

PROPOSAL

Center for Excellence in Telecommunications and Space (CETS)

Submitted by Dr. Herbert Charles, Morehouse College

In Collaboration with Dr. Hans Kruse, Ohio University

Content

Executive Summary.....	3
Goal and Objectives.....	4
Program Plan.....	6
Evaluation Plan	9
Timeline.....	10
Line Item Budget	12
Budget Narrative.....	13
Certifications.....	14

Executive Summary

Morehouse College in collaboration with Ohio University proposes the formation of the Center of Excellence in Telecommunications and Space to address the need for a skilled workforce in the telecommunications and space communications industries. The Center will be based on the undergraduate telecommunications program at Morehouse College and a state-of-the-art laboratory, as well as the graduate programs in Computer Science and Communications Technology and Policy at Ohio University. We intend to not only improve the supply of professionals in the area of telecommunication and space communication, but we will also insure a strong minority participation in this profession by having the Center headquartered at Morehouse College. Starting in year two, the Center will extend the reach of these courses to other HBCUs as well. Morehouse College will develop distance learning programs with key collaborators such as Ohio University and NASA to educate future leaders with expertise in telecommunications technology, policy, and organizational management. We believe that the promise of learning about telecommunications and space through hands-on activities -- using a working satellite and real-world applications -- is so unique to a prospective student that the Center will be able to attract very high quality students and prepare them for the most challenging careers in this industry. Therefore, the technology lab at Morehouse College, a satellite ground station to be installed at Morehouse College, and the existing lab and satellite communications facilities at Ohio University are all key elements in the success of the Center. We will take advantage of commercial satellite capacity, the 10 years of data collected by NASA using the ACTS spacecraft, and the ACTS system itself to create a successful lab environment. Furthermore, faculty in the Center will engage both undergraduate and graduate students in active research in the "Space Internet", i.e. the use of internet protocols for communications between space assets (Space Station and Shuttle), and from space assets to the ground.

Goals and Objectives

The satellite industry in the United States is poised to deploy a number of space-based communications networks in the newly developed Ka frequency band. These new systems will be substantially different from the current generation of satellites both in their design and their intended use; these systems will use focused spot beams for broadband data communications world-wide. At the same time the industry is faced with supplying systems for increasingly complex NASA missions in near-earth and interplanetary exploration. As a result, there is a pressing need for professionals educated in the design, operation, and management of telecommunications and space systems using the most recent advances in satellite technology.

Morehouse College and Ohio University both house interdisciplinary degree programs in telecommunications. The program at Ohio University has been in existence for about 13 years; the program at Morehouse was modeled after the Ohio University program. The two schools have been collaborating on curriculum issues for the past 5 years. Ohio University has had operational control over the NASA ACTS spacecraft since 2001, using the spacecraft and the many years of archived ACTS telemetry data as a teaching laboratory, and as an R&D resource for the space communications industry.

The Center will accomplish three key goals:

1. Attract students into the science and technology field, and enhance the higher education capacity in the space communications field to fill future NASA and industry workforce needs.
To this end the Center will develop curriculum and programmatic elements that provide for classroom and hands-on learning in telecommunications, space systems, and satellite communications. Courses and hands-on activities will be conducted by Ohio University and Morehouse faculty and will be available, via distance delivery, to students at both institutions. The distance delivery model will be designed in such a way that delivery to other HBCUs will be possible in the future. Ohio University students will pursue Bachelor and Master degrees in Communication Systems Management or Computer Science. Morehouse College students will complete a Minor in telecommunications and will have the option of completing an engineering degree at Georgia Tech and/or a dual degree at Ohio University as part of the proposed program.
2. Utilize leading-edge communications resources, and in particular capabilities unique to NASA, to create unique teaching tools and environments.
To this end the Center will create and maintain the infrastructure needed to provide hands-on education, a research platform, and the means to conduct distance delivery of the educational content for the Center. Initially, ACTS, and the ACTS telemetry data archive, will form the basis for teaching and research activities. Other partnerships with industry and government agencies are being developed to insure the continuity of the program. In keeping with the mission of the Center, the distance delivery infrastructure will rely on leading-edge

- commercial satellite services, and NASA resources to create both unique content and a unique learning environment.
3. Enhance the educational mission of the Center, and the quality of its graduates, by fostering a vibrant research environment in all aspects of space communications, involving faculty and graduate as well as undergraduate students.
To this end, the Center will provide systematic grant preparation assistance for faculty and students pursuing government or commercial research funding, and access to the Center's lab facilities for research use.

Program Plan

CETS is a joint activity between Morehouse College and Ohio University. CETS will be headquartered at Morehouse College; the director of CETS will be selected by Morehouse College.

In addition to its Headquarters at Morehouse College, CETS will have an Office at Ohio University, headed by an Associate Director. The Associate Director is selected by the McClure School of Communication Systems Management and the School of Electrical Engineering and Computer Science at Ohio University, in consultation with the CETS Director.

CETS will focus on four areas of activity: operation of the ACTS Spacecraft and satellite communication networks based on commercial satellite services, research in the area of Space Communications, curriculum development in Telecommunication, Space Communication, and spacecraft operation, and outreach to HBCUs as well as secondary schools, including the creation of a model telecommunications curriculum for potential implementation at other HBCUs.

Spacecraft and Satellite Network Operations

CETS will have use of the ACTS spacecraft and the archived ACTS telemetry data for use in its educational, outreach, and research activities. Through partnerships with the other members of the Ohio Consortium for Advanced Communications Technology (OCACT), CETS will have access to a wide range of telecommunications and satellite communications projects and activities in which its students and faculty can participate. Ohio University is the Managing Member of OCACT, and Morehouse College will become a voting member of OCACT under this proposal.

While ACTS is active, CETS will assume responsibility for the management of ACTS operations through its Ohio University office. At the same time CETS will deploy commercial satellite communication systems for its use, and participate in the deployment of satellite networks that are being designed (and funded) by other OCACT members.

Research

Faculty members at both Morehouse College and Ohio University currently have active research agendas in telecommunications and space topics. CETS will add additional faculty at Morehouse college to further strengthen this presence.

Not only will CETS faculty have access to the ACTS spacecraft as long as it is operational, but researchers will also be able to work with over 10 years of archived telemetry data from ACTS. Several promising avenues of research have already been identified, and will be pursued as soon as staffing permits:

- **Magnetic field events in the vicinity of ACTS:** Since ACTS uses magnetic torquers for yaw and roll control, properties of the magnetic field at the orbital location of ACTS can be deduced and correlated with other know data regarding the earth's magnetic field.

- Radiation effects on Ka band hardware: ACTS carries many types of circuits that have not been used previously in a communications satellite. Even the primary commanding and telemetry functions are carried out via the Ka band. The performance of these system under various solar wind conditions can be studied.
- Communications experiments, mainly involving TCP/IP protocols, continue over ACTS. The goal of developing cost effective hardware and software to utilize the bandwidth promised by the Ka band will require further research.

Curriculum Development and Implementation

CETS aims to provide a comprehensive curriculum in space communications to its students. In the curriculum development, the principles of accessibility and portability will be emphasized.

Accessibility means that the components of the curriculum are available to all students in the Center regardless of their physical location. A course taught at any of the Center locations (Morehouse College, Ohio University, or future members) can be taken for credit by any student associated with an institution participating in the Center.

Portability means that, once developed, all or some of the curriculum can be offered at any institution that has the right skill sets among its faculty members. In this way, other institutions can expand their course offerings into this area without incurring extensive delays or costs. We plan to utilize this concept to readily offer a space communications curriculum at other HBCUs.

Ohio University already has some courses that fit into the general subject area covered by the Center. Morehouse College will bring additional faculty into its Telecommunications program to facilitate the curriculum expansion there, and to design accessibility and portability into both existing and new courses. This activity will include Ohio University courses and will be carried out in close cooperation with Ohio University faculty. In addition, Morehouse College and Ohio University faculty will jointly design lab facilities needed for this curriculum, and cooperate in the implementation of the labs.

We anticipate that during the first year, courses will be taught locally at each institution to facilitate the curriculum development process; classes at both institutions will cooperatively carry out lab exercises. Joint classes will begin in year 2.

As part of the curriculum development process, we will begin to utilize the vast telemetry database collected during the operation of the ACTS program. Use of this database will expand and improve the range of topics we can cover with hands-on experiences, while preparing the curriculum for the time when ACTS will no longer be available. The lab and course design will also include commercial alternatives to ACTS for hands-on exercises with satellite communications equipment, again preparing the curriculum for the time after ACTS, while taking maximum advantage of the ACTS Spacecraft while it is available.

Outreach

We will conduct outreach activities at both secondary and post-secondary educational sites, with an emphasis on schools, colleges, and universities that serve minority populations.

As stated above, we intend to extend the reach of the Center to other HBCUs over the next few years. As an initial step we will identify interested faculty and departments at HBCUs and plan one-time events that expose students to the technology and potential of space communications, as well as engineering, math, and science topics that relate in some form to telecommunications and space issues.. These one-time events will then be followed by more regular engagements and potentially joint curriculum development if the visited institution expresses an interest in that level of interaction.

At the secondary education level, the outreach activities will be much broader. We will again conduct events centered around telecommunications, space, math, science, and engineering. However, the potential of a mobile communications facility goes beyond this direct involvement in space communications into the natural sciences, the humanities and the arts. We will explore ways to use communications to bring virtual art exhibits or performances to schools, to have multiple schools cooperate in art project and cross-cultural exchanges, and to have students explore remote areas of the world through remote interaction with scientists in the field.

A range of activities compatible with these goals have already been proposed for prototyping over ACTS, and some are in the process of setting up funding. Through synergy with these projects we are confident that we can conduct a number of the outreach activities described above within the existing funding for CETS. If successful, additional funding will be pursued by CETS from appropriate agencies or foundations.

Evaluation Plan

The Center will submit progress reports to NASA on Nov 1, 2003; Feb 1, 2004; May 1, 2004; and Aug 1, 2004. The Aug 1, 2004 report will review the 1st year of Center operation. As we anticipate this project to be carried out over three years, a final report will be submitted on Aug 1, 2006.

In addition to reporting the status of the activities described in this proposal, we will develop data which can appropriately track the success of this project as measured against its key objectives stated earlier. While the development of the precise measurements and measurement instruments is part of the work to be performed, we will certainly track the following:

1. Completion of the telecommunications laboratory facilities.
2. Satellite ground station deployment.
3. The number of students taking courses in the Center curriculum, and the number of graduates who pursue careers in the space communications industry and within NASA.
4. Number and type of outreach activities.
5. Evaluations collected from participants in outreach and distance learning activities.
6. Grant proposals developed by Center faculty, levels of funding, and publications submitted by Center faculty and students.

Timeline

July 1, 2003 – September 30, 2003:

- Hire faculty members at Morehouse College
- Hire an administrative assistant for the Center
- Complete lab installation at Morehouse College
- Deploy satellite communications capabilities at Morehouse and Ohio University, and incorporate sites operated by other OCACT members as appropriate.
- Identify two Ohio University graduate students to work for the Center
- Identify two Morehouse College undergraduate students to work for the Center

October 1, 2003 – December 31, 2003

- Develop the technical means of accessing the ACTS telemetry database collected by the NASA Glenn Research Center, and develop guidelines for database access by US researchers.
- Identify 2-4 research projects based on the areas identified above, and create faculty/student teams to begin work on these projects.
- Identify one or more HBCU and several secondary schools as partners for outreach events.
- Develop a space communications seminar suitable for integration into the Morehouse and Ohio University curricula.
- Develop a series of laboratory experiments in space communications, using the infrastructure created earlier, that will be jointly carried out by Morehouse and Ohio University students.
- Develop evaluation plan and finalize longitudinal data to be collected.

January 1, 2004 – March 31, 2004

- Continue research activities
- Plan outreach events
- Begin comprehensive curriculum development for year 2 of operation
- Finalize the seminar and lab exercise preparations.
- Students at Morehouse College and Ohio University jointly carry out the first series of joint lab exercises.

April 1, 2004 – June 30, 2004

- Teach the space communications seminar both at Morehouse College and at Ohio University. The two classes will interact over the satellite communications infrastructure maintained by the Center.
- Students at Morehouse College and Ohio University jointly carry out the second series of lab exercises.

- Conduct outreach events for at least one HBCU and several secondary schools.
- Continue curriculum development.
- Continue research activities.
- Present the Program Review and the 2nd year plan to NASA.

Budget

Budget Item		Direct Cost	Indirect Cost	Total
No.	Description			
1	2 full-time faculty	\$ 191,000	\$ 92,635	\$ 283,635
2	Administrative and Technical support time	\$ 80,500	\$ 39,043	\$ 119,543
3	Travel	\$ 40,000	\$ -	\$ 40,000
4	Equipment, Supplies, and Labor	\$ 60,000	\$ 29,100	\$ 89,100
5	Telecommunication Lab Equipment	\$ 75,000	\$ -	\$ 75,000
6	Installation and recurring communication service charges	\$ 30,000	\$ 14,550	\$ 44,550
7	Scholarships	\$ 40,000	\$ -	\$ 40,000
8	<i>Ohio University</i>			
9	Equipment repairs	\$ 33,800	\$ 15,210	\$ 49,010
10	Travel	\$ 5,000	\$ 2,250	\$ 7,250
11	Faculty Time	\$ 30,250	\$ 13,613	\$ 43,863
12	2 Graduate Students	\$ 29,500	\$ 13,275	\$ 42,775
13	Spacecraft operations consulting services	\$ 22,000	\$ 9,900	\$ 31,900
14	OCACT membership	\$ 19,841	\$ 5,159	\$ 25,000
	Total	\$ 656,891	\$ 234,734	\$ 891,625

Every effort has been made to maintain the line items originally proposed to the US Congress. Small adjustments have been made to account for the 1% withholding at NASA HQ. Morehouse College and Ohio University use different indirect cost rates, the Morehouse College rate of 48.5% has been applied to items 1 through 7 (indirect costs do not apply to equipment, travel, or scholarships); the Ohio University rate of 45% has been applied to items 9-13, and the Ohio University off-campus rate of 26% has been applied to item 14.

Budget Narrative

1. Salary and Benefits for two faculty to be hired at Morehouse College.
2. Salary and Benefits for an Administrative Assistant and hourly charges for technical services.
3. Travel expenses for faculty and students involved in outreach activities.
4. Expenses directly related to the installation and maintenance of a satellite ground station at Morehouse College, including the purchase of ground station and communications equipment.
5. Purchase of teleconferencing equipment for use in the laboratory and with the satellite ground station.
6. One-time and recurring charges for terrestrial and satellite communications services to be used for distance education delivery.
7. Scholarships for minority students attending Morehouse College
8. Items 8-13 are expenses that will be incurred at Ohio University
9. Hourly wages, supplies and small equipment to be used in repairs and modifications of ground station equipment.
10. Travel for Ohio University personnel to Atlanta and to outreach events.
11. 3 months of faculty summer support at Ohio University
12. Stipends for 2 graduate students (full-time) at Ohio University, for the project year.
13. Consulting services for spacecraft operations specialists. These services will be needed when either curriculum design or spacecraft operations issues require specialized operational knowledge not resident at either Ohio University or Morehouse College.
14. Membership fee to establish Morehouse College as a voting member of OCACT.

Certifications

Certifications are not required for the draft submission.