REPORT ON THE IMPLEMENTATION OF SB 18-086

OCTOBER 4, 2022

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Overview

C.R.S. 24-33.5-1905 (4) directs the Department of Higher Education (DHE, the Department) to prepare a report detailing progress made towards critical state cyber-security goals at institutions of higher education that received an appropriation through SB 18-086. Specifically, the report must include, at a minimum:

1. The number of faculty or adjunct faculty hired at each institution of higher education as a result of the funding;
2. The number of student internships created with the funding at each institution of higher education;
3. The number of degrees or certificates that have been awarded at each institution of higher education in connection with the funding;
4. The number of scholarships awarded at each institution in connection with the funding;
5. The number of presentations and seminars given on cybersecurity by each institution of higher education; and
6. The amount of all other money that has been raised to match the state investment, which may include tuition, fees, federal funds, and industry donations.

Six governing boards were awarded funding in the 2020-21 fiscal year. The following report summarizes their spending.

Key Findings

Fiscal Year 2021-22 was the fourth year in which funding was awarded to support cybersecurity and distributed ledger technology activities at institutions. Despite the lingering impact of the COVID-19 pandemic on campus operations, institutions remained committed to offering cybersecurity activities and programming to both students and their communities.

Table 1 shows, by governing board, SB 18-086 appropriation, actual expenditures, required scholarship award total, and actual scholarships awarded.

	SB 18-086 Appropriation	Total Amount Expended	SB 18-086 Scholarship Requirement	Total Amount Spent on Scholarships
Colorado Mesa University	$300,000	$226,130	$30,000	$31,900
Metropolitan State University of Denver	$300,000	$291,146	$30,000	$28,500
Western State Colorado University	$200,000	$323,185	$20,000	$35,000
Colorado State University System	$1,200,000	$1,054,525	$180,000	$1,166,083
University of Colorado System	$2,800,000	$2,800,000	$420,000	$1,251,901
Colorado Community College System	$300,000	$300,000	$30,000	$30,000

Fiscal Year (FY) 2021-22 was the fourth year in which institutions received this funding. In addition to several programs requiring a longer period of implementation, the COVID-19 pandemic also caused interruptions on campuses across the state. As institutions continue to receive funding to support cybersecurity programs, the amount of programming they are able to offer will likely increase.

Table 2 summarizes activities funded by SB 18-086 funding.

	Faculty and Adjuncts Hired	Internships Created	Degrees and Certificates Awarded	Scholarships Awarded	Presentations and Seminars Given	Amount of Other Funding Raised
Colorado Mesa University	1	12	5	35	2	
Metropolitan State University of Denver	12	17	86	19	0	$133,033
Western Colorado University	0.97	4	7	12	0	$186,363
Colorado State University System	22	198	1,061	237	123	$5,231,369
University of Colorado System	10	25	1,160	337	267	$7,034,038
Colorado Community College System	3	15	87	12	7	$50,000

Full Institutional Responses

Institutions used the funds received to support a wide range of public facing activities, such as hosting summer camps, presenting at conferences, and offering trainings for community members. Institutions also raised significant additional funds to support their work in the cybersecurity realm. For additional details on institutional activities and fund raised, each institution's full response has been included in the subsequent pages. In some cases, responses have been edited for formatting and grammar but are otherwise unchanged.

COLORADO MESA UNIVERSITY

SB 18-086 Appropriation Expenditure Report		
Governing Board Name	Colorado Mesa University	
Total SB 18-086 Appropriation	$	300,000
Actual Amount Spent on Scholarships	$	31,900
Total number of scholarships awarded	35	
Required Allotted Amount Earmarked for Scholarships	$	30,000
At or above allotted amount of scholarship earmark	Yes	
Number of faculty/adjucts hired as a result of funding		1.00
Number of student interships created	12	
Number of degrees/certificates awareded in connection with SB 086 funding	5	
Number of presentations/seminars given on cybersecurity	2	
Amount of all other money raised to match state investment		
Total Amount Expended	$	226,130

Please discuss any additional ways in which SB 086 money was spent, which may not be captured in lines 6-9 and fundraising efforts as reported in FY22 and any other information you would like to be included in the report.

a) Student researchers at the Cybersecurity Center published 3 peer-reviewed journal articles on IEEE Access and 1 is under review.

b) Bachelor's in Computer Science and Professional Certificate in Cybersecurity program as a combination is validated by NSA and CMU is awarded the National Center of Excellence in Cybersecurity Education by NSA for the next 5 years.

METROPOLITAN STATE UNIVERSITY

SB 18-086 Appropriation Expenditure Report		
Governing Board Name	Metropolitan State University of Denver	
Total SB 18-086 Appropriation	$	300,000
Actual Amount Spent on Scholarships	$	28,500
Total number of scholarships awarded	19	
Required Allotted Amount Earmarked for Scholarships	$	30,000
At or above allotted amount of scholarship earmark	No	
Number of faculty/adjucts hired as a result of funding		12.00
Number of student interships created	17	
Number of degrees/certificates awareded in connection with SB 086 funding	86	
Number of presentations/seminars given on cybersecurity	0	
Amount of all other money raised to match state investment		133,033.49
Total Amount Expended	$	291,146

Please discuss any additional ways in which SB 086 money was spent, which may not be captured in lines 6-9 and fundraising efforts as reported in FY22 and any other information you would like to be included in the report.

The Bachelor of Science Degree in Cyber Security

The Bachelor of Science Degree in Cyber Security successfully launched in Fall 2018 with 47 majors. Currently, (Fall of 2022) the B.S. in Cybersecurity has 326 majors—marking nearly 600% growth in the degree program over 4 years. During the spring of 2022, the BS in Cybersecurity was designated by the National Security Agency (NSA) as National Center of Academic Excellence in Cyber Defense. A Master's Degree in Cybersecurity started in the Fall of 2019 with 15 students, and current enrollment for Fall 2022 is 59 students.

Faculty and Staff

The department continued funding a full-time Cybersecurity specialist faculty in Computer Information Systems with SB 18-086 monies. In addition, we used SB 18-086 monies to partially fund a Cybersecurity Program Manager (the remaining funding comes from the M.S. in Cybersecurity degree program funding) and a Cyber Range Director (the balance of funding comes from private donation monies). Moreover, as the Cybersecurity Range took off, we supported three lab coordinators to complete Cyberbit training (focusing on live-fire cloud security exercises) via a partnership with Purdue University's Cyberbit Range. Two of the lab coordinators were supported with SB 086 monies during AY21-22 to offer a Cyberbit course via the

range, as well as industry-related certificates and opportunities. Lastly, MSU-Denver has continued to hire 12 part-time faculty to teach 18 different Cybersecurity undergraduate courses each Fall, Spring and Summer. Though, the number of total faculty teaching in both the undergraduate and graduate programs is 25.

Scholarship

MSU-Denver created a scholarship in Fall of 2018 and we have allocated 10% of the annual SB 18-086 awards to be distributed for scholarships. In FY 22, $30,000 was earmarked for scholarships in the amount of $1,500. Of those who applied, 20 students qualified and were awarded scholarships. Due to one of the awarded students stopping out of the Cybersecurity program during the academic year, only 19 scholarships ($28,500) were ultimately paid out in FY22.

Other areas and institutional matches

In FY22, $81,000 from the private sector was provided to continue supporting the Cyber Range Director. Approximately, $100,000 from the previous matched $450,000 was put toward running the Cybersecurity Operations course for students fall 2021 and spring 2022. The Cyber Range also received a few other donations to support the Cybersecurity Certification Club (C3) to provide students with certification opportunities. Lastly, the program continues to partner with MindSpark to provide STEMPath, cybersecurity certificates, to teachers in Denver.

Graduate or Certificates:

There were 9 STEMPath students that earned graduate certificates in Cybersecurity. The students are current teachers in Denver Public Schools and Aurora Public Schools, who will teach Cybersecurity to K-12 students in their respective school districts in their individual classrooms or Cybersecurity/Computer labs. Additionally, 12 students received their Master's degree in Cybersecurity and finally, 37 received their B.S. in Cybersecurity for the FY21. Lastly, The Cyber Range has provided a couple of industry-related opportunities for students. During Fall 2021 and Spring 2022 28 students participated in the Cybersecurity Operations course offered in the Cyber Range via the partnership with Purdue University's Cyberbit Range, which include defender, raider, and ransomware scenarios. The Cyber Range also coordinated with MSU Denver's Classroom to Career Hub to partner with CompTIA to provide certifications through the Cybersecurity Certification Club (C3). The Cyber Range is also providing experience for students via the Public Infrastructure Security Cyber Education System (PISCES).

Amount of matching monies, including tuition, fees, federal funds, and industry donations:

In FY22, cybersecurity received a total of $133,033.49 in matching monies that went toward supporting the Cyber Range Director position, the C3 Club, and STEMPath graduate certificates.

WESTERN COLORADO UNIVERSITY

SB 18-086 Appropriation Expenditure Report			
Governing Board Name	Western Colorado University		
Total SB 18-086 Appropriation		$	200,000
Actual Amount Spent on Scholarships		$	35,000
Total number of scholarships awarded			12
Required Allotted Amount Earmarked for Scholarships		$	20,000
At or above allotted amount of scholarship earmark			Yes
Number of faculty/adjucts hired as a result of funding			.97 FTE ($100,025)
Number of student interships created			4
Number of degrees/certificates awareded in connection with SB 086 funding			7
Number of presentations/seminars given on cybersecurity			
Amount of all other money raised to match state investment		$	186,363
Total Amount Expended	Western Colorado University	$	323,185

Please discuss any additional ways in which SB 086 money was spent, which may not be captured in lines 6-9 and fundraising efforts as reported in FY22 and any other information you would like to be included in the report.

We anticipate delivering a cyber security high school summer camp in FY23. Additional cyber security graduate educational grant awarded to faculty member for FY23. Anticipated ~45% increase in student scholarships to be awarded FY23. NSA CAE designation planned for the Informational Security program in FY23. Faculty remain actively involved in the MWCC (Mountain West Cybersecurity Consortium.) Please note that $1,900 was spent on student work study in FY22 which is included in the total amount expended.

CSU SYSTEM

SB 18-086 Appropriation Expenditure Report		
Governing Board Name	Colorado State University System	
Total SB 18-086 Appropriation	$	1,200,000
Actual Amount Spent on Scholarships	$	1,166,083
Total number of scholarships awarded	237	
Required Allotted Amount Earmarked for Scholarships	$	180,000
At or above allotted amount of scholarship earmark	Yes	
Number of faculty/adjucts hired as a result of funding		22.00
Number of student interships created	198	
Number of degrees/certificates awareded in connection with SB 086 funding	1061	
Number of presentations/seminars given on cybersecurity	123	
Amount of all other money raised to match state investment		5,231,369
Total Amount Expended	$	1,054,525

Please discuss any additional ways in which SB 086 money was spent, which may not be captured in lines 6-9 and fundraising efforts as reported in FY22 and any other information you would like to be included in the report.

More than 180 faculty and interns hired under the grant. More than 500 student participants have graduated, virtually all have jobs in IT with IT Security prominent. The CSU system invested $79810 for computers at Sturm, serving over 200 Students in ITSec courses.

University of Colorado, Colorado Springs (UCCS)

Cybersecurity Initiative (CSI)

FY21 Annual Report

September 1, 2022

Approved:

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Executive Summary

On May 30th, 2018, former Governor Hickenlooper signed Senate Bill (SB) 18-086 granting UCCS $2.8 million annually for workforce development, research and development, and support to law enforcement enhancing cybersecurity for the State and the Nation. In May 2021, the bill was extended for another three-year term. This document provides a consolidated report of FY 2021 CSI expenditures as required by SB18-086.

Altogether, UCCS in partnership with the National Cybersecurity Center (NCC) spent all of the FY 2022 State appropriation of $2,800,000, as shown in Figure 1. Additionally, nearly $8M in grants and additional funds were awarded to, and obtained by, UCCS, NCC and Space ISAC. These are also reported in Figure 1.

Figure 1: SB18-086 Reporting Criteria

SB 18-086 Appropriation Expenditure Report		
Governing Board Name	University of Colorado System	
Total SB 18-086 Appropriation	$	2,800,000
Actual Amount Spent on Scholarships		1,251,901
Total number of scholarships awarded		337
Required Allotted Amount Earmarked for Scholarships	$	420,000
At or above allotted amount of scholarship earmark	Yes	
Number of faculty/adjuncts hired as a result of funding		10
Number of student internships created		25
Number of degrees/certificates awarded in connection with SB 086 funding		1,160
Number of presentations/seminars given on cybersecurity		267
Amount of all other money raised to match state investment		7,034,038
Total Amount Expended	$	2,800,000
Please discuss any additional ways in which SB 086 money was spent, which may not be captured in lines 6-9 and fundraising efforts as reported in FY21 and any other information you would like to be included in the report.		

In addition to SB18-086 reporting criteria, the impact of the state's investment in the Colorado cybersecurity ecosystem including academic and community programs, industry outreach and partnership and filling workforce needs cannot be understated. These efforts are critical to Colorado's support expanding and strengthening the UCCS ties with Space Force and Space Command in Colorado and to continue being a national leader in public and private sector activities related to cybersecurity. The following narrative provides more detail on the comprehensive impact these funds have had on UCCS efforts to engage, support, and grow cybersecurity in Colorado and beyond.

Together, UCCS and NCC are continuing along the path of exponentially expanding the cybersecurity ecosystem with initiatives, programs, research, and partnerships that are paying large dividends by enhancing cybersecurity for Colorado and the Nation. Both UCCS and NCC are grateful to the Colorado Legislature and Governor for giving us this opportunity.

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University of Colorado Colorado Springs

UCCS has leveraged SB-086/CSI $2,800,00 in 2021-2022 from the JBC to achieve the following under the broad legislation requirements:

Scholarship Amount – $1,251,901

- 76 Engineering students were awarded cybersecurity scholarships totaling $388,850
- 60 Business students were awarded cybersecurity scholarships totaling $128,320
- 7 Letters, Arts and Sciences students were awarded cybersecurity scholarships totaling $8,500
- College of Public Service students were awarded cybersecurity scholarships totaling $ 19,965
- 12 College of Education students were awarded cybersecurity scholarships totaling $20,000
- UCCS was awarded funding from NSF for DoD Scholarship for Service (SFS) program- 11 cybersecurity students (3 PhD, 4 MS and 4 Undergraduate) – $638,523 for AY 2021-2022 ($1,311,199 cumulative since Fall 2019)
- Space ISAC provided funding for 3 cybersecurity students - $10,867 in wages for a total of $11,743 including payroll tax
- The NCC, based on additional funds leveraged as a result of state money, offered non-academic scholarship funds in FY 2022 totaling $36,000

Total Students Scholarships Awarded – 337

- 18 graduate and 67 undergraduate Engineering cybersecurity students
- 11 EDBA, 3 MBA, 16 undergraduate and 41 undergraduate certificate business cybersecurity management students
- 7 Letters, Arts and Sciences cybersecurity students
- 39 College of Public Service cybersecurity students
- 12 College of Education cybersecurity students
- Space ISAC, in partnership with UCCS, provided paid Graduate Fellowship and Undergraduate Scholar opportunities for 3 student in 2021-2022 to expand their awareness and involvement in the growing cybersecurity and space connections.
- The NCC, based on additional funds leveraged as a result of state money, offered 120 additional scholarships to adult and high school students participating in cyber security camps.

Faculty Hires – 10

- **College of Engineering and Applied Science (EAS)**
    - In addition to the previously hired Endowed Gallogly cybersecurity chair in 2021, EAS hired a cybersecurity instructor, Dr. Serena Sullivan in 2022. EAS still employs 2 faculty and 1 instructor with this funding - cybersecurity areas of focus for these faculty include cybersecurity operations and security in intelligent transportation and privacy and anonymous networks.

- **Cybersecurity Program Office** -still employing the Director of Cybersecurity Programs with this funding and have added a cybersecurity grant manager, a marketing and outreach position (.4 time), and a HR and budget position
- **College of Business** is still employing 1 tenure track faculty with this funding and hired one instructor of cybersecurity in 2022.
- The **NCC**, based on additional funds leveraged as a result of state money, were able to hire four new employees.
- The **Space ISAC** converted three college interns positions to full-time permanent employees.

Student Internships Created – 25

- **UCCS cybersecurity students** obtained 7 (6 EAS, 1 COB) cybersecurity internships in 2021-2022
- **UCCS EAS Blockchain research project** supports 2 part-time interns and directly executes the legislative SB18-086 requirement to conduct research and development on encryption and data integrity techniques
- The NCC hosted 5 high school cybersecurity students during the summer and 4 college students to help with student cyber camps and one summer intern supported the Elections Program
- NCC, in partnership with Daniels Funds, provided paid Undergraduate and Graduate Internships for 9 students in Spring 2022.
- The Space ISAC hosted three cybersecurity college interns for Summer 2022, fellows that conducted strategic planning and evaluation of the cybersecurity threat intelligence platform

Degrees and Certificates Awarded – 1,178

In addition to the degrees and certificates awarded below, UCCS Engineering and Applied Science School and Cybersecurity Program Office obtained from the National Security Agency (NSA) redesignation of their Cybersecurity Master of Engineering cybersecurity degree program as a Center of Academic Excellence (CAE) in cybersecurity.

- **UCCS EAS/COB degrees – 131 graduated**
  - Bachelor's degree in Innovation – graduated 2021-2022 44 (0 COB, EAS 44); Enrolled 203 (COB 7, EAS 196)
  - Bachelors of Science – graduated 2021-2022 66 (COB 2, EAS 64); Enrolled 343 (COB 49, EAS 324; 19 Cybersecurity)
  - BS in Business Emphasis Area in Cybersecurity Management – Graduated 2021-2022 2; Enrolled 49
  - Bachelor of Arts in Computer Science (BACS) Cybersecurity Graduated 2021-2022 0; Enrolled 23
  - Master's Degree in Computer Science – Graduated 2021-2022 12; Enrolled 58
  - Master's Degree in Cybersecurity-Graduated 2021-2022 6; Enrolled 19
  - MBA Emphasis in Cybersecurity Management – Graduated 1 2021-2022 Enrolled 25
  - Doctor of Philosophy Degree – graduated 2021-2022 0; Enrolled 27
  - Doctor of Business Administration in Cybersecurity Management –2021-2022 0; Enrolled 19
  - **UCCS certificates – 12**
    - Network System Security –graduated 2021-2022 0; Enrolled 0 (students self-report)
    - Undergraduate Applied Cybersecurity Certificate – 2021-2022 0; Enrolled 0
    - CoB Graduate Certificate in Cybersecurity Management – graduated 2021-2022 2; Enrolled 18

  - CoB Undergraduate Certificate in Cybersecurity Management – graduated 2021-2022 unknown; enrolled unknown (students self-report)
  - As part of a STEM grant UCCS has awarded scholarships to 16 students for a Security + industry certification course in Jan 2022, **10** of the 16 obtained certifications

- **The School of Letters, Arts and Sciences is developing a cybersecurity program**
- **The College of Public Service** has developed a Focus Area in Cybercrime and Cybersecurity for students that began Fall Semester 2021 – 2021-2022 Enrolled 6
- Three NCC cybersecurity non-credit programs were offered during this past FY. Many of the students and adults who completed the cybersecurity courses earned nationally recognized certifications in areas such as IT Fundamentals and Security+
  - Cyber camps – 160 participants
  - NCC Student Alliance (NCCSA) in Cybersecurity (CTSO) – 1100 participants (1100 students, 60% **770** achieved certification)
  - Cybersecurity training – Adults – 274 participants (274 adults, 90% **247** achieved certification)
- The NCC, based on additional funds leveraged as a result of state money, was able to increase Adult Education Initiative offerings to include CySA+ and Network +
- The NCC, based on additional funds leveraged as a result of state money, was approved to be on the Colorado Eligible Training Provider List (EPTL)
- The cybersecurity building and Space ISAC construction, was complete in Spring 2022. The US Cybersecurity Director to the President, Chris Inglis, was the keynote at the UCCS Kevin W. O'Neil Cybersecurity Education and Research building opening ceremony in May 2022.

Seminars, Publications and Presentations on Cybersecurity – 245

- **UCCS Cybersecurity Distinguished Lecture Series: 6**
  - Hosted six Distinguished Lectures by world-renown scientists, with attendees primarily from UCCS students and faculty. The speakers also interacted with UCCS students and faculty intensively after the lecture.
- **School of Engineering and Applied Sciences – 24 Publications**
  - A. Duby, T. Teryl, **G. Bloom**, and **Y. Zhuang**, "Detecting and Classifying Self-Deleting Windows Malware Using Prefetch Files," in 2022 IEEE 12th Annual Computing and Communication Workshop and Conference (CCWC), January 2022.
  - V. Banerjee, R Rabinowitz, M. Stidd, **R. Lewis**, **P. Brown**, and **G. Bloom**, "The Tragedy of the Miners," in IEEE Consumer Communications and Networking Conference (CCNC), IEEE CCNC 2022, January 2022.
  - H. Lawrence, U. Ezeobi, **G. Bloom**, and **Y. Zhuang**, "Shining New Light on Useful Features for Network Intrusion Detection Algorithms," in IEEE Consumer Communications and Networking Conference (CCNC), IEEE CCNC 2022, January 2022.
  - S. Hounsinou, M. Stidd, U. Ezeobi, H. Olufowobi, M. Nasri, and **G. Bloom**, "Vulnerability of Controller Area Network to Schedule-Based Attacks," 42nd IEEE Real-Time Systems Symposium (RTSS'21), December 2021.

- S. Hounsinou, V. Banerjee, C. Peng, M. Hasan, and **G. Bloom**, "Work-in-Progress: Enabling Secure Boot for Real-Time Restart-Based Cyber-Physical Systems," in Real-Time Systems Symposium, Dortmund, Germany, Dec 2021.
- R. Dubey, V. Banerjee, S.Hounsinou, and **G. Bloom**, "Work-in-Progress: Strong APA Scheduling in a Real-Time Operating System," in Embedded Systems Week (ESWEEK), 2021.
- Adam Duby, Teryl Taylor, Gedare Bloom, Yanyan Zhuang, "Evaluating Feature Robustness for Windows Malware Family Classification", the 31st International Conference on Computer Communications and Networks (ICCCN'22), July 2022.
- Adam Duby, Teryl Taylor, Gedare Bloom, Yanyan Zhuang, "Detecting and Classifying Self-Deleting Windows Malware Using Prefetch Files", the 12th Annual Computing and Communication Work- shop and Conference (CCWC'22), January 2022, Best Presenter Award.
- Adam Duby, Teryl Taylor, Yanyan Zhuang, "Malware Family Classification via Residual Prefetch Artifacts", in Proc. 19th IEEE Consumer Communications and Networking Conference (CCNC'22), Las Vegas, Nevada, USA, January 2022.
- Heather Lawrence, Uchenna Ezeobi, Gedare Bloom, Yanyan Zhuang, "Shining New Light on Useful Features for Network Intrusion Detection Algorithms", in Proc. 19th IEEE Consumer Communications and Networking Conference (CCNC'22), Las Vegas, Nevada, USA, January 2022.
- Heather Lawrence, Uchenna Ezeobi, Orly Tauil, Jacob Nosal, Owen Redwood, Yanyan Zhuang, Gedare Bloom, "CUPID: A Labeled Dataset with Pen testing for Evaluation of Network Intrusion Detection", Journal of Systems Architecture, 2022.
- Z. Li, Q. Chen, C. Chen, Y. Zou and **Shouhuai Xu**. *RoPGen: Towards Robust Code Authorship Attribution via Automatic Coding Style Transformation*. International Conference on Software Engineering (ICSE'2022).
- J. Shi, D. Zou, **Shouhuai Xu**, X. Deng, and H. Jin. *Does OpenBSD and Firefox's Security Improve with Time?*, Accepted to IEEE Transactions on Dependable and Secure Computing (IEEE TDSC), to appear
- Rosana Montanez Rodriguez and **Shouhuai Xu**. *Cyber Social Engineering Kill Chain*. In the Proceedings of the International Conference on Science of Cyber Security (SciSec'2022), 2022.
- N. Daughety, M. Pendleton, R. Perez, **Shouhuai Xu**, J. Franco. *Auditing a software-defined cross domain solution architecture*. In Proceedings of IEEE International Conference on Cyber Security and Resilience (IEEE CSR'2022).
- Brandon Collins, **Shouhuai Xu**, and Philip Brown. *Paying Firms to Share Cyber Threat Intelligence*. Proceedings of The 2021 Conference on Decision and Game Theory for Security (GameSec'2021).
- Nathan Daughety, Marcus Pendleton, **Shouhuai Xu**, Laurent Njilla, and John Franco. *vCDS: A Virtualized Cross Domain Solution Architecture*. Proceedings of The 2021 IEEE Military Communications Conference (Milcom'2021).
- Deqiang Li, Qianmu Li, Yanfang Ye, and **Shouhuai Xu**. *Arms Race in Adversarial Malware Detection: A Survey*. ACM Computing Survey, Volume 55Issue 1January 2023 Article No.: 15pp 1–35.

- Deqiang Li, Tian Qiu, Shuo Chen, Qianmu Li, and **Shouhuai Xu**. *Can We Leverage Predictive Uncertainty to Detect Dataset Shift and Adversarial Examples in Android Malware Detection?* Proceedings of The 2021 Annual Computer Security Applications Conference (ACSAC'2021).
- Huashan Chen, Hasan Cam, and **Shouhuai Xu**. *Quantifying Cybersecurity Effectiveness of Dynamic Network Diversity*. Accepted to IEEE Transactions on Dependable and Secure Computing, 2021.
- **Shouhuai Xu**. SARR: A Cybersecurity Metrics and Quantification Framework (Keynote Address). Proceedings of The 3rd International Conference on Science of Cyber Security (SciSec'2021), pages 3-17.
- Wenjun Fan, Sang-Yoon Chang, Xiaobo Zhou and **Shouhuai Xu**. *ConMan: A Connection Manipulation-based Attack Against Bitcoin Networking*. Proceedings of the IEEE 2021 Conference on Communications and Network Security (IEEE CNS), 2021.
- J. Charlton, P. Du, and **Shouhuai Xu**. *A New Method for Inferring Ground-Truth Labels and Malware Detector Effectiveness Metrics*. Proceedings of The 3rd International Conference on Science of Cyber Security (SciSec'2021), pages 77-92.
- Rosana Montanez Rodriguez, Adham Atyabi, and **Shouhuai Xu**. *Social Engineering Attacks and Defenses in the Physical World vs. Cyberspace A Contrast Study*. Invited Book Chapter to "Cybersecurity and Cognitive Science", 2021.

- **Keynote, and panel and other presentations in year 2021: 5 Presentations**
  - **Shouhuai Xu**. Computationally Robust Election (CoRE): A Framework for Thwarting Election Manipulations. Technical Briefing to USCYBERCOM Leadership, May 18, 2022.
  - **Shouhuai Xu**. Towards Quantifying Cybersecurity, Invited Research Seminar Talk University of Central Florida, March 31, 2022
  - **Shouhuai Xu**. Impact of COVID-19 on Corporate Cybersecurity, Invited Talk at The 17th Annual Forum on Financial Information Systems and Cybersecurity: A Public Policy Perspective, University of Maryland College Park, March 25, 2022
  - **Shouhuai Xu**. Space Foundation Symposium 365 Panel on "Redefining the Digital World Around Us", Invited Panelist, March 9, 2022
  - **Shouhuai Xu**. SARR: A Cybersecurity Metrics and Quantification Framework. NSA/DHS CAE Forum, Oct. 6, 2021.
- **School of Business – 1 Publication**
  - *Conference Proceeding (Published)* Tejay, G., Mohammed, Z., Luo, X. (2021). *Discovering Factors Influencing Information Believability to Mitigate Dissemination of (Mis)information: An Experimental Neuroscience Study for Trustworthy Cyberspace.* IFIP WG8.11/WG11.13.
- **Scholarship for Service students – 15 publications**
  - Yoon, Kay and Chang, Sang-Yoon. (2021). Teaching Team Collaboration in Cybersecurity: A Case Study from the Transactive Memory Systems Perspective. IEEE Global Engineering Education Conference (EDUCON). 841 to 845. Status = Deposited in NSFPAR https://doi.org/10.1109/EDUCON46332.2021.9453894
  - Fan, Wenjun and Hong, Hsiang-Jen and Kim, Jinoh and Wuthier, Simeon James and Nakashima, Makiya and Zhou, Xiaobo and Chow, Edward and Chang, Sang-Yoon. (2022). Lightweight and Identifier-Oblivious Engine for Cryptocurrency Networking Anomaly Detection. IEEE Transactions on Dependable and Secure Computing. 1 to 1. Status = Deposited in NSF-PAR https://doi.org/10.1109/TDSC.2022.3152937

- Raavi, Manohar and Wuthier, Simeon and Chandramouli, Pranav and Balytskyi, Yaroslav and Zhou, Xiaobo and Chang, Sang-Yoon. (2021). Security Comparisons and Performance Analyses of Post-quantum Signature Algorithms. Applied Cryptography and Network Security (ACNS). 12727 . Status = Deposited in NSF-PAR https://doi.org/10.1007/978-3-030-78375-4_17
- Kim, Jinoh and Nakashima, Makiya and Fan, Wenjun and Wuthier, Simeon and Zhou, Xiaobo and Kim, Ikkyun and Chang, Sang-Yoon. (2021). Anomaly Detection based on Traffic Monitoring for Secure Blockchain Networking. IEEE International Conference on Blockchain and Cryptocurrency (ICBC). 1 to 9. Status = Deposited in NSFPAR https://doi.org/10.1109/ICBC51069.2021.9461119
- Raavi, Manohar and Chandramouli, Pranav and Wuthier, Simeon and Zhou, Xiaobo and Chang, Sang-Yoon. (2021). Performance Characterization of Post-Quantum Digital Certificates. International Conference on Computer Communications and Networks (ICCCN). 1 to 9. Status = Deposited in NSFPAR https://doi.org/10.1109/ICCCN52240.2021.9522179 Bai, Yan and Chang, Sang-Yoon and Lew, Ken and Wuthier, Simeon. (2021). Enhancing
- Cybersecurity Education and Workforce Through Colorado-Washington Security Scholar Program. Journal of computing sciences in colleges. 37 (1) 38-44. Vaszary, Mark and Slovacek, Andreas and Zhuang, Yanyan and Chang, Sang-Yoon. (2021). Securing Tire Pressure Monitoring System for Vehicular Privacy. IEEE 18th Annual Consumer Communications & Networking Conference (CCNC). 1 to 6. Status =Deposited in NSF-PAR https://doi.org/10.1109/CCNC49032.2021.9369576
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- Kelei Zhang, S. Wuthier, K. Yoon, and S.Y. Chang, Designing and using capture the flag for coordination and interaction in engineering education, IEEE EDUCON, 2022.
- K. Hines, M. Raavi, J.M. Villenueve, S. Wuthier, J. Moreno-Colin, Y. Bai, and S.Y. Chang, Poster: post-quantum cipher power analyses in lightweight devices, ACM WiSec, 2022.
- T. Gamboni-Diehl, S. Wuthier, J. Kim, J. Kim, S.Y. Chang, Poster: lightweight code assurance proof for wireless software, ACM WiSec, 2022.
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- **Research Projects Publications 22**
  - Adam Duby, Teryl Taylor, Gedare Bloom, Yanyan Zhuang, "Evaluating Feature Robustness for Windows Malware Family Classification", the 31st International Conference on Computer Communications and Networks (ICCCN'22), July 2022.

- Adam Duby, Teryl Taylor, Gedare Bloom, Yanyan Zhuang, "Detecting and Classifying Self-Deleting Windows Malware Using Prefetch Files", the 12th Annual Computing and Communication Workshop and Conference (CCWC'22), January 2022, Best Presenter Award.
- Adam Duby, Teryl Taylor, Yanyan Zhuang, "Malware Family Classification via Residual Prefetch Artifacts", in Proc. 19th IEEE Consumer Communications and Networking Conference (CCNC'22), Las Vegas, Nevada, USA, January 2022.
- Heather Lawrence, Uchenna Ezeobi, Gedare Bloom, Yanyan Zhuang, "Shining New Light on Useful Features for Network Intrusion Detection Algorithms", in Proc. 19th IEEE Consumer Communications and Networking Conference (CCNC'22), Las Vegas, Nevada, USA, January 2022.
- Heather Lawrence, Uchenna Ezeobi, Orly Tauil, Jacob Nosal, Owen Redwood, Yanyan Zhuang, Gedare Bloom, "CUPID: A Labeled Dataset with Pen testing for Evaluation of Network Intrusion Detection", Journal of Systems Architecture, 2022.
- Thesis: Emmanuel Wamuo, "Fine-Grained Analysis of IoT Firmware Updates", Advisor: Yanyan Zhuang (this is funded by CSI: Curating an IoT Firmware Update Dataset)
- Brandon Collins, Shouhuai Xu, and Philip Brown. Paying Firms to Share Cyber Threat Intelligence. Proceedings of The 2021 Conference on Decision and Game Theory for Security (GameSec'2021).
- Nathan Daughety, Marcus Pendleton, Shouhuai Xu, Laurent Njilla, and John Franco. vCDS: A Virtualized Cross Domain Solution Architecture. Proceedings of The 2021 IEEE Military Communications Conference (Milcom'2021).
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- D. Li, T. Qiu, S. Chen, Q. Li, and S. Xu. Can We Leverage Predictive Uncertainty to Detect Dataset Shift and Adversarial Examples in Android Malware Detection? Proceedings of The 2021 Annual Computer Security Applications Conference (ACSAC'2021)
- H. Chen, H. Cam, and S. Xu. Quantifying Cybersecurity Effectiveness of Dynamic Network Diversity. accepted to IEEE Transactions on Dependable and Secure Computing, 2021.
- S. Xu. SARR: A Cybersecurity Metrics and Quantification Framework (Keynote Address). Proceedings of The 3rd International Conference on Science of Cyber Security (SciSec'2021), pages 3-17.
- W. Fan, S. Chang, X. Zhou and S. Xu. ConMan: A Connection Manipulation-based Attack Against Bitcoin Networking. Proceedings of the IEEE 2021 Conference on Communications and Network Security (IEEE CNS), 2021.
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- Rosana Montanez Rodriguez, Adham Atyabi, and Shouhuai Xu. Social Engineering Attacks and Defenses in the Physical World vs. Cyberspace A Contrast Study. Invited Book Chapter to "Cybersecurity and Cognitive Science", 2021.
- Z. Li, Q. Chen, C. Chen, Y. Zou and S. Xu. RoPGen: Towards Robust Code Authorship Attribution via Automatic Coding Style Transformation. International Conference on Software Engineering (ICSE'2022)."
- J. Shi, D. Zou, S. Xu, X. Deng, and H. Jin. Does OpenBSD and Firefox's Security Improve with Time?, accepted to IEEE Transactions on Dependable and Secure Computing (IEEE TDSC), to appear

- Rosana Montanez Rodriguez and Shouhuai Xu. Cyber Social Engineering Kill Chain. In the Proceedings of the International Conference on Science of Cyber Security (SciSec'2022), 2022.
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- Chang, S., Yoon, K., Wuthier, S., & Zhang, K., (2022). Capture the Flag for team construction in cybersecurity. arXiv:2206.08971. http://doi.org/10.48550/arXiv.2206.08971
- Zhang, K., Wuthier, S., Yoon, K., & Chang, S. (March 2022). Designing and using Capture the Flags (CTF) for coordination and interaction in engineering education. IEEE EDUCON2022: Global Engineering Education Conference, Tunis, Tunisia.

- **Cybersecurity Program Office – 123 presentations**
  - Presentations were given to ISSA, AFCEA, SBDC, 10 corporate partners, Space ISAC membership, CS Rocks K-12 conference, Cyber First Fridays, Colorado Springs K-12 school superintendents, CUS All girls Cyber camp, Women Cybersecurity (WiCyS) events at 3 CU campuses, UCCS Cybersecurity Career Panels, NSA Centers of Academic Excellence, and many other local, national, and international partners.
- **College of Public Service - 4 presentations**
  - Faculty Presentations- 2
    - Quintana, Kate, Dan Olson, Anna Kosloski, YongJei Lee, Tabitha Sleeger, Gia Barboza. "Cybersecurity Needs and Demands for Criminal Justice Professionals." Western Criminology Conference, February 2022.
    - Olson, Dan and Kate Quintana. 2022. "Cybersecurity for Criminal Justice Professionals." Catalyst Campus, April 2022.
  - Guest Lecture Series in Cybercrime and Cybersecurity- 2
    - Nussbaum, Brian. "Protecting the Smart City: Growing Cyber Risks." UCCS Campus, April 2022.
    - Nussbaum, Brian. ""Cybersecurity Outside the Mainstream: Insights from State and Local Governments and Remote Environments." UCCS Campus, April 2022.
- **National Cybersecurity Center – 42 presentations**
  - based on a combination of state and additional funds, participated in cybersecurity presentations (27) and seminars (15)
- **Space ISAC- 25 presentations**
  - Based on a combination of state and additional funds, attended, and presented at national and international conferences including Space Symposium, DEFCON, ACCRES NOAA, AFS Space Innovation Summit Panel, the Emerging Space-Cyber Theater Panel, Rapid Fire Resource Panel, Small Sat and more.

Matching/additional grants – $7,034,038

- **Cybersecurity Program Office - $949,907**

- NSA $300,000 - Intro Middle School and teacher GenCyber Camps for Summer 2023– 2-year period
- Ongoing Grants - $649,907
  - **NSA -** $349,907 - CAE Northwest Hub grant – year 1 of 2
  - **NSA** $300,000 - Intro and Advanced GenCyber Camp for Teachers Summer 2022 – 2 year period

- **UCCS Engineering/Cybersecurity Grants – $4,479,174**
  - **New grants $284,049**
    - **NSA** $244,969 University of Colorado Colorado Springs CAE Grant 8/2021 – 8/2023 Gedare Bloom, Shouhuai Xu, Philip Brown
    - **Rebellion Defense Inc.** $15,000 UCCS Sub-Proposal to Rebellion STTR Proposal 4/22/21 – 9/15/21 Gedare Bloom, Shouhuai Xu, Jugal Kalita
    - **UCCS** $24,080 Equity, Diversity, and Inclusion (EDI) Recruiting and Retaining Women in Cybersecurity – 2022-2025
  - **Ongoing Grants - $4,195,125**
    - **NSF** $292,141 Enforcing Security and Privacy Policies to Protect Research 2019-2022
    - **NSA** $135,100 2019 DOD CYBER SCHOLARSHIP
    - **NSF** $1,132,100 COLORADO-WASHINGTON SECURITY
    - **NSF** $20,620 Investigate and enhance cybersecurity of automotive systems
    - **NSF** $708,581 Cybersecurity hardening for scientific industrial control systems
    - **NSF** $599,000 Career grant for Dr Gedare Bloom – 5 years
    - **NSF** $499,094 Assuring Cyber Security and Privacy for Human Resilience Research: Requirements, Framework, Architecture, Mechanisms and Prototype – 3 year
    - **NSF** $250,472 Game Theoretic Methods for Socially Networked Multi-Agent Systems – 3 year
    - **NSF** $438,823 A Framework for Enhancing the Resilience of Cyber Attack Classification and Clustering Mechanisms - 2 year
    - **Whatcom Community College** $119,194 Junior Reserve Officer Training Corps (JROTC) Cyber Academy Pilot Program - 1 year
- The NCC, based on additional funds leveraged as a result of state money, organized Workforce Development Summit with Cyber.org and National Cryptological Foundation
- The NCC, in partnership with the Daniel's fund and Deloitte offered quarterly Capture the Flag competitions
- NCC leveraged state funds to obtain $1,872,000 from multiple funding sources in FY 2021-2022
- BlockChain Development Community: Volunteer Members and Companies provided 86% of 29,470.48 hours contributed to the effort from 2017-2022. In comparison to the $300,000 invested by the State this provides an equivalent in-kind community sponsored effort of $2,799,145.
- BlockFrame Incorporated: provided in-kind sponsorship providing media outreach services, refreshments and prizes, venue cost, and professional services for weekly meetings. These in-kind services and sponsorship over a four (4) year period provided matching support of approximately $140,000.
- Bees Computing & Ajames Technologies: provided in-kind sponsorship including management platforms, volunteer and community coordination support platforms and services, IT Managed Services, and web repositories. These in-kind services and sponsorship over a five (5) year period provided matching support of approximately $60,000.

- **SPACE ISAC – $ 1,000,000**
  - Membership dues valued at $1.0 million in FY 2022.
- **CSI funded Faculty Seed Grants Projects - $28,450**
  - **COB and LAS -** The Behavioral and Management Side of Cybersecurity –Cyberhygiene, Cyberpsychology, and Impacting the Future Workforce - $6,200
  - **COB** - Improving Cybersecurity Training Through Andragogical Approach: A Design Science Study for Secure Cyberspace - $7,250
  - **EAS -** Partial Differential Equations Approach to Modeling and Controlling Cybersecurity Dynamics: Dimension and Non-Linearity Reduction - $7,500
  - **EAS -** Curating an IoT Firmware Update Dataset - $7,500
- **CSI funded Research Projects - $576,507**
  - **COPS** - Public Safety Initiative (PSI) Cybersecurity Initiative Funding Request - $95,000
  - **LAS and EAS** - Team Collaboration in Cybersecurity: The Development of a Skill Building Workshop - $31,418
  - **COPS -** Understanding the Social & Behavioral Role in Cybercrime & Cybersecurity - $15,568
  - **COE -** Enhancing Digital Leadership for Student Affairs and Higher Education Professionals - $6,900
  - **LAS** - Developing Language and Cultural Literacy Skills to Address Strategic Diversity Needs in Cybersecurity – $13,333.
  - **COB** - Graduate Certificate in Space Cyber Enterprise - $20,000
  - **COB** - Cybersecurity Management National Case Competition - $20,000
  - **COB -** Cybersecurity Management Council - $50,000
  - **COB -** Cybersecurity Emergent Research Symposium - $20,000
  - **COB and EAS -** International Alliance of Trust Chains - $23,000
  - **Library -** O'Reilly for Higher Education Subscription - $8,463
  - **EAS -** Student Empowerment in Cybersecurity - $24,000
  - **EAS -** An Exploratory Study for Preparing UCCS to Earn NSA/DHS National Centers of Academic Excellence Designations in Cybersecurity Research (CAE-R) and Cyber Operations (CAE-CO) - $15,000
  - **EAS -** Creating and Holding UCCS Distinguished Lecture Series in Cybersecurity - $10,000
  - **EAS -** Creating a Cybersecurity Metrics Framework to Enable Quantitative Decision-Making - $50,000
  - **EAS and Blockframe -** PhilosBDL Blockchain Development Research Program - $87,418
  - **Pre-Collegiate -** Superheroes - Cybersecurity Middle School Camps - $19,734
  - **Pre-Collegiate –** Cyber Girls- Cybersecurity Middle School Camp - $9,867
  - **Marketing -** UCCS Cybersecurity Diversity National Marketing Campaign - $40,000
  - **COE -** Campus Connections: Cultivating Social and Emotional Wellness in At-Promise Youth through Digital Citizenship - $16,806

<u>In addition to the University specific requirements, UCCS has undertaken significant work on legislation specific technical requirements:</u>

- **UCCS College of Public Service - Public Safety Initiative (PSI) –** In support of SB 18-086 Section 4 24-33.5-1904 paragraph 2f, "Support state and federal law enforcement agencies with their responsibilities for investigating and collecting information related to cyber-based criminal and

national security threats" continued to facilitate professional development education and training for 32 area law enforcement agencies across Colorado.

- 100 Digital Forensic Investigators received cybercrime training, and two agencies received hardware and software to enhance their cybercrime investigative abilities.
- PSI Support to Law Enforcement (LE) delivered $125,822 in cybercrime training and equipment to 32 area LE agencies, sponsoring 8 cybercrime investigation courses for 100 law enforcement Investigators.
- Most of the LE agencies that received support are also members of the Internet Crimes Against Children (ICAC) Task Force. The ICAC program helps state and local law enforcement agencies develop an effective response to technology-facilitated child exploitation and Internet crimes against children. In FY21, the Colorado ICAC Task Force conducted over 1,230 investigations and 2,351 forensic exams. *Cellebrite: Seattle PD ICAC- https://youtu.be/F_pcWXohOMY
- PSI heightens awareness and expands the training and education of law enforcement personnel to prevent, investigate, and respond to cybercrimes.
- PSI delivers cybersecurity capability and expertise in an increasingly critical area of law enforcement
- PSI offers insight and advice necessary to adapt and contend with a rapidly evolving cybersecurity threat

- **UCCS funded "Blockchain Research Program in Support of Colorado Senate Bill SB18-086**," in support of the SB18-086 section two requirements. The largest efforts were in applied development of MVP version of the components designated for public use by the State of Colorado programs, key developments include:
  - The standing up and performance testing for Project Philos™ distributed ledgers
  - the publication of the operations of the Carbon-Neutral Distributed Ledger and "The Philos Trust Algorithm: Preventing Exploitation of Distributed Trust" for peer review
  - Setting up first two Consortium Servers for International Alliance of Trust Chains (IATC) organization
  - The development of Administrative Console platform for administration of governance for the Philos™ distribute ledger platform
    - *This has incorporated the needs and requirements to enforce programmatic governance which is modeled after the Colorado Department of Regulatory affairs and U.S. Department of Commerce. The workflow and processes enabled by this feature will allow for multiple programs to operate seamlessly as the State of Colorado needs for program adoption are identified.*
  - The continued strength of the Blockchain Development community has maintained a steady but reduced growth while many other organizations have slowed with the onset of the COVID pandemic. There has been a steady influx of participation as the registered number of members grew to over 395.
  - Engagement in the second proof-of-concept prototype was partly funded under a grant from IEEE Blockchain Transactive Energy. This prototype is supporting a local utility company in Colorado to implement transactions for renewable energy. An alpha vision of the demonstration can be found at www.philos.us .
  - Alliances with Colorado Office of Information Technology were expanded as demonstrations to state officials of the program capably were given and an event for state program

managers to be scheduled early in 2023 FY. This has been delayed some, as the Colorado CISO position changed over just after he is beginning of the new State FY.

- Alliances with IEEE have expanded as the principal investigator Mr. Gorog was promoted to global chair for the IEEE Digital Privacy Initiative, details can be found at www.digitalprivacy.ieee.org .
- Several speaking engagements were given over the course of the program year as for both the IEEE Blockchain Initiative, IEEE Digital Privacy Initiative, the IAPP, and the U.S. Department of Energy.
  - IEEE ISGT Conference presented on Blockchain Governance for Transactive Energy - New Orleans
  - IEEE TESC Conference presented paper "Carbon-Neutral Distributed Ledger" - Online
  - Conference Paper "The Philos Trust Algorithm: Preventing Exploitation of Distributed Trust" - Online
  - RSA Presented IAPP panel representing Digital Privacy Initiative – San Francisco
  - DOE Cybercon presented on Transactive Energy Project – Portland OR
  - IEEE PES General Presentation on Governance requirements for large scale distributed ledger – Denver Colorado
  - NCSL's Cybersecurity Task Force/Privacy Work Group session on Sunday, July 31 at the Colorado Convention Center
  - Monthly IEEE Digital Privacy Imitative, Meetings include 6 subgroups which meet regularly – Online
- **BlockChain Development Community:** Volunteer Members and Companies provided 86% of 29,470.48 hours contributed to the effort from 2017-2022. In comparison to the $300,000 invested by the State this provides an equivalent in-kind community sponsored effort of $ 2,799,145.36.
- **BlockFrame Incorporated:** provided in-kind sponsorship providing media outreach services, refreshments and prizes, venue cost, and professional services for weekly meetings. These in-kind services and sponsorship over a four (4) year period provided matching support of approximately $140,000.
- **Bees Computing & Ajames Technologies:** provided in-kind sponsorship including management platforms, volunteer and community coordination support platforms and services, IT Managed Services, and web repositories. These in-kind services and sponsorship over a five (5) year period provided matching support of approximately $60,000.

- **Space ISAC –** Membership dues valued at $ 1 million dollars in FY 2022.
  - Space ISAC participated in the ribbon cutting ceremony held by University of Colorado Colorado Springs (UCCS) to celebrate the expansion of the Kevin W. O'Neil Cybersecurity Education and Research Center and the Space ISAC HQ facility
  - Maintained engagement for Space ISAC collaborative groups – Information Sharing Working Group, Exercise Task Force, CMMC Task Force, Smallsat Community of Interest, SPD-5 Task Force, Value of Space Summit Task Force, Blockchain Community of Interest, Analyst Working Group and more.

COLORADO COMMUNITY COLLEGE SYSTEM

SB 18-086 Appropriation Expenditure Report		
Governing Board Name	Colorado Community College System	
Total SB 18-086 Appropriation		$ 300,000
Actual Amount Spent on Scholarships		$ 30,000
Total number of scholarships awarded (see note 5)		12
Required Allotted Amount Earmarked for Scholarships		$ 30,000
At or above allotted amount of scholarship earmark		Yes
Number of faculty/adjucts hired as a result of funding (see note 1)		3.00
Number of student interships created (see note 2)		15
Number of degrees/certificates awareded in connection with SB 086 funding (see note 3)		87
Number of presentations/seminars given on cybersecurity (see note 4)		7
Amount of all other money raised to match state investment (see note 5)		$ 50,000.00
Total Amount Expended		$ 300,000

Please discuss any additional ways in which SB 086 money was spent, which may not be captured in lines 6-9 and fundraising efforts as reported in FY22 and any other information you would like to be included in the report.

Note 1: SB 18-086 funds have been used to pay the salary and benefits for 3 full-time cyber security faculty members (2 full salaries and 1 partial salary).

Note 2: Grant funds have been utilized to facilitate student connections with internship sites by funding hiring events, community partner gatherings, and travel related to building community partnerships. The Cyber Security program saw the largest cohort of internship students in academic year 2021.

Note 3: Completers of the Cyber Security degree and certificates nearly doubled between Academic Year 2020 and the past academic year. Of the 87 completers in the program, 27 earned an Associate of Applied Science degree in Cyber Security while 60 were awarded certificates in Cyber Security. The increased capacity in full-time personnel provided for with the SB 18-086 appropriation allowed for the increase in completers. Cyber Security certificates have become in demand as they represent the most expedient way for current and new Cyber Security professionals to refresh and become familiar with current best practices and industry norms.

Note 4: SB 18-086 has allowed for students in the Cyber Security program to participate in state and national cyber security competitions, as well as allowing for faculty to participate in cyber security industry events to further the program's connection with the community and local industry. PPSC students have consistently placed and excelled in CyberMaryland, Cyber Capture the Flag (CTF), and the Rocky Mountain Collegiate Cyber Defense (RMCCD) competitions.

Note 5: In addition to the $30,000 apportionment of scholarship monies from SB 18-086, the PPSC Foundation raised $50,000 additional dollars for cyber security related grants. Both SB 18-086 and PPSC Foundation scholarships were $2,500 per student awards.

Conclusion

FY 2021-22 was the fourth year of additional funding for cybersecurity and distributed ledger technologies. After receiving limited funding due to the COVID pandemic, funding was fully restored for FY 2021-22, and institutions remain committed to fully implementing the goals of the legislation.

Outside of offering scholarships to students pursuing degrees and credentials related to cybersecurity, and the hiring of faculty and staff, institutions focused funding on improving their cyber facilities and offering outreach events through cyber centers. With ongoing investment in cybersecurity and ledger technology, institutions will be well equipped to continue to invest in these programs and the students enrolled in them.