

**Collaborative Research:
CT-T:
Explainable Policies for Establishing Trust in Web
Applications**

**Team Proposal to National Science Foundation in response to Cyber Trust (CT)
solicitation NSF-05-518**

NSF Proposal number 0524842 submitted February 7 2005

Florida Institute of Human and Machine Cognition

PI: Jeff Bradshaw

co-PI: Pat Hayes

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Project Summary.

As daily reliance on networked information and services becomes increasingly vital to every aspect of our lives, the requirement for dependable functionality of both national infrastructures and localized embedded systems naturally moves to the forefront. These systems must be dependable and trustworthy even in the face of cyber attacks and periodic fluctuations of capability. People need assurance of the integrity and confidentiality of organizational and personal information, and to have confidence that system behavior will conform to policy constraints; but the network must be capable of responding adequately to important and unusual information requests.

This requires research at several levels. Information exchange protocols must be secure and scalable, able to deal with issues of information release and exposure, credential checking to establish authenticity of remote participants on an open network, and attribution and reliability and timeliness of information. Software agents must behave in ways that are reliably sensitive to policies concerning obligations, constraints and permissions; software must be capable of reasoning about such policies and applying them reliably, and finally, a working system must be capable of communicating explanations of its decisions to human users in a comprehensible manner, and able to support after-the-fact analyses of why decisions were taken and what reasoning justified them. Researchers from psychology, sociology, artificial intelligence, and computer security have investigated all of these issues within their own domains, but have never tried to integrate their approaches to create an end to end, scalable, human-friendly, and secure architecture for cross-organizational information sharing. This proposal aims to create such a framework and evaluate it in the context of cross-organizational information sharing for disaster response in Champaign, Illinois.

The research threads being woven together to create the framework are the TrustBuilder project (BYU and Illinois) for scalable, policy-based trust establishment in virtual organizations; the KAoS project (IHMC) for policy-based agent reasoning; the Inference Web project (Stanford KSL) for web-based handling of justifications proofs and generation of explanations; and the Common Logic project (IHMC) which supplies a semantically secure basis for a wide variety of kinds of information and reasoning. In addition, IHMC researchers will study the influence of cognitive bias on human understanding of explanations under conditions of stress. These all represent different levels of analysis, from controlling details of safe Web transactions up to human perception of trustworthiness of an entire system, or even an entire technology. This proposal forces an integration of these different levels of analysis together on a concrete and demanding application, with the ultimate goal of developing of a unifying *theory* of trust negotiation and inference which can be applied as a single connecting framework across all the technological levels present in virtual organizations.

Intellectual Merit. By pursuing an interdisciplinary research thread that begins in basic theory, is applied in the context of challenging elements of trustworthy system components, is deployed in realistic use scenarios, and is extended to achieve a better understanding of social mechanisms relating to trust, the proposed work will expand our understanding of trustworthy systems and their place in society in a way that single-discipline efforts cannot.

Broader Impact. The work will involve student effort at the undergraduate, master's, doctoral and postgraduate levels at four institutions, with mutual coordination between them. Insights and ideas which emerge will be incorporated rapidly into teaching curricula at BYU and Illinois, and (through other linked collaborative activity) in Southampton. Two of the co-PIs are women who exhibit leadership in IT research and are role models for female students. IHMC will support high school student research assistants, and IHMC faculty and scientists will participate in monthly science-oriented programs for elementary school age children. In the longer term, the project's results have the potential to improve disaster response in small- and medium-size cities across the nation. The PIs will continue their long-standing participation in world-wide standard-setting activities, including W3C Working Groups and ISO standardization efforts, so that technical results and insights will be quickly incorporated into emerging standards. Finally, software produced by the project will be made available for public use.

SUMMARY PROPOSAL BUDGET YEAR 1

ORGANIZATION Florida Institute for Human and Machine Cognition, Inc.				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Jeffrey M Bradshaw				AWARD NO.	Proposed	Granted	
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
		CAL	ACAD	SUMR			
1.	Jeffrey M Bradshaw - PI	0.00	1.80	0.60	\$ 30,984	\$	
2.	Patrick J Hayes - CO-PI	0.00	1.80	0.60	28,866		
3.							
4.							
5.							
6.	(0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0		
7.	(2) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	3.60	1.20	59,850		
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1.	(0) POST DOCTORAL ASSOCIATES	0.00	0.00	0.00	0		
2.	(2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	3.60	0.00	0.00	37,355		
3.	(1) GRADUATE STUDENTS				10,000		
4.	(2) UNDERGRADUATE STUDENTS				16,000		
5.	(0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0		
6.	(0) OTHER				0		
TOTAL SALARIES AND WAGES (A + B)					123,205		
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					31,305		
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					154,510		
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT					0		
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					7,820		
2. FOREIGN					8,450		
F. PARTICIPANT SUPPORT COSTS							
1.	STIPENDS \$ _____	0					
2.	TRAVEL _____	0					
3.	SUBSISTENCE _____	0					
4.	OTHER _____	0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS					0		
G. OTHER DIRECT COSTS							
1.	MATERIALS AND SUPPLIES				1,000		
2.	PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0		
3.	CONSULTANT SERVICES				0		
4.	COMPUTER SERVICES				0		
5.	SUBAWARDS				0		
6.	OTHER				6,000		
TOTAL OTHER DIRECT COSTS					7,000		
H. TOTAL DIRECT COSTS (A THROUGH G)					177,780		
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) F&A (Rate: 59.0000, Base: 177781)							
TOTAL INDIRECT COSTS (F&A)					104,891		
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					282,671		
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.)					0		
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)					\$ 282,671	\$	
M. COST SHARING PROPOSED LEVEL \$ 0				AGREED LEVEL IF DIFFERENT \$			
PI/PD NAME Jeffrey M Bradshaw				FOR NSF USE ONLY			
ORG. REP. NAME* Larry warrenfeltz				INDIRECT COST RATE VERIFICATION			
		Date Checked	Date Of Rate Sheet	Initials - ORG			

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION Florida Institute for Human and Machine Cognition, Inc.				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Jeffrey M Bradshaw				AWARD NO.	Proposed	Granted	
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
				CAL	ACAD	SUMR	
1.	Jeffrey M Bradshaw - PI			0.00	1.80	0.60	\$ 32,843
2.	Patrick J Hayes - CO-PI			0.00	1.80	0.60	30,598
3.							
4.							
5.							
6.	(0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)			0.00	0.00	0.00	0
7.	(2) TOTAL SENIOR PERSONNEL (1 - 6)			0.00	3.60	1.20	63,441
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1.	(0) POST DOCTORAL ASSOCIATES			0.00	0.00	0.00	0
2.	(2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)			3.60	0.00	0.00	39,596
3.	(1) GRADUATE STUDENTS						10,600
4.	(2) UNDERGRADUATE STUDENTS						16,960
5.	(0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)						0
6.	(0) OTHER						0
TOTAL SALARIES AND WAGES (A + B)							130,597
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							33,186
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							163,783
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							0
E. TRAVEL							12,330
1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)							12,330
2. FOREIGN							0
F. PARTICIPANT SUPPORT COSTS							
1.	STIPENDS \$ _____			0			
2.	TRAVEL _____			0			
3.	SUBSISTENCE _____			0			
4.	OTHER _____			0			
TOTAL NUMBER OF PARTICIPANTS (0)							
TOTAL PARTICIPANT COSTS							0
G. OTHER DIRECT COSTS							
1.	MATERIALS AND SUPPLIES						1,500
2.	PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION						0
3.	CONSULTANT SERVICES						0
4.	COMPUTER SERVICES						0
5.	SUBAWARDS						0
6.	OTHER						6,000
TOTAL OTHER DIRECT COSTS							7,500
H. TOTAL DIRECT COSTS (A THROUGH G)							183,613
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
F&A (Rate: 59.0000, Base: 183612)							
TOTAL INDIRECT COSTS (F&A)							108,331
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							291,944
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.)							0
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							\$ 291,944
M. COST SHARING PROPOSED LEVEL \$				0	AGREED LEVEL IF DIFFERENT \$		
PI/PD NAME Jeffrey M Bradshaw				FOR NSF USE ONLY			
ORG. REP. NAME* Larry warrenfeltz				INDIRECT COST RATE VERIFICATION			
		Date Checked		Date Of Rate Sheet		Initials - ORG	

SUMMARY PROPOSAL BUDGET YEAR 3

ORGANIZATION Florida Institute for Human and Machine Cognition, Inc.				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Jeffrey M Bradshaw				AWARD NO.	Proposed	Granted	
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
	CAL	ACAD	SUMR				
1. Jeffrey M Bradshaw - PI	0.00	1.80	0.60	\$ 34,814			
2. Patrick J Hayes - CO-PI	0.00	1.80	0.60	32,433			
3.							
4.							
5.							
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0			
7. (2) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	3.60	1.20	67,247			
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. (0) POST DOCTORAL ASSOCIATES	0.00	0.00	0.00	0			
2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	3.60	0.00	0.00	41,972			
3. (1) GRADUATE STUDENTS				11,236			
4. (2) UNDERGRADUATE STUDENTS				17,978			
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0			
6. (0) OTHER				0			
TOTAL SALARIES AND WAGES (A + B)				138,433			
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				35,175			
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				173,608			
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT				0			
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				7,820			
2. FOREIGN				8,450			
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS \$ _____				0			
2. TRAVEL _____				0			
3. SUBSISTENCE _____				0			
4. OTHER _____				0			
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0			
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES				1,000			
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0			
3. CONSULTANT SERVICES				0			
4. COMPUTER SERVICES				0			
5. SUBAWARDS				0			
6. OTHER				6,000			
TOTAL OTHER DIRECT COSTS				7,000			
H. TOTAL DIRECT COSTS (A THROUGH G)				196,878			
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) F&A (Rate: 59.0000, Base: 196879)							
TOTAL INDIRECT COSTS (F&A)				116,159			
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				313,037			
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.)				0			
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				\$ 313,037			
M. COST SHARING PROPOSED LEVEL \$ 0				AGREED LEVEL IF DIFFERENT \$			
PI/PD NAME Jeffrey M Bradshaw				FOR NSF USE ONLY			
ORG. REP. NAME* Larry warrenfeltz				INDIRECT COST RATE VERIFICATION			
		Date Checked	Date Of Rate Sheet	Initials - ORG			

SUMMARY PROPOSAL BUDGET Cumulative

ORGANIZATION Florida Institute for Human and Machine Cognition, Inc.				FOR NSF USE ONLY			
				PROPOSAL NO.	DURATION (months)		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Jeffrey M Bradshaw				AWARD NO.	Proposed	Granted	
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)				NSF Funded Person-months		Funds Requested By proposer	Funds granted by NSF (if different)
				CAL	ACAD	SUMR	
1.	Jeffrey M Bradshaw - PI			0.00	5.40	1.80	\$ 98,641
2.	Patrick J Hayes - CO-PI			0.00	5.40	1.80	91,897
3.							
4.							
5.							
6.	() OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)			0.00	0.00	0.00	0
7.	(2) TOTAL SENIOR PERSONNEL (1 - 6)			0.00	10.80	3.60	190,538
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1.	(0) POST DOCTORAL ASSOCIATES			0.00	0.00	0.00	0
2.	(6) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)			10.80	0.00	0.00	118,923
3.	(3) GRADUATE STUDENTS						31,836
4.	(6) UNDERGRADUATE STUDENTS						50,938
5.	(0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)						0
6.	(0) OTHER						0
TOTAL SALARIES AND WAGES (A + B)							392,235
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)							99,666
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)							491,901
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.)							
TOTAL EQUIPMENT							0
E. TRAVEL							
1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)							27,970
2. FOREIGN							16,900
F. PARTICIPANT SUPPORT COSTS							
1.	STIPENDS \$ _____			0			
2.	TRAVEL _____			0			
3.	SUBSISTENCE _____			0			
4.	OTHER _____			0			
TOTAL NUMBER OF PARTICIPANTS (0)							
TOTAL PARTICIPANT COSTS							0
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES							3,500
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION							0
3. CONSULTANT SERVICES							0
4. COMPUTER SERVICES							0
5. SUBAWARDS							0
6. OTHER							18,000
TOTAL OTHER DIRECT COSTS							21,500
H. TOTAL DIRECT COSTS (A THROUGH G)							558,271
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)							
TOTAL INDIRECT COSTS (F&A)							329,381
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)							887,652
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.)							0
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)							\$ 887,652
M. COST SHARING PROPOSED LEVEL \$ 0				AGREED LEVEL IF DIFFERENT \$			
PI/PD NAME Jeffrey M Bradshaw				FOR NSF USE ONLY			
ORG. REP. NAME* Larry warrenfeltz				INDIRECT COST RATE VERIFICATION			
		Date Checked	Date Of Rate Sheet	Initials - ORG			

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Budget Justification Page

Collaborative Research: CT-T: Explainable Policies for Establishing Trust in Web Applications

BUDGET JUSTIFICATION

Salaries and Fringe Benefits: The budget anticipates funding from 9/1/05 through 8/31/08. Salaries for Drs. Bradshaw, Hayes, two research associates, one graduate student, and two undergraduate students are calculated at current base plus 6% increase each year. Benefits are based on current Florida Institute for Human and Machine Cognition rates.

Travel: As this proposal is part of a collaborative research team proposal, travel is vital to the accomplishment of the work. Travel is budgeted at \$16,270 in year one to cover two domestic trips from Pensacola and one international trip to Ireland. In year two, \$12,330 is requested for three domestic trips from Pensacola. In the last year, \$16,270 is requested to support two domestic trips and one international trip.

Other Direct Costs: Supplies and Materials: This includes licenses for desktop software, production of technical reports, submission of papers to journals and conferences, and page charges for journals. A total of \$3,500 is requested. **Other:** \$6,000 is requested in each year of the proposal to purchase computer hardware that falls under the \$5,000 equipment limit.

Indirect Costs: The current rate is 59%.
