



UNC CHARLOTTE
College of Computing and Informatics

Office of the Dean

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September 15, 2015

Dr. Courtney Thornton
Associate Vice President for Research and Graduate Education
General Administration
University of North Carolina
PO Box 2688
Chapel Hill, NC 27515

Dear Dr. Thornton:

Thank you for your careful review of our proposed M.S. in Cyber Security. In this letter, I address each of your questions or concerns in italics below and describe where and how we revised the proposal in response to those questions or concerns.

1. Curriculum

a. What is the difference between the educational objectives listed (p. 2) for this program and for the existing graduate certificate?

We respond to this question on page 3: Although the Master of Science in Information Technology offers a concentration in information security and privacy, students in that program can take a maximum of only 12 credit hours in information security and privacy, which makes it difficult for students to acquire a deep understanding of the rapidly expanding knowledge and skills in Cyber Security. The new program will require students to take up to 30 credit hours in Cyber Security and privacy, as well as a culminating experience relevant to Cyber Security.

b. The proposal indicates no new courses are required. We seek to better understand the potential for overlap with the existing MS in IT and the elective courses that will be available to the MS Cybersecurity students.

We respond to this on page 11: UNC Charlotte has been building education and research capabilities in Cyber Security over the past 15 years. We currently offer 12 graduate level courses (36 credit hours) related to Cyber Security. We expect to further improve and increase our course offering over time, however, the proposed program does not require the development of new courses to get started. In response to demands from the proposed program and the interests of our industry partners, we



expect more security courses will be offered each semester thus providing more electives for all graduate students at UNC Charlotte including those enrolled in the MSIT program.

c. Would the information security concentration in the MS in IT be eliminated upon approval of a MS in Cybersecurity? Roughly what % of all MS IT students enrolled pursue that concentration?

No, we do not plan to eliminate the information security concentration because this serves a different population than the proposed MS. As we explain on page 3: The Master of Science in Cyber Security will complement the Master of Science in Information Technology (MSIT) program offered at UNC Charlotte.

d. The proposal indicates only coursework requirements (4 core courses, 6 electives); therefore, we assume the primary aim of the program is to prepare individuals for clearly identified professional opportunities at the master's level (instead of for further graduate study), but direct clarification on that point may be helpful for future reviewers.

- We note that the MS in Information Technology, per your website, has a thesis option. Is a thesis option planned for the MS in Cybersecurity, and why or why not?

We have provided more information on the proposed curriculum on page 2: The program requires that students take four core courses and six elective courses, including the selection of a concentration and a culminating experience. The core courses are designed to prepare students with fundamental knowledge and skills in Cyber Security and privacy protection that are essential to all Cyber Security professionals. The elective courses give students an opportunity to further broaden their knowledge and skills in areas that are of particular interest to them. The selection of a concentration allows students to choose to learn more depth in a particular area of Cyber Security such as information security, network security, or secure software development. For the culminating experience, the student may choose an industry internship or a Master's thesis. Together these components will equip students with necessary skill sets in specific areas in Cyber Security and privacy where they wish to pursue their professional careers.

- Has there been any consideration to plan this as a Professional Science Master's (PSM) program?

We explain our rationale for proposing a MS instead of a PSM on page 4: We chose to create the proposed program as a MS program instead of as a Professional Science Master's because it provides flexibility for students to choose either a research focus, by selecting the Master's Thesis option, or a professional focus, by choosing an internship. In this critical area of Cyber Security, producing students with either advanced knowledge in the form of research or industry experience is critical to safeguarding information assets.

2. Student Demand

a. Student demand evidence on p. 4 is not specific to information security. The evidence could be strengthened by providing data on the number of students enrolled in UNCC's current MS IT concentration in information security as well as in your graduate certificate.

We address this question on page 5: The existing Master of Science in Information Technology (MSIT) at UNC Charlotte is designed to equip students with advanced skills and knowledge in the planning, design, implementation, testing and evaluation, deployment, maintenance, and management of applications and systems that embody information and communication technologies for their proper functioning. These skills form the necessary foundations for solving practical problems that arise in business, industrial, governmental, and other organizations, as well as for pursuing doctoral studies in information technologies. The current areas of concentration in the MSIT are: Advanced Data and Knowledge Discovery, Design, Emerging Technologies, Human-Computer Interaction, Information Security and Privacy, Information Technology Management, Software Systems Design and Engineering, and Web Development. The number of students enrolled in the MSIT has grown from 50-60 in Fall 2013 to 170-180 (a 300% increase). In Fall 2015, 10% of students enrolled in the MSIT program chose the Information Security and Privacy concentration (18 out of 176).

b. You might also consider moving the table on p. 8, which does help establish demand specific to cybersecurity programs, to the section on student demand.

This table has been moved.

c. On what basis are you projecting that 80% of your prospective students would be able to attend full-time? Without more insight on the target audience for this program, we cannot ascertain if this is a reasonable projection.

On page 11, we justify the 80% based on the trends we have seen in our other MS degrees.

3. Societal demand

The proposal did not make a strong enough case as to why a master's degree program is needed. For example, why/when would a master's degree graduate be preferred to an individual with a bachelor's degree in computer science, a few years of work experience, and a graduate certificate in cybersecurity?

A Master's degree is proposed to address the need for more advanced understanding of the challenges, issues, and solutions for cyber security that cannot be covered in an undergraduate degree or a graduate certificate. The faculty in CCI believe that the problems associated with cyber security cannot be resolved with the amount of cyber security content that can fit into a more general undergraduate program in CS or a graduate certificate. There is a sense in government and industry that the cyber security problems need to be owned by everyone, including computing professionals with more general degrees, but that

there needs to be individuals with more advanced understanding of the issues and technical solutions that provide leadership.

- The national employment projection data provided for information security jobs are not specific to master's degree holders.

The table on page 8 provides data on employment projections that include information security jobs.

- What do job posting analyses reveal for master's trained individuals in information security (not computer science)?

We provide references to job posting analyses from US Department of Labor Bureau of Labor Statistics and Occupational Outlook Quarterly on page 8.

- Would local employers provide support letters and rationale as to the need for master's trained individuals in cybersecurity?

We attach letters of support from employers in the Charlotte region, including Wells Fargo and the City of Charlotte.

- What about employment outcomes for UNCC graduates who pursue your information security concentration? Are these the 60 students mentioned on p. 4? It was unclear.

We describe our scholarships from the Federal Government as an example of the employment outcomes for our cyber security students that then work for the Federal Government (see page 9). In addition, our letters of support from regional industry partners provide a strong argument for potential employment opportunities for the graduates from the proposed MS in Cyber Security.

From page 9: Demand for UNC Charlotte graduates with Cyber Security training has been very strong. For example, we have trained and placed over 150 MS graduates with concentration in Cyber Security for federal, state and local government. In fact, the demand for Cyber Security skills is so great in the public sector, the federal government offers generous scholarships for students to study Cyber Security in return to work in the public section upon graduation. The Department of Software and Information Systems has had a Scholarship for Service program funded by the Federal government for over 10 years to attract more students to study in the area of Cyber Security (<http://sfs.uncc.edu/>).

4. Other programs

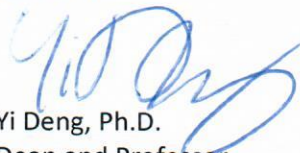
We believe more master's level cybersecurity degree programs exist than acknowledged in the proposal, p. 5, and exist in the region. A quick web search yielded Georgia Tech's MS in Information Security. Also, Virginia Commonwealth and UAB's Masters in Computer Forensics and Security Management. Please revisit that analysis.

We reviewed our survey of existing Master's level cyber security programs, and

acknowledge that Pearsons.com shows there are 55 programs within 300 miles of Charlotte that mention information security as part of or the focus of the Master's level programs. Upon closer look, these programs are either a concentration in information security (fewer credit points on cyber security topics), or a graduate certificate in information security rather than Masters level, or, in the case of Georgia Tech, the MS program is fully online. We are proposing a campus-based MS in Cyber Security that provides a small percentage of our courses online. We propose predominantly campus-based experience in order to improve the regional talent pipeline for our industry partnerships in cyber security. There is a campus-based Masters level program at Kaiser University in Florida, but it is a MA (not MS) in Homeland Security as one of their Criminal Justice programs. Our proposed MS is located in a College of Computing and Informatics with a strong technology and formal analytics focus.

On page 7: In the UNC system, no university currently offers a Master's degree in Cyber Security. Of the 55 existing Master's programs within 300 miles of Charlotte that currently specify a degree that includes information security, only one in the southeast region is a campus-based degree specifically about information security: Master of Arts in Homeland Security, Keiser University, Ft. Lauderdale, FL. [Source: Petersons.com, retrieved September 13, 2015; search criteria = MS information security].

Sincerely,

A handwritten signature in blue ink, appearing to read 'Yi Deng', is written over the typed name.

Yi Deng, Ph.D.
Dean and Professor



UNC CHARLOTTE

Office of the Chancellor

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August 7, 2015

Dr. Chris Brown
Vice President for Research and Graduate Education
University of North Carolina
Post Office Box 2688
Chapel Hill, North Carolina 27515-2688

Dear Dr. Brown:

Enclosed is UNC Charlotte's request for authorization to plan a M.S. in Cyber Security. The proposed program would prepare graduates to work in the high-demand field of cyber security and privacy in a variety of industries including business, healthcare, government, and the banking and energy industries. The program would build upon the internationally recognized faculty that UNC Charlotte has in this field.

Thank you for your consideration of this request. Provost Joan Lorden or I would be pleased to respond to any questions that you may have.

Cordially,

Philip L. Dubois
Chancellor

cc: Joan F. Lorden, Provost and Vice Chancellor for Academic Affairs
Yi Deng, Dean, College of Computing and Informatics
Courtney Thornton, Associate Vice President for Research and Graduate
Education
Cody Thompson, Coordinator for Academic Planning





UNC CHARLOTTE

Office of Academic Affairs

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August 10, 2015

Dr. Chris Brown
Vice President for Research and Graduate Education
University of North Carolina
Post Office Box 2688
Chapel Hill, North Carolina 27515-2688

Dear Dr. Brown:

Enclosed is UNC Charlotte's Appendix A: Request for Authorization to Plan a M.S. in Cyber Security. The proposal provides a summary budget which includes enrollment increase funding. UNC Charlotte is committed to funding the expenses for the degree as described by reallocating funds, if needed.

Thank you for your consideration of this request.

Sincerely,

Joan F. Lorden
Provost and Vice Chancellor for Academic Affairs

cc: Courtney Thornton, Associate Vice President for Research
and Graduate Education
Cody Thompson, Coordinator for Academic Planning



APPENDIX A
UNIVERSITY OF NORTH CAROLINA
REQUEST FOR AUTHORIZATION TO PLAN
A NEW DEGREE PROGRAM

THE PURPOSE OF ACADEMIC PROGRAM PLANNING: Planning a new academic degree program provides an opportunity for an institution to make the case for need and demand and for its ability to offer a quality program. The notification and planning activity to follow do not guarantee that authorization to establish will be granted.

Date: September 14, 2015

Constituent Institution: The University of North Carolina at Charlotte

CIP Discipline Specialty Title: Computer & Information Sciences

CIP Discipline Specialty Number: 11.1003 Level: B M X Res. Doc. Prof. Doc.

Exact Title of the Proposed Program: Cyber Security

Exact Degree Abbreviation (e.g., B.S., B.A., M.A., M.S., Ed.D., Ph.D.): M.S.

Does the proposed program constitute a substantive change as defined by SACS? Yes X No

The current SACS Substantive Change Policy Statement may be viewed at:
<http://www.sacscoc.org/pdf/081705/Substantive%20Change%20policy.pdf>

If yes, please briefly explain.

As required by the Policy Statement on Substantive Change for Accredited Institutions of the Commission on Colleges, the University of North Carolina at Charlotte (UNC Charlotte) is required to submit a letter of notification prior to implementation for new degree programs. Notification of this new degree program will be provided to SACS after approval by the University of North Carolina Board of Governors and prior to implementation.

Proposed date to enroll first students in degree program: *Month* August *Year* 2016

1. Provide a summary of the status of this proposal in your campus review processes.
 - a. List the campus bodies that reviewed and commented on this Appendix A proposal before submission to UNC General Administration. What were their determinations? Include any votes, if applicable.

This proposal has been reviewed by the following campus bodies. All these bodies have approved the proposal unanimously.

- The graduate curriculum committee of the Department of Software and Information Systems
- The Department of Software and Information Systems
- The graduate committee of the College of Computing and Informatics

b. Summarize any issues, concerns or opposition raised throughout the campus process and comment periods. Describe revisions made to address areas of concern.

No major issues were raised during the consultation process.

2. Describe the proposed new degree program. The description should include:

a. A brief description of the program and a statement of educational objectives;

The Master of Science in Cyber Security is designed to equip students with the latest knowledge and skills in Cyber Security and privacy. Graduates of the program will be employable by both businesses and governments that have important information assets to be protected from increasingly sophisticated cyber-attacks.

Specific educational objectives of the program include:

- A fundamental understanding of:
 - common vulnerabilities of computing and networked systems,
 - cyber-attacking methods,
 - human and organizational aspects of Cyber Security,
 - methods for compromising privacy, and
 - risk assessment of cyber-attacks.
- Able to apply security techniques to analyze and evaluate the security risk of information systems and networks.
- Able to design information systems and networks with security controls to minimize security risks.

The program requires students take four core courses and six elective courses, including the selection of a concentration and a culminating experience. The core courses are designed to prepare students with fundamental knowledge and skills in Cyber Security and privacy protection that are essential to all Cyber Security professionals. The elective courses give students an opportunity to further broaden their knowledge and skills in areas that are of particular interest to them. The selection of a concentration allows students to choose to learn more depth in a particular area of Cyber Security such as information security, network security, or secure software development. For the culminating experience, the student may choose an industry internship or a master's thesis. Together these components will equip students with necessary skill sets in specific areas in Cyber Security and privacy where they wish to pursue their professional careers.

UNC Charlotte has offered a 12 credit graduate certificate in information security for over ten years. The proposed program requires 30 credit hours of graduate level Cyber Security courses to provide much more technical depth content than is provided in the graduate certificate. Furthermore, the selection of a Cyber Security concentration area allows specialization in an area in which UNC Charlotte has been certified by the National Security Agency and the U.S. Department of Homeland Security as a Center of Academic Excellence. The proposed program also differs from the graduate certificate in that it allows the students to choose to do a master's thesis or an industry internship. The master's thesis option offers an opportunity for students to solve a unique problem under the direction of an experienced research faculty and is often a stepping-stone towards pursuing a career in advanced research. The internship option provides students with guided industry experience in Cyber Security.

- b. The relationship of the proposed new program to the institutional mission;

The proposed Master of Science in Cyber Security closely aligns with the UNC Charlotte mission as North Carolina's urban research university. It strongly supports the university's focus on community engagement, graduate education, and the economic and social needs of the greater Charlotte region. The program also aligns with the missions of the Department of Software and Information Systems (SIS) and College of Computing and Informatics (CCI). The master's program is built upon a strong record of faculty achievement in the areas of Cyber Security and privacy.

The University is committed to growing graduate programs in areas of national, state, and regional need. The proposed program will help address an increasingly strong demand for employees with information and network security knowledge and skills. Further, it aligns well with growing national security needs in safeguarding the nation against emerging threats emanating from the cyber space. President Obama has declared that the "cyber threat is one of the most serious economic and national security challenges we face as a nation" and that, "America's economic prosperity in the 21st century will depend on cyber-security." According to Steve Rosenbush, the Deputy Editor of the CIO journal belonging to the Wall Street Journal, the demand for Cyber Security experts is growing at 3.5 times the pace of the overall IT job market, and 12 times the overall job market. Because of the sensitivity of responsibilities in Cyber Security, many of these jobs cannot be out-sourced. At the same time, economic drivers in the Charlotte region such as the power and financial service industries have been frequent targets of cyber-attacks. The proposed degree addresses the need for a skilled Cyber Security workforce. The program is designed to ensure that students are well equipped for employment in a wide variety of industries including financial services, energy, retail/supply chain and health care where data and infrastructure security and safety are of paramount importance.

- c. The relationship of the proposed new program to existing programs at the institution and to the institution's strategic plan; and

The Master of Science in Cyber Security will complement the Master of Science in Information Technology (MSIT) program offered at UNC Charlotte. Although the Master of Science in Information Technology offers a concentration in information security and privacy, students in that program can take a maximum of only 12 credit hours in information security and privacy, which makes it difficult for students to acquire a deep understanding of the rapidly expanding knowledge and skills in Cyber Security. The new program will require students to take up to 30 credit hours in Cyber Security and privacy, as well as a culminating experience relevant to Cyber Security. The proposed program will better equip students with state of the art knowledge and skills in the areas that are essential in safe-guarding information assets.

Enrollment of international students in the existing MSIT program has been growing at a pace far greater than that of domestic students (see Section 3 for details). On the other hand, domestic students have historically shown more interest in information security. The new Master of Science in Cyber Security will attract more domestic students into the graduate programs of the College of Computing and Informatics, resulting in a more diverse and balanced graduate student body.

The proposed program will also strengthen our MSIT program. We do not plan to eliminate our current information security concentration in the MSIT program because it provides more flexibility for students to pursue a broader education in information technology. The proposed program will attract more students to our graduate programs

in Cyber Security and create a larger community interested in this topic. In fall 2015, 10% of the MSIT students enrolled choose the information security concentration (18 out of 176).

The students in the PhD program in Computing and Information Systems have also expressed interested in Cyber Security that will benefit from the proposed program. In addition, the courses in the proposed master's degree will serve our PhD program as most of these courses are cross-listed as 8000-level courses. The new program will increase the number of students in these cross-listed courses. The number of PhD students working in the area of Cyber Security has been increased substantially (more than ~50%) in our department in the past five years.

We chose to create the proposed program as a MS program instead of as a Professional Science Master's because it provides flexibility for students to choose either a research focus, by selecting the master's thesis option, or a professional focus, by choosing an internship. In this critical area of Cyber Security, producing students with either advanced knowledge in the form of research or industry experience is critical to safeguarding information assets.

d. Special features or conditions that make the institution a desirable, unique, or cost effective place to initiate such a degree program.

UNC Charlotte is situated in the region's largest city. Charlotte is ranked as the 17th largest U.S. city and is a financial, energy, healthcare, distribution and transportation center for the region. The business research company Hoover's lists 3,464 companies with \$1 million or more in revenues located in the city of Charlotte and Mecklenburg county. Two hundred and seventy-four Fortune 500 companies have facilities in Charlotte, with eight headquartered here, including Bank of America, Lowe's, Nucor, Duke Energy, Family Dollar Stores, Goodrich, Sonic Automotive, and SPX. Charlotte is also home to the third largest public healthcare system in the country, Carolinas Healthcare System. The business community provides strong support for the Cyber Security program, as evidenced by attendance at regular information security events hosted by UNC Charlotte, including the annual information security symposium. This symposium is now in its 15th year and draws over 500 in attendance.

As the only public doctoral research university in the Charlotte region, UNC Charlotte is well positioned to offer this program. The Department of Software and Information Systems has been recognized by the National Security Agency (NSA) and the National Science Foundation (NSF) as a center of excellence in information and assurance education and research during the past decade. Faculty from the department include internationally recognized experts in Cyber Security whose research results are widely cited by peers and have also been adopted as international standards for data security. The Department has been a participant in NSF/Department of Defense Cyber Security Scholarship programs during the past 14 years, and have graduated over 60 master's students who have all been hired by federal government agencies.

3. Provide documentation of student demand. Discuss the extent to which students will be drawn from a pool of students not previously served by the institution. Evidence of student demand should reflect likely applicant pools (local, regional, statewide, national, or global) and could include:

a. Surveys of potential enrollees (such as students or alumni of feeder programs, community college enrollees, etc.).

In lieu of surveys of potential enrollees, we have obtained letters from major corporations in the Charlotte region (see attached) that indicate both a demand for students graduating with a specialization in Cyber Security and an interest in having their employees gain additional knowledge and skills in Cyber Security.

b. Enrollment data from existing minor, concentration or certificate programs on your campus.

National enrollment trend indicators for computer science have begun to show increases in the last decade. Freshmen interest in computing majors (HERI, <http://www.heri.ucla.edu/tfsPublications.php>) is increasing, as is actual enrollment in computing programs, which has increased by approximately 13% since 2011-12 (Taulbee, <http://cra.org/resources/taulbee/>).

The existing Master of Science in Information Technology (MSIT) at UNC Charlotte is designed to equip students with advanced skills and knowledge in the planning, design, implementation, testing and evaluation, deployment, maintenance, and management of applications and systems that embody information and communication technologies for their proper functioning. These skills form the necessary foundations for solving practical problems that arise in business, industrial, governmental, and other organizations, as well as for pursuing doctoral studies in information technologies. The current areas of concentration in the MSIT are: Advanced Data and Knowledge Discovery, Design, Emerging Technologies, Human-Computer Interaction, Information Security and Privacy, Information Technology Management, Software Systems Design and Engineering, and Web Development. The number of students enrolled in the MSIT has grown from 50-60 in Fall 2013 to 170-180 (a 300% increase). In Fall 2015, 10% of students enrolled in the MSIT program chose the Information Security and Privacy concentration (18 out of 176). More data will be presented in Section 4.g showing the strong market demand for IT workers with Cyber Security skills.

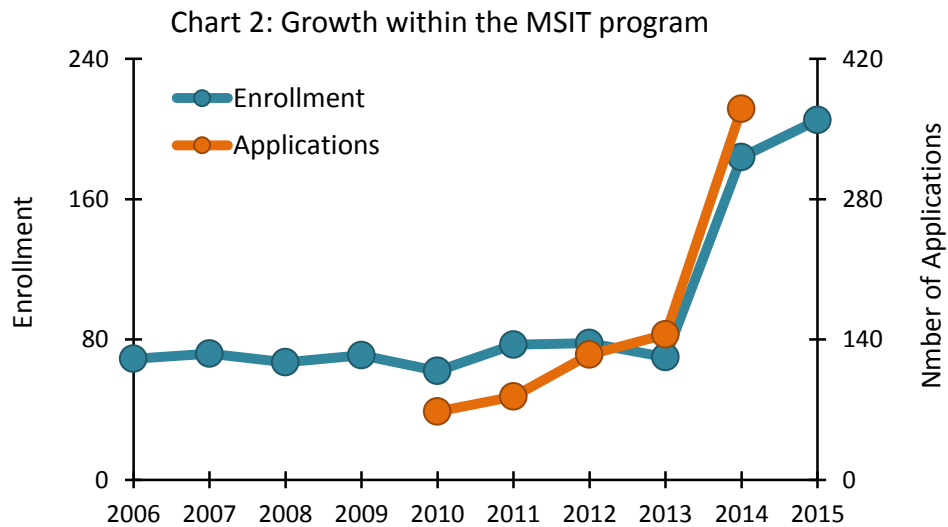
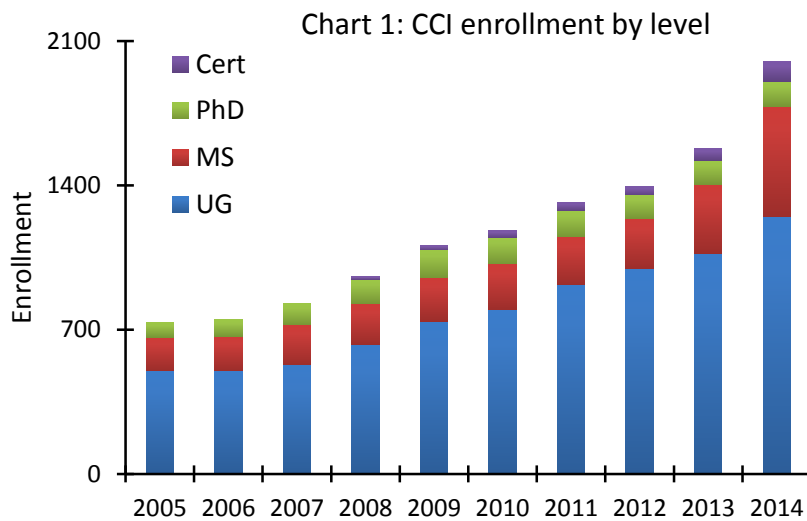
The SIS department currently offers the following Graduate Certificates:

Graduate Certificate in Health Information Technology: This graduate certificate program is jointly offered by the College of Computing and Informatics and the College of Health and Human Services. The program provides healthcare professionals with an opportunity to advance their level of competence in the management of healthcare information as well as the secure and reliable exchange of the information among consumers, healthcare providers and other stakeholders in the industry.

Graduate Certificate in Information Security and Privacy: This graduate certificate provides professionals with an opportunity to advance their level of competence in the understanding, management, and applications of Cyber Security and privacy technology. We do not plan to eliminate our current graduate certificate in Information Security and Privacy because it provides more flexibility for students to pursue a broader IT education. The proposed program is designed to provide an in depth focus on Cyber Security.

Graduate Certificate in Management of Information Technology: This graduate certificate provides professionals with an opportunity to advance their level of competence in the management and applications of computing and information technology through formal training.

The SIS department is one of three departments within the College of Computing and Informatics (CCI) at UNC Charlotte. The College offers a variety of degree programs at all levels, including two doctoral programs, two MS programs, and partners with others on three Professional Science Master's programs. All of our programs have experienced dramatic growth in demand over the past decade, with our total enrollment nearly tripling in that time (see *Chart 1*). Moreover, growth within and applicant interest for the SIS department's existing MSIT program strongly parallels the College's overall growth (see *Chart 2*).



- c. Enrollment data from similar programs in UNC, the state, or country.

In the UNC system, no university currently offers a master's degree in Cyber Security. Of the 55 existing master's programs within 300 miles of Charlotte that currently specify a degree that includes information security, only one in the southeast region is a campus-based degree specifically about information security: Master of Arts in Homeland Security, Keiser University, Ft. Lauderdale, FL. [Source: Petersons.com, retrieved June 2, 2015; search criteria = MS information security].

- 4. Provide evidence of societal demand and employability of graduates from as many of the following sources as feasible unless a good reason exists why such evidence cannot be obtained and similar evidence is presented from sources not listed here.

- a. Labor market information (www.ncworks.gov) – Current and projected industry and occupational data by region and statewide from the NC Department of Commerce. Available data include (but are not limited to):

- (1) Area, occupation, and industry profiles.
- (2) NC occupational and employment projections.
- (3) Job postings.
- (4) Economic and demographic indicators.

- b. National occupational and industry projections (<http://www.bls.gov/data/>) – National, regional and state outlook for occupations, also including wage data.

- c. Wages and employment of graduates in North Carolina – Percentage of graduates of UNC programs employed in North Carolina and wages paid to graduates of UNC programs employed in North Carolina.

- d. Wages and employment of graduates nationally when these data becomes available (see http://www.doleta.gov/performance/pfdocs/wris2_status_state_optin.pdf) – Wages paid to graduates of UNC programs employed nationally (North Carolina partnership in WRIS2 forthcoming).

- e. Job-posting analyses.

- f. Projections from professional associations or industry reports.

- g. Data concerning employment and wages for graduates of a particular program area from the UNC alumni survey when this survey and data become available.

Cyber security requires special skills beyond what is generally covered in a baccalaureate degree. For example, to understand network security one must first understand networking well. Similarly, to understand software security one must have sufficient appreciation of software development and engineering. Given typical credit hour limits for a four-year degree program it is difficult to provide adequate coverage of Cyber Security topics in a four-year undergraduate degree program. It is therefore essential to offer Cyber Security at the master's level.

According to the US Department of Labor Bureau of Labor Statistics, employment in information security jobs is “projected to grow 37 percent from 2012 to 2022, much faster than the average for all occupations. It is estimated that this growth will result in 27,400 new jobs needed to fill the

industry. Demand for information security analysts in North Carolina is expected to be very high” (retrieved from NCWorks.gov on September 13, 2014).

Occupational Outlook Quarterly projected in its Spring 2014 issue that demand for information security analysts (i.e. Cyber Security professionals) will grow the fastest among all major STEM occupations, at 37% on average between 2012-2022. Demand for information security analysts is expected to be very high as these analysts will be needed to come up with innovative solutions to prevent hackers from stealing critical information or creating havoc on computer networks.

Occupation	Employment growth, projected 2012–22 (percent)	Employment		Median annual wage, May 2013
		2012	Projected 2022	
Information security analysts ²	37%	75,100	102,500	\$88,590
Operations research analysts	27	73,200	92,700	74,630
Statisticians	27	27,600	34,900	79,290
Biomedical engineers	27	19,400	24,600	88,670
Actuaries ³	26	24,300	30,600	94,340
Petroleum engineers	26	38,500	48,400	132,320
Computer systems analysts	25	520,600	648,400	81,190
Software developers, applications	23	613,000	752,900	92,660
Mathematicians	23	3,500	4,300	102,440
Software developers, systems software	20	405,000	487,800	101,410
Computer user support specialists ⁴	20	547,700	658,500	46,620

Source: Occupational Outlook Quarterly (<http://www.bls.gov/careeroutlook/>), Spring 2014

According to *Cisco 2014 Annual Security Report*, currently there is a global shortage of over one million Cyber Security professionals, with the majority of the demand being located in developed economies including the U.S.

The City of Charlotte has reported in their letter of support for this program that *Burning Glass Technologies* research shows that North Carolina experienced 127% growth in Cyber Security job postings between 2010 and 2014, with Charlotte experiencing 147% growth in the same period. This outstrips the 91% growth rate cited for Cyber Security job postings nationwide.

A recent report entitled *Understanding the Changing Market for Professional Master’s Programs* from the Educational Advisory Board identified Cyber Security as one of three specialized areas that will have the fastest growth in master’s enrollments in the next decade.

Demand for UNC Charlotte graduates with Cyber Security training has been very strong. For example, we have trained and placed over 150 MS graduates with concentration in Cyber Security for federal, state and local government. In fact, the demand for Cyber Security skills is so great in the public sector, the federal government offers generous scholarships for students to study Cyber Security in return to work in the public section upon graduation. The Department of Software and Information Systems has had a Scholarship for Service program funded by the Federal government for over 10 years to attract more students to study in the area of Cyber Security (<http://sfs.uncc.edu/>).

5. List all other public and private institutions of higher education in North Carolina currently operating programs similar to the proposed new degree program, including their mode of delivery.

Currently no university in North Carolina offers a master's program specifically in Cyber Security and Privacy. There are Graduate Certificates and MS degrees that have a concentration in Cyber Security, but North Carolina is underserved in providing a master's degree that is specifically in Cyber Security. Given the regional economy's reliance on financial service and energy as critical infrastructure, the proposed program will fill this gap.

- a. Show a four-year history of enrollments and degrees awarded in similar programs offered at other UNC institutions (using the format below for each institution with a similar program); describe what was learned in consultation with each program regarding their experience with student demand and job placement. Indicate how their experiences influenced your enrollment projections.

Institution:

Program Title:

	(year)	(year)	(year)	(year)
Enrollment				
Degrees-awarded				

- b. Identify opportunities for collaboration with institutions offering related degrees and discuss what steps have been or will be taken to actively pursue those opportunities where appropriate and advantageous.

- c. Present evidence that establishment of this program would not create unnecessary program duplication.

6. Are there plans to offer all or a portion of this program to students off-campus or online?

Yes

If so,

- a. Briefly describe these plans, including sites and method(s) of delivering instruction.

A limited number of courses will be available online to complement the on-campus instruction course offerings. The program will be offered on the UNC Charlotte Main Campus with a plan to offer some courses at the Center City Building in the future.

- b. Indicate any similar programs being offered off-campus or online in North Carolina by other institutions (public or private).

No other institution in North Carolina is offering a similar program.

c. What is the estimated percentage of courses in the degree program that will be offered/available off-campus or online: 10-20%

d. Estimate the number of off-campus or online students that would be enrolled in the first and fourth years of the program:

First Year Full-Time 0 Part-Time 0

Fourth Year Full-Time 10 Part-Time 10

Note: If a degree program has not been approved by the Board of Governors, its approval for alternative, online, or distance delivery is conditioned upon BOG program approval. (400.1.1[R], page 3)

7. Estimate the total number of students that would be enrolled in the program during the first year of operation: *Full-Time 20 Part-Time 10*

Estimate the total number of students that would be enrolled in the program during the fourth year of operation: *Full-Time 80 Part-Time 20*

These numbers take into consideration that this is a two-year program and reflect the projected new and graduating student numbers. We estimate that 80% of the new students will enroll full-time based on our current enrollment demographics in graduate programs in the College of Computing and Informatics. We are also encouraging undergraduates to complete a master's degree with an early entry program which encourages students to enroll in the master's degree full time when they complete the Bachelor's degree (<http://graduateschool.uncc.edu/future-students/programs/early-entry-graduate-programs>).

8. Will the proposed program require development of any new courses: No

UNC Charlotte has been building education and research capabilities in Cyber Security over the past 15 years. We currently offer 12 graduate level courses (36 credit hours) related to Cyber Security. We expect to further improve and increase our course offerings over time, however, the proposed program does not require the development of new courses to get started. In response to demands from the proposed program and the interests of our industry partners, we expect more security courses will be offered each semester thus providing more electives for all graduate students at UNC Charlotte including those enrolled in the MSIT program.

9. Will any of the resources listed below be required to deliver this program? (If yes, please briefly explain in the space below each item, state the estimated new dollars required at steady state after four years, and state the source of the new funding and resources required.)

a. New Faculty: Yes

We plan to request one new faculty position in Cyber Security in the first year of the new MS and up to three new faculty over the first four years of the program, depending on program growth. These faculty will contribute to both the MS in Cyber Security and the expansion of the PhD program in Computing and Information Systems. Currently the Department has the following demographics in 2015:

- 16 tenure-track faculty and three non-tenure-track faculty
- Two administrative support positions
- 330 BA students
- 200+ MSIT students for Fall 2015

- 55 PhD students

The request for new faculty positions will be based on enrollment in the MS and expansion of our research capacity in Cyber Security. Additional faculty will ensure that our existing MSIT programs and this proposed new Master of Science in Cyber Security are delivered at the highest quality.

- | | | |
|----|--------------------------------------|-----|
| b. | Additional Library Resources: | No |
| c. | Additional Facilities and Equipment: | Yes |

One-time investment in establishing two Cyber Security laboratories, one in Network Security and the other in Malware Analysis, is requested. The amount needed is \$60,000 (\$30,000 for each laboratory), including support for equipment, networking and required software. The primary reasons for the request are as follows:

- A quality Cyber Security program must provide students with adequate opportunities for hands-on experience.
- Due to the nature of Cyber Security, most of the projects to be carried out students must be conducted in an isolated computing environment so that impact of accidents is controlled and confined.
- Currently the Department has only an infrastructure laboratory that is extensively used by undergraduate classes. It will be inadequate for cater for the needs of the proposed master's program.

- | | | |
|----|---|----|
| d. | Additional Other Program Support:
(for example, additional administrative staff, new master's program graduate student assistantships, etc.) | No |
|----|---|----|

10. Does the program require enrollment growth funding in order to be implemented and sustained? If so, can the campus implement and sustain the program should enrollment growth funding be unavailable? Letters of commitment should be provided.

Yes, enrollment growth funding will be required to support the additional faculty and facility needs. A letter of support from the Provost is attached.

Does the program require a tuition differential or program specific fee in order to be implemented and sustained?

Yes.

- | | |
|----|---|
| a. | If yes, state the amount of tuition differential or fee being considered, and give a brief justification. |
|----|---|

The tuition differential being considered is \$2000 per semester. The requested tuition differential will be used to maintain the high quality of the program, specifically for the following purposes:

New tuition dollars will be used to provide seminars and workshops, strengthen student recruitment, purchase specialized technology, and provide student financial assistance. The MS in Cyber Security program is estimated to enroll 20 full time and 10 part time students the first year of the program. Through aggressive recruitment efforts, it is expected that the student base will increase by 21-22 students in subsequent years. Based on this enrollment, the program will generate approximately

\$100,000 in the first year from the increment. In the first year, 25% of the total tuition increment will be allocated to graduate assistantships; 60% percent will support .5 FTE of an Assistant Professor (the CCI will provide 50% salary support for the Assistant Professorship in the first year of the program); 15% will be allocated for recruitment costs including printing costs. The subsequent years will be budgeted as follows:

Need Based Graduate Assistantships (25%):

A portion of the tuition funds will be used to increase the number of assistantships in CCI. These Graduate Assistantships and the financial support they provide are essential in attracting the best available graduate students to the program. Assistantships offer an invaluable opportunity for graduate assistants to work with renowned faculty and allow faculty members to better leverage their teaching and research efforts through these talented students. The plan is to focus on students with financial need in the Charlotte region and on U.S. domestic students, raising the percentage of U.S. students in our program. This support will also be used to increase the enrollment of underrepresented populations.

Assistant Professor (50%):

An assistant professor will be hired in the 1st year of the MS program who is specialized in the area of Cyber Security; specifically, this faculty member will teach in the area of malware analysis. In subsequent years, new faculty and lab coordinators will be requested to address areas of high enrollment and research potential.

Recruitment and Technology (25%)

Ongoing recruitment costs will be capped at \$10,000 each year. Recruitment costs include recruitment materials, campaigns, national travel to college fairs and industry engagements, supplies, and advertising costs. Starting in year three, salary support for a graduate program coordinator is budgeted to support recruitment efforts specific to the Cyber Security program.

Cyber Security is a technology-intensive field. Graduate students need a high level of technological interaction in the classroom. Hands on experience and realistic classroom exercises and simulations are required to provide students with the relevant exposure that potential employers are seeking. Standard network configurations, software, workstations and laptops are often inadequate for classroom assignments using the latest methods and larger scale data. High performance computing, software and data storage resources will need to be bolstered to support classroom instruction in order to prepare MS Cyber Security students for this type technology.

The remaining portion of the proposed tuition adjustment will be used to sponsor student learning enhancement in the form of seminars, workshops, and networking events with high-profile academic and industry leaders. The format of these events may include experts brought in to address particular courses

among other possible formats and will be designed to give students an opportunity to meet and learn from professionals in the Cyber Security arena. Additionally, these events will provide excellent opportunities for students to learn about job opportunities and to network with industry employers.

SUMMARY OF ESTIMATED ADDITIONAL COSTS FOR PROPOSED PROGRAM

INSTITUTION	<u>UNC Charlotte</u>
Degree(s) to be Granted	<u>M.S. Cyber Security</u>
Differential tuition requested per student per academic year	<u>\$4,000</u>

PROJECTED ENROLLMENT

	Year 1	Year 2	Year 3	Year 4
Projected Full Time Student (1.0 FTE)	20	40	60	80
Projected Part Time Students (0.5 FTE)	10	15	18	20
Projected annual FTE students	25	47.5	69	90
Projected annual differential tuition	\$ 100,000	\$ 190,000	\$ 276,000	\$360,000

PROPOSED BUDGET OF DIFFERENTIAL TUITION

	Year 1	Year 2	Year 3	Year 4
Need-Based Graduate Assistantships/ Scholarships	\$ 25,000	\$ 47,500	\$ 69,000	\$ 90,000
Full Time Teaching/Assistant Professor*	\$ 60,000	\$ 95,000	\$ 138,000	\$ 180,000
Recruitment	\$ 15,000	\$ 10,000	\$ 10,000	\$ 10,000
Program Workshops/Seminars	\$ -	\$ 10,000	\$ 15,000	\$ 15,000
Technology	\$ -	\$ 27,500	\$ 44,000	\$ 65,000
TOTAL ADDITIONAL COSTS	\$ 100,000	\$ 190,000	\$ 276,000	\$360,000

**.5 FTE in year 1; 1.0 FTE with 3% escalation in future years; \$95,000 salary base + fringe*

b. Can the campus implement and sustain the program if the tuition differential or program fee is not approved? Letters of commitment should be provided.

See attached letter from the Office of Academic Affairs.

12. For doctoral programs only:

a. Describe the research and scholarly infrastructure in place (including faculty) to support the proposed program.

b. Describe the method of financing the proposed new program (including extramural research funding and other sources) and indicate the extent to which additional state funding may be required.

c. State the number, amount, and source of proposed graduate student stipends and related tuition benefits that will be required to initiate the program.

13. List the names, titles, e-mail addresses and telephone numbers of the person(s) responsible for planning the proposed program.

- Dr. Mary Lou Maher, Chair, Department of Software and Information Systems, College of Computing and Informatics, M.Maher@uncc.edu, 704 687 6065

This request for authorization to plan a new program has been reviewed and approved by the appropriate campus committees and authorities.

Chancellor: _____ **Date:** _____



September 4, 2015

Yi Deng, Ph.D.
Dean and Professor
UNC Charlotte, College of Computing and Informatics
9201 University City Boulevard
Charlotte, North Carolina 28223

Dear Dr. Deng,

We in the City of Charlotte strongly support the proposed new Master of Science in Cybersecurity degree by the College of Computing and Informatics at UNC Charlotte, which will train advanced professionals in the area of cybersecurity and privacy. There is a rapidly expanding demand for such advanced cybersecurity professionals and a widening shortage of talent supply in this critical area both regionally and nationally. Burning Glass Technologies has researched that North Carolina experienced 127% growth in cybersecurity job postings between 2010 and 2014, with Charlotte experiencing 147% growth in the same time period. This far outstrips the 91% growth rate cited for cybersecurity job postings nationwide and clearly illustrates the need for a strong local source for cybersecurity talent.

The proposed new degree program will not only expand the much needed new talent supply for the region and beyond, but will also create opportunities for organizations like ours to upgrade the knowledge and skills of our employees in the fast changing area of information security. In the next few years, we expect to expand our cybersecurity team by 50% after having expanded at least 25% for the past two years consecutively. We look forward to working with UNC Charlotte to expand talent supply and training in this area critical to our industries and economy in the region and nationwide.

Best regards,

A handwritten signature in black ink that reads "Jeffrey W. Stovall". The signature is written in a cursive style.

Jeffrey W. Stovall
Chief Information Officer
Innovation & Technology Department
City of Charlotte, North Carolina



301 South Tryon Street
Charlotte, NC 28262

Mr. Yi Deng, Ph.D.
Dean and Professor
UNC Charlotte, College of Computing and Informatics

Dear Mr. Yi Deng,

"We strongly support the proposed new MS in Cybersecurity degree by the College of Computing and Informatics at UNC Charlotte, which will train advanced professionals in the area of cybersecurity and privacy. There is a rapidly expanding demand for such advanced cybersecurity professionals and widening shortage of talent supply in this critical area both regionally and nationally. This proposed new degree will not only expand the much needed new talent supply for the region and beyond, but also create opportunities for companies like ours to access top, current talent in the fast changing area of cybersecurity. We are investing substantial resources and expanding our team in the area of cybersecurity and expect that trend to continue in the coming years. We look forward to working with UNC Charlotte to expand talent supply and training in this area critical to our industry and economy in the region and in the nation."

Rich Baich

A handwritten signature in black ink, appearing to read "R Baich", written over a horizontal line.

Chief Information Security Officer
Corporate Risk

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rich.baich@wellsfargo.com