### STAFF SUMMARY SHEET

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### SUMMARY

1. PURPOSE. To provide security and policy review on the document at Tab 1 prior to release to the public.

2. BACKGROUND.
Authors: Maj Michael Chiaramonte, Maj David Caswell, Col Gregory Schechtman

Title: The Case for an ABET Accredited Computer and Network Security Program

Circle one: Abstract Tech Report Journal Article Speech Paper Presentation Poster

Check all that apply (For Communications Purposes):

- [ ] CRADA (Cooperative Research and Development Agreement) exists
- [ ] Photo/Video Opportunities
- [ ] STEM-outreach Related
- [ ] New Invention/Discovery/Patent

Description: Paper for 18th Colloquium for Information Systems Security Education

Release Information:
Previous Clearance information: (If applicable) N/A

Recommended Distribution Statement: Distribution A: approved for public release, distribution unlimited

3. DISCUSSION. The material is based on work to develop a computer and network security degree. The paper discusses the merits of having this type of degree ABET accredited.

4. RECOMMENDATION. Sign Coord block above indicating document is suitable for public release. Suitability is based solely on the document being unclassified, not jeopardizing DoD interest, and accurately portraying official policy.

David J. Caswell, Maj, USAF
Assistant Professor

I Tab: Tab 1) Paper for Approval
The Case for an ABET Accredited Computer and Network Security Program

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Abstract — Cyber security is a losing battle. Faced with the challenge of always being right, network defenders and secure systems developers are constantly being overwhelmed with attacks by nation states, criminal organizations and other hackers. This paper outlines the need for a formal program accreditation for cyber security academic programs as a means of meeting the nations need for personnel with deep understanding of cyber security spanning from hardware, software, and advanced technologies to risk mitigation, decision strategies, law, ethics and policy. This paper advocates for a multi-discipline ABET program accreditation to facilitate workforce hires, and skillset-job matching with a greater degree fidelity.

Keywords — Cyber, Security, Networks, Computer Science, Information Technology, Computer Engineering, Computing, Accreditation

I. INTRODUCTION
Each year the number of cyber-attacks increases. These attacks have a profound impact on society including direct monetary losses, corporate and government privacy infringements, and lost consumer confidence. Today’s users don’t simply want immediate online access to bank accounts, stores, and social media. They implicitly demand secure access. This is evidenced by the outcry of the recent Target breach or increased scrutiny of time taken by Apple to push critical security patches.

These realities foster strong demand for highly educated computing specialists that understand the nuances of cyber security. Currently roughly 2% of all computing and mathematical graduates have earned a degree with some specialization in cyber security [1]. This is completely at odds with workforce demand for Cyber which needs at least 50,000 cyber specialists in the near future [1]. Additionally, these numbers do not reflect the need for cyber security understanding above the technical level. Managers, practitioners, legal departments, and senior leadership must understand how cyber security strategies can affect the bottom line. A recent PWC study showed that corporations with cyber security strategies in place fell victim to 50% fewer cyber security attacks than their competitors [2].

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Similar to the past pushes for STEM education, the Federal Government has recognized the need for a holistic push for cyber education. The National Initiative for Cyber Education (NICE) lists as one of its major initiatives the expansion of cyber education. This initiative specifically highlights the limited focus of existing cyber training programs and the imperative to have a sound educational pipeline into the cyber security workforces of both the commercial and governmental sectors [4].

Despite the clear need for these professionals there is no official accreditation standard for undergraduate programs to follow. This lack of standardization obscures the comparative value of degree programs from students and leaves companies guessing as to what skills and knowledge the graduates may have acquired. This then encourages graduates to rely on certification programs to vouch for the students’ credibility.

In this paper we will examine existing guidelines for computer and network security (CNS) programs. We then discuss different curricula developed by universities who offer CNS focused degrees. Having discussed the guidance and implementations, we then conclude with how an ABET accreditation would benefit this growing academic field.

As a note, we use the term computer and network security to refer to both information assurance and cyber education. While some will argue that these are independent topics, we view them as being so closely related that an educational program cannot teach one without understanding of the other.

II. EXISTING CURRICULA GUIDANCE

Currently there are no formally recognized academic program accrediting bodies that recognize CNS degree specializations. There are, however, a number of certifications that can be obtained by an institute of higher education to validate its programs. Two such certifications are awarded by the National Security Agency (NSA) and the Department of Homeland Security (DHS). The NSA/DHS currently certifies universities and colleges as either Centers for Academic Excellence (CAE) in Information Assurance (IA) or Cyber Operations. Table 1 lists a summary of the CAE criteria.

The CAE designations provide a good, and the primary, starting point for schools interested in designing a CNS program. They are, however, biased to support the needs of the NSA and DHS whereas not all programs are, nor should be, focused on developing students for the requirements of these government institutions. In addition, the large list of topics required by the CAE certification is not necessarily items that would or should be expected by students in an undergraduate program. This may make it difficult for undergraduate only institutions to achieve CAE status due to the lack of the course options available in graduate programs.

Another form of CNS related guidance is through the training organizations and their certification programs. With a lack of academic accreditations, employers often rely on these certifications to validate employee skill-
levels. Such training certifications can be
carried through organizations such as the
SysAdmin Audit, Network Security institute
(SANS) and the Information Security
Institute (INFOSEC). These programs
provide specialized training in a variety of
CNS focus areas. SANS even has a
regionally accredited graduate degree
program. These certifications provide
employers evidence of specialization in
particular CNS topics however they do not
provide the broad educational foundation
that an undergraduate program is expected
to imbue.

Table 1: Summary of criteria for NSA
centers of excellence [6][7].

<table>
<thead>
<tr>
<th>NSA-CAE Cyber Ops</th>
<th>NSA-CAE Info Assurance</th>
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<tbody>
<tr>
<td>Telecommunications</td>
<td>Database Management</td>
</tr>
<tr>
<td>Low-level Programming</td>
<td>Network Defense</td>
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<tr>
<td>Reverse Engineering</td>
<td>Networking</td>
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<tr>
<td>Operating System Theory</td>
<td>Operating Systems</td>
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<tr>
<td>and Virtualization</td>
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<tr>
<td>Networking</td>
<td>Probability and Statistics</td>
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<tr>
<td>Cyber Offense/Defense</td>
<td>Programming</td>
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<td>Analog and Digital Communications</td>
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<tr>
<td>Usable Security</td>
<td>Cryptography</td>
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</tbody>
</table>

III. COMPUTER AND NETWORK
SECURITY CURRICULA

A. Who currently teaches undergraduate
computer and network security

Despite the lack of formal accreditation
many schools offer some form of a CNS
degree. Table 2 lists several universities and
their CNS style degree. Each of these
programs provides undergraduate students
an education focused on CNS topics.
However, without the formal accrediting
standards employers have little to rely on
with regards to the skills being developed by
the institution. This is the impetus behind
NSA’s development of the CAE programs.

Table 2: Example undergraduate degree
programs with a cyber-security focus

<table>
<thead>
<tr>
<th>School</th>
<th>Degree</th>
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<tbody>
<tr>
<td>University of Maryland and University Center</td>
<td>Computer Networks and Security</td>
</tr>
<tr>
<td>George Mason University</td>
<td>Cyber Security</td>
</tr>
<tr>
<td>New York University Polytechnic</td>
<td>Computer Science (cyber security focus)</td>
</tr>
<tr>
<td>United States Military Academy</td>
<td>Computer Science (information assurance focus)</td>
</tr>
<tr>
<td>United States Air Force Academy</td>
<td>Computer and Network Security</td>
</tr>
</tbody>
</table>

You will notice that two of the
programs listed in Table 2 are tracks within
an accredited Computer Science degree.
While this is an option, we believe that more
focus can be achieved by decoupling
Computer Science from Cyber Security and
treat each as a specialization within the world of computing.

B. The case for ABET Accreditation

Currently Computer Science, Computer Engineering, and Information Technology degrees all are accredited technical computing degrees. Each of these degrees have different foci that requires rigorous study to master. Computer Engineering focuses on hardware design and its interfacing with software. Computer Science develops algorithms for software and networking. Information Technology typically focuses on applied technology such as systems administration and network design. Each of these has some overlapping concepts and may include some security topics.

![Venn Diagram showing CNS, CE, IT, and CS intersections]

**Figure 1: Relationship of major computing degree programs**

Unfortunately, a computer and network security program needs to focus on a variety of topics that crosses all three programs as well as material that would not typically be included as primary criteria for any of these accepted programs. As an example, computer science and computer engineering both would work with assembly languages to understand how a program is working on the hardware. However, neither CS nor CPE typically has a need to study reverse engineering whereas this topic would be highly relevant to the Computer and Network Security graduate.

From a workforce perspective, having an accredited security focused degree provides employers and graduate schools knowledge of what to expect from students who earn a degree from these from accredited programs. This allows employers to hire from a variety of institutions with confidence that the incumbent has the required skills. Further, by having the academic approval that a Computer and Network Security accreditation provides, more employers may become more aware of the skill sets and thus become open to hiring in the field.

From the degree granting institution’s perspective, having a computer and network security accreditation provides both guidance for the curricular depth and breadth as well as increases the credibility of the granted degree. While many programs could apply for the ABET General Computing Program this does not highlight the specialization of a Computer and Network Security professional.

Another key aspect of a CNS ABET program is to ensure that the programs do not cross the academic-training divide. An educational CNS degree must focus not on the tools but the theories that underpin the development, operations and management of secure systems. An example of training would be a Security + or CISSP course that prepares a person for a certification test. While the CISSP is a solid certification, it does not teach underlying fundamentals such a memory management or cellular network design strategies. As shown in Figure 2, it is the depth of understanding and the ability to apply these theoretical security
fundamentals that distinguish CNS programs from training courses and other educational programs.

Figure 2: CNS builds on select topics from IT, CS and CpE programs to build security experts

IV. CONCLUSION

As computer security continues to grow as an accepted industry profession so to must academia grow to support the need. Without an ABET accredited CNS degree we leave students and employees in an uncertain realm as to what foundational knowledge is being developed in the different undergraduate programs. Employers are currently forced to rely on training certifications. While the NSA/DHS CAE provides useful guidance it is not tailored to support undergraduate programs. ABET has experience in developing for other key engineering technology degrees.

Developing cyber savvy professionals requires a focus on tailored topics from at least six disciplines. This unique characteristic must be accepted and integrated into collegiate accreditation programs to ensure that our professionals understand the business, political, legal, strategic, and technical implications of cyber. As Sandor Boyson, a research professor and cybersecurity expert, puts it: “There is an emerging need for cybersecurity expertise that can be applied to business, policy and international issues. [9]” A CNS accreditation program would move the state of education closer to fulfilling this need.

As FBI director Muller put it, the “cyber threat will pose the number one threat to our country…Now we must position ourselves to best combat the cyber threat as it grows and morphs over the next 10 years” [3]. Developing rigorous criteria that validates the computer security credentials of undergraduate institutions is critical to the healthy development and sustainment of the professional workforce.

Disclaimer
The views expressed in this paper are those of the authors and do not necessarily reflect the official policy or position of the Department of the Air Force, the Department of Defense, or the U.S. Government.

REFERENCES


