



Award Specific Terms and Conditions for the EEC-0812072 / 1159203, “NSF Engineering Research Center for Integrated Access Networks (CIAN)”, University of Arizona Cooperative Agreement

The terms and conditions stated herein are the minimum but not sufficient requirements to fulfill the responsibilities to achieve the goals expected under ERC solicitation NSF 07-521. All referenced documents including websites are made a part of this Cooperative Agreement. The absence of a compelling strategy for achieving demonstrable impact in and of the key features of a Gen-3 ERC incorporated in this agreement and described in full details in NSF 07-521 is sufficient reason to deny continued funding.

The following includes revisions to the generic ERC terms and conditions that impact all ERCs since NSF 07-521 was issued.

1. Project Description:

The ERC will develop the fundamental knowledge and technology and the academic and industrial partnerships needed to bridge the access aggregation bottleneck that is steadily increasing between the development of long-haul core networks and local access optical networks to enable delivery of network services more broadly in society.

Education, research, and knowledge transfer will be integrated through the ERC's team-based multidisciplinary environment.

2. Project Governance and Governing Responsibilities:

The Awardee will ensure that an efficient and effective project governing structure is in place throughout the award period to support all critical significant project activities. The awardee will also ensure efficient and effective performance of all project responsibilities by the governing components throughout the award period.

3. Key Personnel:

The following positions are considered Key Personnel and are essential to the work of this ERC. Any contemplated changes in Key Personnel for these positions should be discussed with the NSF Program Officer. Written approval from the NSF Program Officer must be secured before any change is implemented. Any anticipated change in the people serving as the Center Director or the Deputy Director to be effective within the

next performance year must be disclosed in the ERC's annual report, and a succession plan must be provided in the report.

Center Director - Nasser Peyghambarian (UA)
Deputy Director - Yeshiahu (Shaya) Fainman (UCSD)
Administrative Director – Alan Kost (UA)
University Education Director – Kimberly Sierra-Cajas (UA)
Pre-College Education Director - Supapan Seraphin (UA)
Industrial Collaboration and Innovation Director – Daniel Carothers (UA)
Diversity Directors - Frances Williams (NSU)

In the case of the departure of the Center Director, the lead university and the affected university, in consultation with NSF, will find a replacement suitable to NSF. Before a change is implemented within the lead university, written approval from the NSF Program Officer must be secured. In the case of the departure of (a) the Center Director from the lead university, or (b) one of the PIs from a core partner university, and NSF does not find the person or persons recommended by the Center to be suitable, the Foundation reserves the right to recommend termination of the ERC or the core partner's affiliation with the ERC.

4. Lead and Core Partner Universities:

The Engineering Research Center for Integrated Access Networks (CIAN) is configured as follows: University of Arizona (UA) is the lead university in the ERC, and the University of California-San Diego (UCSD), the University of Southern California (USC), the California Institute of Technology (CalTech), Stanford University (SU), Columbia University (CU), the University of California-Berkeley (UCB), the University of California-Los Angeles (UCLA), Norfolk State University (NSU), and Tuskegee University (TU) are core partner universities. In the case of inadequate performance at the lead university or at one or more of the core partner universities, the Foundation reserves the right to recommend termination of, respectively, the ERC or one or more of the inadequately performing core partners.

5. Requirements for the Implementation of the Key Features (Revisions Since the Release of the ERC Solicitation:

a. Strategic Research Planning and the Research Program:

- (1) Support for the Research Experiences for Undergraduates Program (REU) program, at a minimum of \$42K per year, will be provided using ERC base budget funds. The ERC may seek an REU site award under the REU Program Solicitation to augment these funds. The ERC also may augment base REU Program support through a combination of REU supplemental awards to individual ERC faculty as long as those students have an interdisciplinary ERC experience with exposure to industry.

- (2) U.S. Student Involvement at Foreign University Partners: If there is a large number of U.S. ERC students who work in the foreign partner university(ies)' laboratories resulting in a large accrual of materials costs, the ERC may provide a subaward to that foreign partner to cover those costs.

b. University Education:

The ERC's university education program will function with a governing hypothesis of how to develop creative, innovative, and globally competitive engineers, will implement a set of activities and experiences designed to impart those characteristics to students, and will assess the impact of the program in achieving the desired characteristics in the impacted students.

c. Pre-college Education Program:

Support for the Research Experiences for Teachers (RET) Program, at a minimum of \$42K per year, will be provided using ERC base budget funds. The ERC may seek an RET site award under the Program Solicitation to augment these funds. The ERC also may augment base RET Program support through a combination of RET supplemental awards to individual ERC faculty as long as those teachers work in ERC laboratories and have an interdisciplinary ERC experience. A short-term workshop designed only to inform pre-college teachers about engineering concepts may also be carried out but not in lieu of the required RET program.

d. ERC Innovation Ecosystem:

- (1) The ERC's industrial/practitioner partnership program will be governed by an ERC-wide membership agreement, including a uniform IP policy for ERC-generated IP at the lead and each of the ERC's partner universities. The membership agreement defines the scope and function of the ERC's partnership with industry/practitioner organizations, the types of membership such as full, affiliate, contributing, etc, the respective membership fees, and the ERC's Intellectual Property (IP) policy. The ERC has developed an IP policy that facilitates the roles of industrial partners in Gen-3 ERCs and is flexible in recognizing IP jointly developed by faculty in different universities or that developed by joint industry and university research.
- (2) Foreign firms may be members of the ERC as long as they participate in accordance with the same membership agreement as U.S. firms do. Domestic and foreign member firms/practitioner organizations will contribute financially to the ERC and will have first rights of refusal for ERC-generated Intellectual property (IP),

- according to the terms of the agreement.
- (3) The ERC will function with an Industrial Advisory Board (IAB) involving all of its Industry/practitioner members. The IAB will meet at least twice a year, carry out an annual analysis of the ERC's strengths, weaknesses, opportunities and threats to survival (a SWOT analysis), and participate in the annual NSF review of the ERC's performance and plans. During the meeting with the NSF site visit team, the Chair of the IAB will present the IAB's SWOT analysis to the review team and discuss the findings. The SWOT will be updated annually and progress of the ERC in addressing the SWOT will be discussed with the NSF site visit team as well. The Chair and the IAB members also will discuss the annual SWOT analysis with the ERC Director and the ERC Leadership team to determine appropriate future strategies to deal with the weaknesses and threats.
 - (4) Industrial consortia may join the ERC, but benefits of membership do not accrue to firms that are consortia members, unless they are also paying membership fees to the ERC as members separate from the consortia
 - (5) Throughout the course of the ERC's funding by NSF, the Center shall continue to develop and refine its technology transfer and innovation strategy and its Intellectual Property policy, the latter in accordance with NSF's Intellectual Property guidelines (NSF Award and Administration Guide, Chapter VI.D., "Intellectual Property") and the Awardee's policies.
 - (6) Industrial membership fees are treated as Program Income, and must be allocated for use for Center purposes. Industrial membership fees that are not expended in the year in which they are received must be placed in a Center account and reported to NSF and industry as 'unexpended funds' that are held in reserve for future use. Progress reports on the expenditure of these funds should be included in the Center's annual report and reported to IAB during the IAB meetings. Industrial members may provide additional support for activities such as sponsored research projects, equipment donations, intellectual property donations, or educational grants.
 - (7) Costs for organizing meetings with industry members will be borne by the ERC or the participants through a registration fee, as deemed appropriate. Costs for attending these meetings by industry members will be borne by their organizations.
 - (8) All ERCs will have member firms engaged in translational research through sponsored projects, and small firms carrying out translational research supported by funds from the ERC Program's Translational Research Fund or other non-ERC, non-member, non-university sources for ERC-generated Intellectual Property (IP) that member firms do not license.

- (9) In addition, the ERC will develop and nurture the innovation ecosystem for the purposes of accelerating the translation of knowledge into innovation, by:
- (i) Stimulating member firms to support sponsored projects for the purposes of translating ERC-generated IP to commercialization,
 - (ii) Forming collaborations with small firms for the purpose of translating ERC-generated IP to the marketplace, if member firms do not license the IP - (This should be done via licensing IP, knowledge transfer to the firm, and/or securing translational research funds to accelerate commercialization of the technology by the small business in partnership with the ERC. Translational research funds could be secured from the ERC Translational Research Fund and/or from funding from other non-ERC/non-member/non-university sources);
 - (iii) Building partnerships with federal, state, or local government programs designed to develop entrepreneurs, support start-up firms, and otherwise speed the translation of ERC-generated knowledge and technology into practice and products; and
 - (iv) Leveraging technology commercialization opportunities offered by the federal Small Business Innovation Research (SBIR)/Small Business Technology Transfer Research (STTR) programs. The ERC will include analyses to determine the most effective methodologies to use to achieve these innovation goals through these types of partnerships.
 - (v) In reference to 9(ii) above, ERCs will classify their IP generated from research under the scope of the ERC's strategic plan as core IP (IP resulting from center-controlled unrestricted funds) and Project IP (IP resulting from restricted funds that flow through the center or flow directly to a PI). For Core IP and Project IP, the member firms/practitioner organizations or the sponsoring firm/practitioner organization, respectively, will be offered the first option to negotiate a license. If there is no license forthcoming in either case, the IP can be offered to a non-member small firm and a partnership formed between that firm and ERC faculty to carry out translational research to accelerate product development. Support for a translational research project to accelerate product development can be sought from NSF through the ERC Translational Research Fund; in that case, the small firm would be the submitting organization, with a subaward to the ERC faculty. In

addition, in that case, the university must screen the project for ERC faculty, Industrial Liaison Officers (ILO) and/or ERC Executive Management personnel conflicts of interest. When conflicts are disclosed for any of the above three categories of personnel, the university impacted must develop a conflict management plan for each disclosure.

(vi) In the case of a conflict, there will be a conflict of interest management plan. Progress and impacts of the project would be reported in the ERC's annual report. Because NSF would support such a project as an associated project outside the center's core funds, any additional IP developed from that project would not revert to the university or member firms.

- e. Student Leadership Council. The SLC is responsible for organizing student activities to achieve the ERC's goals for research and education. The SLC will be comprised of undergraduate and graduate students and will have a Chair and a Co-Chair. The Chair will serve as a member of the ERC's Leadership Team. The SLC also is responsible for carrying out a SWOT analysis of the ERC and communicating the results to the ERC Director, the ERC's leadership team, and the NSF site visit team.

6. Programmatic Activity Requirements:

- a. Joint NSF-Awardee Activities:

The ERC will participate in evaluation and other types of studies of the ERC Program initiated by NSF. Such studies include but are not limited to the outcomes and impacts of the ERC Program. The ERC will also participate in workshops organized by NSF to study various issues common to the system of centers. Costs for attending these meetings must be included in the budget submitted to NSF.

- b. Electronic Access: The Awardee shall establish and maintain an electronic access capability via the Internet to transfer the quantitative and qualitative data to an NSF database. The access to this electronic information will be protected and only NSF will have and grant access. The Center will establish a WWW "Home Page" containing some elements with public access to make available any information about the Center's goals, activities, and accomplishments. The Center will develop and use an identifying logo that is consistent with the Awardee's policies and procedures and approved by the Awardee as a graphic identity to be used on brochures, newsletters, on the Center's WWW "Home Page," etc.

7. NSF Ongoing Project Oversight:

The Awardee will ensure full commitment and cooperation among the governing structure components, and all project staff during ongoing NSF project management and oversight activities. The awardee will ensure availability of all key institutional partners during any desk or on-site review as well as timely access to all project documentation. As a minimum requirement, the Center Director will meet annually at NSF with the NSF ERC Program Officer assigned to the ERC for oversight to discuss progress and other issues. The timing of the visit is to be determined by mutual agreement between the Center Director and ERC Program Officer.

- a. Annual Review: NSF will carry out annual site visits to review the progress and plans of the Center. Renewal reviews will be carried out in years three and six. Based on the performance of the ERC, and in consultation with the ERC Director, the NSF Program Officer may determine that an annual site review is not necessary. In that case, the Center Director and a team of key individuals may visit NSF to update the NSF Program Officer and other NSF staff on progress and plans of the Center. For the purpose of the annual review, site visits will be conducted a minimum of six weeks prior to the anniversary date of the award to review performance and to provide advice to the ERC. The level of continued NSF support will be negotiated with the Awardee annually and will depend upon a review of progress through the annual site review or other means, the performance metrics, the industrial support level, and the Program Officer's assessment of progress, and the availability of funds for the program.
- b. Renewal Proposal Review: If a renewal proposal is submitted during the sixth year of the Center's operation, the ERC will be evaluated in the manner described above to determine whether NSF will continue to support full ERC operations or provide decreased funding to phase out NSF support of the ERC over Years 7 and 8 of the Center's operation. If NSF decides to continue full ERC operations, a new level of funding support will be negotiated for years 7 and 8 and two years will be added to the agreement to extend it through year 10. If the Awardee chooses not to submit a renewal proposal, NSF support to the ERC will be phased down over the two-year period covering Years 7 and 8 of the Center's operation.
- c. NSF will specify the format of the progress report/renewal proposal, the review process, and review criteria approximately six months before the date agreed upon for submission.
- d. Termination of the Cooperative Agreement. NSF's agreement with a Center might be terminated as a result of an annual review indicating insufficient progress in organizing the ERC to achieve its vision, or not addressing one or more key features of the Center. In the case of termination, NSF support to the Center will be phased down over the one

or two years following notice of termination by NSF.

- e. NSF may carry out a summative site visit at the end of the 10th year of support to determine the long-term value added by the ERC.
- f. After the end of the Cooperative Agreement with NSF, NSF expects the ERC to continue in a self-sufficient mode, maintaining the ERC culture with support from funds outside the ERC Program. Under no circumstances will the ERC receive ERC Program support to continue its full center operations after the Cooperative Agreement expires, although it may receive ERC Program support through subawards from other ERCs or through special purpose awards designed to capitalize on past ERC Program investments.

8. Reporting Requirements:

Awardee will provide *ad hoc* and regular reports as designated by the NSF cognizant Program Official, with content, format, and submission time line established by the NSF cognizant Program Official. The Awardee will submit all required reports via FastLane using the appropriate reporting category; for any type of report not specifically mentioned in FastLane, the Awardee will use the "Interim Reporting" function to submit reports.

- a. Annual Report:

The Awardee shall submit an Annual Report which will contain specific information including, but not limited to, the following: the progress and plans of the ERC in all areas in achieving its vision with supporting data developed from the data submitted to the ERC Program's data base of indicators of progress and impact, information on revenues and expenditures, and proposed budgets. The annual report should also include plans, quantitative information on performance and the ERC's impact on diversity. The annual report is due at least five weeks prior to the annual site visit and at least 11 weeks prior to the anniversary date of the award. The annual report must be prepared according to the online document "Guidelines for Preparing ERC Annual Reports and Renewal Proposals," which is available at: <https://www.erc-reports.org>

- b. Data Tables:

NSF maintains a database, ERCWeb, to collect and report quantitative and qualitative data for all of the ERCs. Each center is required to enter data into the database annually as instructed the "Guidelines for Preparing ERC Annual Reports and Renewal Proposals" and the "Guidelines for ERCWeb Data Entry." Both documents can be found at the website <https://www.erc-reports.org>. Many of the data tables required in the

Annual Report are produced from the data submitted to the ERC database. The Center will print these tables directly from the database website and use them in their respective Annual Reports. Details, data collection requirements and procedures for entering data are available in the “Guidelines for ERCWeb Data Entry” document.

c. Renewal Proposal.

In lieu of the sixth-year annual report, the Awardee may submit a renewal proposal that contains a cumulative progress report covering the period from the beginning of the fourth year to the date of submission of the renewal proposal, a request for support for years seven through ten, and plans for center activities during that last four-year period of this Cooperative Agreement. The progress report/renewal proposal is due at NSF by a date agreed upon between NSF and the Awardee. If the Awardee chooses not to submit a renewal proposal, NSF support to the Center will be phased down over the two years remaining in the period of support provided by this Cooperative Agreement.

d. Summative Report. If NSF decides to carry out a summative review of the long-term impact of the ERC, a summative preliminary final report covering the period from the beginning of the Center to the anniversary date shall be submitted to NSF at least five weeks prior to the final 10th year summative site visit. More details are available at <https://www.erc-reports.org> on the “ERC Library” link.

e. Final Report: A final report prepared according to guidelines provided by the ERC will be due within 90 days of the expiration date of this Cooperative Agreement. Guidelines for the ERC final report are available on the following site: <https://www.erc-reports.org> on the “ERC Library” link.

In addition, to assist NSF in evaluating the ERC programs, the Center Director must also respond to the request for information about project outcomes following the end of the award period. These include the project's impact on workforce needs, awards and other measures of the quality of the project's products, including project technology transfer results not reported in prior years, but due to the ERC investment of prior years. NSF will provide guidelines for the collection and reporting of data and project information.

9. Diversity Strategic Planning:

The leadership, faculty, and students involved in an ERC shall be diverse in gender, race, ethnicity and persons with disabilities at levels that are benchmarked against the academic engineering-wide national averages. The faculty and staff of the ERC and the administrations of lead and partner universities receiving NSF funding shall devote the

time and effort required to ensure that the diversity of the Centers' leadership teams, faculty, and students at all levels serves as a model for diversity within each institution and for the nation as a whole. The ERC will prepare and execute diversity strategic plans in collaboration with the home departments of the ERC-affiliated faculty. These plans shall articulate the ERC's diversity goals and intended actions but need not specify quantitative targets. The ERC also will be multicultural through the involvement of faculty and students from other countries by virtue of their role as faculty or students in the ERC's institutions and, through the involvement of faculty and students from the foreign partner universities. The involvement of foreign faculty and students also is expected to be diverse, representing a broad spectrum of cultures and countries. In fulfilling its obligations under the agreement and in compliance with the requirements of federal law, no university receiving federal funds will employ quotas or set-asides based on race.

Each ERC will:

- a. Demonstrate the existence of a partnership among the affiliated Deans of Engineering, other Deans, and the chairs of departments of the affiliated ERC faculty to increase the diversity of the Center's leadership team, faculty, undergraduate and graduate students, and graduates over the duration of NSF's support.
- b. Include as the lead or one of the domestic partner universities a university that serves large numbers of students predominantly underrepresented in engineering in the U.S. (i.e. women, African Americans, Pacific Islanders, Native Americans, Hispanic Americans, or persons with disabilities). The ERC may also develop non-core partner outreach connections with the same types of institutions.
Develop and strengthen long-term core or outreach partnerships with predominantly female, African-American, Native-American, and Hispanic-American serving institutions and/or institutions serving large number of these underrepresented students who are majoring in engineering and science programs.
- c. The ERC may also, but is not required to, develop outreach connections with NSF programs focused specifically on increasing diversity of engineering students and faculty through the involvement of women, underrepresented racial minorities, and Hispanic-American students. This may include connections with one of the NSF's Louis Stokes Alliance for Minority Participation (LSAMP), and/or with one or more of the NSF-sponsored awardees focused on diversity such as the NSF Alliances for Graduate Education and the Professoriate (AGEP), Colleges and Universities that serve predominantly Native American Populations, and other ongoing NSF programs serving underrepresented groups.

- d. Focus the Research Experiences for Undergraduates (REU) and Research Experiences for Teachers (RET) programs on increasing diversity.

10. ERC Key Features:

- a. Vision of the ERC:

The CIAN vision is to create transformative technologies for optical access networks where virtually any application can be seamlessly and efficiently aggregated and interfaced with existing and future long-haul core networks in a cost effective manner. This research will enable affordable and highly flexible access to any type of services, including delivery of single user data rates approaching 10 Gigabits/sec, to a broad population base anywhere and at anytime.

- b. ERC's Strategic Goals:

The CIAN ERC will use the ERC Program's 3-plane strategic planning chart to display its strategic goals and the integration of its research program, accompanied by a milestone chart depicting the major deliverables through time and their interdependencies.

CIAN's strategic goals are in conducting transformative fundamental and systems-level research that will: (i) transform expensive discrete components based subsystems into flexible cost-effective integrated optoelectronic subsystems to achieve scalable and affordable high data rate access networks that are transparent to the core; and (ii) demonstrate flexible network functionalities that provide transparency and scalability by moving services from the higher layers of the network closer to the physical layer.

The driving force for the ERC is the development of an intelligent network that seamlessly adapts to the growing needs and diverse services of the internet, thereby contributing to the economy and society as a whole.

- c. ERC's Research Goals:

Thrust 1 - Optical Communication Systems and Networks: Thrust 1 will demonstrate novel transformative network functionalities and infrastructure using cost-effective integrated subsystems. It will act as the top-down driver for new paradigms in subsystem integration and device performance under Thrusts 2 and 3 to realize a robust, secure and dynamically reconfigurable physical layer for developing the envisioned network platform. It includes exploratory fundamental research on network approaches that can extract significant performance gains by

exploiting innovative physical layer devices, subsystems, and systems.

Thrust 2 - Subsystem Integration and Silicon Nanophotonics: Thrust 2 will develop compact subsystems to explore the fundamental underlying signal conditioning, processing, reconfiguration, and control functions realized with various platforms, including CMOS compatible nanostructures and silicon nanophotonics. It will address optoelectronics packaging issues, and explore monolithic and heterogeneous integration schemes that will allow construction of optical sources on the chip or will require efficient integration with off-the-chip sources. It will also explore quantum phenomena concepts enabled by novel nanophotonic sources and switches that offer the potential for transformative means of transmitting secure information.

Thrust 3 - Materials and Devices: Thrust 3 will be the scientific and technological foundation for the ERC by conducting fundamental research on optical materials, devices, processing, and integration technologies for chip-scale integrated optoelectronics. It will investigate flexible switching technologies requiring wavelength conversion, amplification, and all-optical buffers. It will also seek to develop tunable and switchable optical channels needed to support research on dynamically reconfigurable heterogeneous traffic in the network.

As CIAN progresses, the platforms evolve to incorporate more innovative technologies. In addition the CIAN ERC team works closely with the NSF *Global Environment for Network Innovations (GENI)* and other networking efforts to leverage architectural drivers for the device and integrated subsystems requirements, as well as to provide a platform for performing architectural experimentations that directly well as to provide a platform for performing architectural experimentations that directly exploit advances in the underlying optical technologies.

d. University Education Program:

CIAN's operational educational hypothesis to create innovative and adaptive engineers by engagement in diverse learning and leadership experiences in CIAN's multi-institutional, inter-disciplinary research environment, and in interactions with industry. In addition, CIAN will: (i) educate a skilled and diverse workforce to lead the next-generation telecommunications industry; (ii) create vertically integrated (pre-college to post-graduate) curricula which are research-inspired and industry-oriented; (iii) integrate fundamental science, applied engineering, and basic business education to stimulate innovative development; and (iv) emphasize diversity in all phases of the program and the inclusion of women and under-represented minorities at all levels, and promote education to K-12 students, teachers, the broader community, and the

general public.

CIAN will develop advanced interdisciplinary courses using hyperlinked modules that allow students from different disciplines and education levels - spanning from middle school to graduate - to access them in a self-teaching mode. CIAN will also assist in developing optics-related associate-degree programs at Pima Community College in Tucson, and B.S. and M.S. degree programs at Norfolk State University and Tuskegee University.

e. Pre-college Education Program:

CIAN will expand the existing UA Research Experience for Teachers program (ROKET) involving graduate K-12 fellows working with middle and high school science teachers in Tucson area school districts and add a Teachers-in-Residence program to help the ERC in developing, refining, and testing the course modules for the schools. A CIAN Young Scholars research opportunity will be offered to motivate students to pursue degrees and careers in engineering by carrying out research in their junior and senior years of high school. CIAN will work with the existing Science Enrichment program or other similar programs at UCSD to reach underrepresented students in San Diego County. CIAN will include partnerships with Native American organizations in Arizona, New Mexico, and Southern California to interest Native American students in science and engineering studies. CIAN will coordinate and offer at least three one-week summer camps for middle and high schools each year on Native American reservations.

CIAN will also support Pima Community College in its effort to recruit high school students into the Optics program by offering an introductory course on Optics at two local underrepresented minority-serving high schools in Tucson, which will be expanded to community colleges in San Diego. At UC Berkeley, CIAN will participate in their Summer High School Apprenticeship Research Program. Graduate students from CIAN will help to design four week-long research projects and serve as mentors to supervise the high school students.

f. Diversity Enhancement Goals:

CIAN will develop comprehensive programs of diversity, outreach, and community building for recruitment and retention, and tracking and assessment to increase over the 10-year span of the ERC the diverse composition of its leadership, faculty, and students from underrepresented groups. This goal will include four main objectives: (i) recruiting pre-college students to science and engineering, (ii) attracting and retaining current college students to science and engineering, (iii) promoting the

hiring of faculty in science and engineering from underrepresented groups, and (iv) increasing the diversity among CIAN ERC participants. Special emphasis will be placed on increasing efforts to involve more underrepresented minorities in the ERC's college-level student body through partnerships with Native American- and Hispanic-serving institutions.

g. Industrial Collaboration and Innovation Ecosystem Program:

CIAN's industrial collaboration and innovation efforts will include partnering with large- and medium-scale established companies as well as start-ups and small businesses. Industrial partners will come from the value chain relevant to integrated access networks, including, etc. For IP not licensed by the member firms, partnerships with start-ups and small businesses will help move technology forward into the commercial realm and provide internship opportunities for CIAN's students. The members will be engaged in the research, education, and technology transfer/innovation efforts of the ERC through the Industrial Advisory Board.

The IAB will work with the Technology Transfer offices at the University of Arizona and other core universities to help foster effective interactions with industry, and ensure a coherent intellectual property (IP) policy for the ERC. The partner institutions, including both U.S. and foreign, will adopt a general framework for IP management, which will be fully determined prior to the initiation of CIAN-funded research. The ERC will include innovation partnerships with the Arizona Center for Innovation and the U.S. and the Small Business Development Center at Pima College to speed the transfer of IP-generated in the ERC to small firms and assist those firms in finding access to potential investors, developing business plans, etc. after member firms decline first options to negotiate a license.

h. Facilities and Headquarters:

CIAN has now established strong test bed capabilities with two major locations at the University of Arizona and the University of California at San Diego. The facility at UA consists of a Testbed for Optical Aggregation Networks (TOAN), dedicated to Working Group 2, and is used to support characterization of novel devices in a realistic network. The platform has been enriched with more functionality, connectivity, and upgraded to 10Gbps speed. The testbed at UCSD is dedicated to working Group 1 and provides chip-scale testing as well as testing of data center interconnects and protocols. There are also two satellite test beds at Columbia University for high-capacity networking and programmable cross-layer functionality, and at University of Southern California for high-

speed transmission and performance impairment monitoring and mitigation.

Faculty Hires:

CIAN has hired one new faculty, is in the process of hiring a second faculty, and will hire one more faculty in the future and has commitment from administrators to hire from various underrepresented groups, and promote collaborative efforts among their faculty.