditions causing numerous ramp closures on Lake Travis, TPWD requested a substitute proposal to provide boating access at lower lake levels than was feasible for a ramp project at Dink Pearson Park. Pace Bend Park was selected by Parks staff as the best location to construct a low water ramp. Since December 2012, all county operated boat ramps on Lake Travis have been closed to the public.

Exhibits: Contract

MDR:SMM:mdr
0804 Pace Bend/ Boating Access Grant Contract

cc: Christopher Gilmore, CA
Matt Naper, Auditor
Charles Bergh, TNR
Melinda Mallia, TNR

TEXAS PARKS AND WILDLIFE DEPARTMENT

BOATING ACCESS GRANT PROGRAM AGREEMENT

Project Number: **F-249-B**

Project Name: **TRAVIS COUNTY, PACE BEND LOW WATER BOAT RAMP CONSTRUCTION**

Project Period: **DATE OF AGREEMENT TO 9-30-2015**

Total Project Cost: **$107,280.00** Approved Federal Funds: **$80,460.00** (75%)

PROJECT SCOPE AND LOCATION:

The Travis County (sponsor) will improve a public boating access to Lake Travis by constructing a concrete boat ramp in the lake bed adjacent to Pace Bend Park. The intent of the project is to provide a public boating access to Lake Travis during periods of low lake levels. Presently, most of the existing ramps are not useable due to low lake levels. The project is funded by federal pass-through funds from the Sport Fish Restoration Program to provide boating access for recreational boaters.

This project is being funded with federal funds generated by recreational boaters. As such, charging a fee to utilize this facility is discouraged. If a fee is charged to utilize the boat ramp, all revenue collected must be used to maintain and operate the boating access facility.

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For and in consideration of the mutual covenants and benefits hereof, the Texas Parks and Wildlife Department ("Department") and **Travis County** ("Sponsor") hereby contract with respect to the above described project ("Project") as follows:

1. No work shall commence until this agreement is signed by both parties.

2. The Sponsor shall submit complete construction plans and specifications (including site map) for the Project to the Department for approval prior to any construction. The Sponsor agrees to construct the Project according to the approved plans and specifications.

3. All construction shall be in compliance with all laws and regulations duly adopted by governmental agencies of competent jurisdiction including meeting current ADA compliance for boating access facilities.

4. After completion and final payment by the Department, the Sponsor shall assume sole responsibility for facility operation including area surveillance, maintenance and repairs for a minimum of twenty-five years.

5. Local regulations may be adopted by the Sponsor pursuant to Parks Section 31.092 of the Parks and Wildlife Code. It is understood and agreed that the Sponsor shall not designate public water served by the Project as areas restricted from use by registered motorboats without Department approval. Violation of this covenant by the Sponsor shall require 100% reimbursement to the Department of the costs of the Project.

6. The Department will assist the Sponsor with only advisory assistance within its capabilities.

7. The Department will perform a completion and acceptance inspection. Progress inspections may be performed at the discretion of the Department.

8. The Sponsor will maintain adequate records to support all claims for reimbursement and submit to the Department copies of all expenditures to be charged against the Project.

9. Sponsor understands that acceptance of funds under this contract acts as acceptance of the authority of the State Auditor's Office, or any successor agency, to conduct an audit or investigation in connection with those funds. Sponsor further agrees to cooperate fully with the State Auditor's Office or its successor in the conduct of the audit or investigation, including providing all records requested. Sponsor will ensure that this clause concerning the authority to audit funds received indirectly by subcontractors through Sponsor and the requirement to cooperate is include in any subcontract it awards.

10. In the event the cost of construction is below the maximum amount authorized, the Sponsor may, at its discretion, include additional improvements or appurtenances on each designated site as long as the project total contract cost figures are not exceeded; provided, however, such improvements or appurtenances are first approved in writing by the Department.

11. Upon completion of a satisfactory acceptance inspection by the Department, the Sponsor will furnish the Department with a certificate of completion and the required cost records. The Department shall remit to the Sponsor the amount of approved State funds within reasonable time from the date the Department approves such documentation as adequate.

12. The Sponsor agrees to comply with U.S. Fish & Wildlife Service Division of Federal Aid Assurances and U.S. Department of Interior Civil Rights Assurance which are attached and made part of this Agreement.

13. The Sponsor agrees that an independent audit will be conducted in accordance with federal circular A-133. Copies of the report will be furnished to the Department.

14. The Agreement is effective upon execution by the Department.

TEXAS PARKS AND WILDLIFE DEPARTMENT	**TRAVIS COUNTY** SPONSOR
by [signature]	by ________________
Tim Hogsett, Director, Recreation Grants Branch Name and Title	________________ Name and Title
5-16-13 Date	

☐ SAM Date __________