The Computing Community Consortium

Renewal Proposal

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Project Summary

The Computing Community Consortium (CCC) is a catalyst and "proxy organization" for the computing research community. It provides leadership for the community, and it gives independent voice to the community, allowing its many members to contribute both to shaping the future of computing and to communicating to a broad audience the myriad ways in which advances in computing will create a brighter future. It encourages the alignment of computing research with pressing national priorities and national challenges. It facilitates the translation of these important research directions into funded programs. By its inclusive nature it grows new leaders for the computing research community.

The CCC operates under a Cooperative Agreement between the National Science Foundation and the Computing Research Association (CRA), a membership organization of over 200 computing research entities in academia, industry and government.

During the founding years of its existence, the activities of the CCC have had a significant impact on the status, direction, and prospects of the computing research community. Opportunities in the coming years are every bit as great. The CCC is an investment that promises to pay off in important ways for the field and for the nation.

We propose to continue the activities of the CCC for an additional four years.

Intellectual Merit: As a field of inquiry, computing research has a rich intellectual agenda – as rich as that of any other field of science or engineering. In addition, computing research is arguably unique among all fields of science and engineering in the breadth of its impact – in the extent to which further advances lie squarely at the center of our nation's ability to achieve many of our priorities and to address many of our challenges. Advances in computing are a key driver of economic competitiveness; they are crucial to achieving our major national and global priorities in areas such as energy and transportation, education and life-long learning, healthcare, and national and homeland security; they accelerate the pace of discovery in nearly all other fields; and they are essential to achieving the goals of effective open government.

The Computing Community Consortium is a leader in the effort to intellectually align computing research with national challenges and national priorities, working equally vigorously with policymakers and with the computing research community. The CCC, in collaboration with many other computing research community members, advances additional compelling computing research visions. By working to establish, communicate, and advance research goals that are appropriately ambitious, the CCC accelerates the pace of discovery and the impact of the field.

Broader Impact: By encouraging computing research that addresses national challenges and national priorities, the Computing Community Consortium has broad impact on the field and on the nation. The CCC is developing into an authoritative mechanism to inform the government about the accomplishments and the promise of computing research. Additionally, the CCC is developing leadership for the field, facilitating the broadening and lengthening of research visions, and helping to attract a new generation of students energized by the visions advanced through the CCC.

Thousands of members of the computing research community have been directly engaged in CCC activities. Thousands more have been indirectly engaged. The CCC fills a unique and important niche, complementing the roles of its sister organizations such as CSTB, the CISE AC, PCAST, ACM, and IEEE.

Introduction

The Computing Community Consortium (CCC) was established in October 2006 through a Cooperative Agreement between the National Science Foundation (NSF) and the Computing Research Association (CRA). This Cooperative Agreement[1] states:

> *The purpose of the Computing Community Consortium (CCC) is to provide a voice for the national computing research community. The CCC will facilitate the development of a bold, multi-themed vision for computing research and education and will communicate that vision to a wide-range of major stakeholders.*

This is summarized on the CCC website[2] as:

> *We support the computing research community in creating compelling research visions and the mechanisms to realize these visions.*

We believe that the CCC, during the founding years of its existence, has had a significant positive impact on the status, direction, and prospects of the computing research community. As we will describe below, the CCC is giving independent voice to the community and allowing its many members to contribute both to shaping the future of computing, and to communicating to a broad audience the myriad ways in which advances in computing will create a better future for society at large. In this way, the CCC has positioned itself as an increasingly important part of the national computing research community, and is becoming a valued source of information for Federal funding agencies and policymakers.

We believe that the opportunities in the coming years are every bit as great. We believe that the CCC is an investment that will continue to pay off handsomely for the field, and for the nation. We therefore propose to continue the activities of the Computing Community Consortium for an additional four years.

The origins of the Computing Community Consortium

The establishment of the Computing Community Consortium was stimulated by a number of concerns within the computing research community in the mid-2000s:

- A flagging Federal commitment to research in general, and to computing research in particular;
- A mistaken public and policymaker perception that computing research innovation was becoming less essential to the nation's future;
- A sense that there were limited independent venues in which the computing research community could articulate and coalesce around exciting research visions – research visions that would galvanize the public, policymakers, researchers, and students;
- The need to groom leadership for the field;
- A decrease in student interest;
- The need to identify constructive means by which to engage the computing research community in discussions about potential high profile, high-cost research investments such as the GENI Project.

To address these concerns, the NSF issued Program Solicitation NSF 06-551[3] in March 2006, indicating the Foundation's desire to establish a Computing Community Consortium. The Computing Research Association, a membership organization of over 200 computing research entities in academia, industry and government, responded eagerly to the solicitation.

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[1] http://www.cra.org/ccc/docs/ccc-term-conds.pdf
[2] http://www.cra.org/ccc/
[3] http://www.nsf.gov/pubs/2006/nsf06551/nsf06551.htm

CRA's proposal[4] – backed by explicit letters of support from 132 Ph.D.-granting academic programs, 16 leading corporations, 7 major national laboratories and research centers, and 5 professional societies in the field – was selected for funding under a Cooperative Agreement[5] in October 2006.

While NSF's solicitation focused on bringing the community together to shape promising infrastructure-intensive projects (initially GENI), considerable refinement took place over the course of the CRA proposal writing process, the NSF merit review process, and the negotiation of a Cooperative Agreement between NSF and CRA, resulting in the statement of purpose that is quoted in the *Introduction* above.

Organizational milestones

The need for an open and inclusive bootstrapping process for the CCC required a cautious ramp-up. An Interim CCC Council (the active governing body) was appointed by the proposal team in December 2006. Following an open recruitment process, Ed Lazowska was selected as Chair of the CCC Council in March 2007. The membership of the inaugural CCC Council was selected through a transparent process and announced in June 2007. The first public activity of the CCC was a set of five plenary talks at the Federated Computing Research Conference during that month[6]. Thus, at this point (Winter 2011), the CCC should be viewed as having been in operation for 3.5 years.

Early on, Susan Graham assumed the role of Vice Chair. Andy Bernat, CRA's Executive Director, served the CCC in the role of staff Director until Erwin Gianchandani was recruited as full-time staff Director in April 2010. In July 2009, the CCC conducted a thorough self-assessment[7], preparatory to a mid-term Reverse Site Visit that took place in February 2010[8]. At about the same time, SRI International was commissioned to conduct an independent assessment of the CCC; this assessment was completed in December 2010[9] and is discussed later in this proposal.

Today, the CCC Council has 18 members on 3-year staggered terms, representing the diverse nature of the computing research field, plus two officers (Lazowska, Graham) and two ex officio members (Bernat, Gianchandani)[10]. The Council operates as a committee of CRA under the CRA bylaws, in many ways analogous to the CRA Committee on the Status of Women in Computing Research (CRA-W): both have a membership that only slightly overlaps the CRA Board of Directors, significant autonomy, and also a great deal of synergistic mutual benefit with CRA. The Council meets three times every calendar year, including at least one meeting in Washington, DC, and has biweekly conference calls in between these meetings. The CCC leadership (Bernat, Lazowska, Gianchandani, and Graham) has biweekly conference calls with NSF CISE leadership.

Goals, strategies, and keys to success

The CCC is a catalyst and "proxy organization" for the computing research community. With our partners, we seek to make computing research more visionary and more impactful. In our 2007-2011 Strategic Plan[11] we identified seven goals, and four strategies for achieving those goals:

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4 http://www.cra.org/ccc/docs/CCC.proposal.pdf
5 http://www.cra.org/ccc/docs/ccc-term-conds.pdf
6 http://www.cra.org/ccc/fcrc/
7 http://www.cra.org/ccc/docs/CCC_Self_Assessment_AR_09.pdf
8 http://www.cra.org/ccc/docs/CCC_Reverse_Site_Visit_2010.pdf
9 http://www.cra.org/ccc/docs/CCC_SRI_evaluation_December2010.pdf
10 http://www.cra.org/ccc/bios.php
11 http://www.cra.org/ccc/docs/CCC_Strategic_Plan_V9.pdf

Goals

0. Establish the CCC as a widely accepted catalyst and voice for the computing research community
1. Bring the computing research community together to envision our future research needs and thrusts
2. Communicate these challenges, needs and thrusts to the broader national community
3. Create within the computing research community more audacious thinking
4. See the ideas developed in the second and fourth points above turned into funded research programs
5. Increase the excitement within computing research and use that excitement to attract students
6. Inculcate values of leadership and service

Strategies

1. Be extremely open and inclusive in launching and operating the CCC, so that it becomes widely accepted as a catalyst and voice for the computing research community
2. Engage the computing research community through a variety of approaches
3. Engage funding agencies
4. Engage external communities

Specific sub-strategies were identified, and the sub-strategies were mapped onto the goals that they supported. Multiple approaches to implementing each of the strategies were specified. While we were quite specific regarding these implementation approaches, the strategies themselves are high-level. As the Strategic Plan explains:

> *It is important to emphasize that we are "learning by doing" on this project. While there are helpful examples from other fields, which we have studied, none are directly and comprehensively applicable. Agility and flexibility and speed will be of central importance.*

The high-level nature of the strategies arises because the CCC is unique – we are feeling our way. The computing research community differs in two ways from physical sciences, such as astronomy and physics, where entire communities gather to prioritize research challenges because addressing each challenge requires extraordinarily expensive instruments. First, most computing research challenges do not require such instrumentation – it is affordable to pursue many challenges in parallel and less necessary to create strict prioritizations. Second, computing research feeds directly into industrial innovation, and the demand to advance rapidly is paramount to sustained competitiveness – thus, the CCC is most effective as it pursues many visions, challenges and opportunities in parallel and as it is a catalyst to drive advancement at the fastest pace possible.

The scope afforded by those high-level strategies has enabled many of our most important activities, which were only implicitly part of our plan. For example, the CIFellows Project and our role in the PCAST NITRD report (described later) were significant opportunities for the field that we were able to create and/or seize. This flexibility to adapt and respond – and the willingness and ability to do so and to do so rapidly and forcefully – has proven critical to the success and impact of the CCC.

Based upon our early experience, at the February 2010 Reverse Site Visit[12] we listed four specific keys to the successes we had achieved to that point:

Keys to success in accomplishing our goals

– Be open, inclusive, transparent, and communicative
– Be proactive
  - Do not wait for ideas to come forward – shake the tree
  - Do not wait for requests for guidance or assistance – volunteer it

[12] http://www.cra.org/ccc/docs/CCC_Reverse_Site_Visit_2010.pdf

    - Do not wait for opportunities to present themselves – create them
- Be opportunistic
    - When NSF, or DARPA, or the Presidential Transition Team, creates an opening, jump at it
- Be agile
    - Many of our greatest successes have been things that we had no way to plan for

Principal activities, to date

Our July 2009 self-assessment[13] and our February 2010 Reverse Site Visit presentation[14] include thorough discussions of the CCC's principal activities at that time, relating them to the goals and strategies above. We briefly summarize those activities and some initiated subsequently:

- Countless talks, countless articles, a blog[15], and a *Computing Research Highlight of the Week* feature[16]. All of these are designed to inspire and engage the computing research community towards more audacious thinking. These activities should be thought of as outreach to the computing research community – primarily they support Goals 0, 1, 3, 5, and 6 through Strategies 1 and 2.
- Community visioning activities (more than a dozen thus far)[17]. These bring together members of the computing research community to coalesce around research visions, to articulate these visions in compelling ways, and ideally to translate these visions into funded programs under the guidance of the CCC. Some of these activities are initiated by members of the computing research community; some by the CCC Council (who are themselves members of the research community); and some by funding agencies working through the CCC. Some have had tremendous impact; the robotics activity, for example, led directly to the new National Robotics Initiative included in President Obama's FY 2012 budget request to Congress. These activities should be thought of as engagement of the computing research community and of policymakers and advancing the computing research agenda – primarily they support Goals 0, 1, 3, 4, and 6 through Strategies 1, 2, and 3.
- CCC-sponsored *Research Frontiers* sessions at major conferences that explore out-of-the-box research ideas in the field; thus far, these have been held at PLDI[18] (programming languages), OSDI[19] (operating systems), and CIDR[20] (databases), with more to come (most immediately, VLDB and SSTD, both database conferences). These activities should be thought of as outreach to and engagement of the computing research community and advancing the computing research agenda – primarily they support Goals 0, 1, and 3 through Strategies 1 and 2.
- *URO* (Undergraduate Research Opportunities) *Zone*, a website (still a work-in-progress) designed to inspire undergraduates to pursue research.[21] This activity should be thought of as outreach to students – primarily it supports Goal 5 through Strategies 1 and 4.
- White Papers describing strategic areas of investment in computing research[22]. A first set was prepared for the 2008 Presidential transition team. A new set has been prepared recently, at the request of OSTP, focused on large-scale data analysis in a broad range of fields. As noted by Tom Kalil, quoted below, these "have had a clear influence on Administration budget and recruiting decisions and have already sparked collaborations between government, industry, and academia." These activities should be thought of as outreach to policymakers, advancing the computing research

[13] http://www.cra.org/ccc/docs/CCC_Self_Assessment_AR_09.pdf
[14] http://www.cra.org/ccc/docs/CCC_Reverse_Site_Visit_2010.pdf
[15] http://www.cccblog.org/
[16] http://www.cra.org/ccc/rharchive.php
[17] http://cra.org/ccc/activities.php
[18] http://www.cccblog.org/2010/07/26/pldis-fun-ideas-thoughts-stimulating-new-research-visions/
[19] http://www.cccblog.org/2010/10/07/research-visions-at-osdi-10/
[20] http://www.cccblog.org/2011/01/18/outrageous-ideas-at-cidr-seeking-to-stimulate-innovative-research-directions/
[21] http://www.cra.org/ccc/uro-zone.php
[22] http://www.cra.org/ccc/initiatives.php

agenda, and outreach to computing researchers (since we used these White Papers to highlight certain new directions for the field) – they support all 6 Goals through Strategies 2, 3, and 4.

- A daylong symposium at the Library of Congress, *Computing Research that Changed the World*, describing the accomplishments and potential of computing research[23]. Valuable collateral materials (slides, short illustrated papers, videos) were created and disseminated. There have been more than 85,000 YouTube views of talks from the symposium. This activity should be thought of as outreach to policymakers, to the computing research community, and to students – primarily it supports Goals 0, 2, 4, and 5 through Strategies 3 and 4.
- *The Computing Innovation Fellows (CIFellows) Project*: a stimulus-oriented postdoctoral program with many unique and beneficial characteristics[24]. More than 1,200 senior computing researchers registered as prospective mentors during the first year of this project, and more than 500 graduating students applied, proposing more than 900 postdoc/mentor pairs. In a survey conducted in early 2010, every one of the 60 members of the first CIFellows cohort reported "highly successful" or "moderately successful" experiences. More than 90% of the first two cohorts participated in a two-day *CIFellows Research Meeting & Career Mentoring Workshop* held in December 2010[25]. This activity should be thought of as strengthening the computing research community: its goal was to keep recently-graduated students "in the research game" during difficult economic times, to provide unique mentoring and career development opportunities, and to establish institutional cross-flow (in 2009, the 60 CIFellows came from 48 different Ph.D.-granting universities and were assigned to 43 host organizations different from their Ph.D.-granting institutions[26]; in 2010, the 47 CIFellows came from 33 Ph.D.-granting universities and they were assigned to 35 host organizations[27]) – primarily it supports Goals 0, 1, 5, and 6 through Strategies 1, 2, and 3.
- A compendium of *Landmark Contributions by Students in Computer Science*, emphasizing the role of undergraduate and graduate education in creating high-impact research breakthroughs[28]. Regina Dugan, the new DARPA Director, highlighted a number of these in early talks. This activity should be thought of as outreach to policymakers and to students – primarily it supports Goals 0, 2, 3, 4, and 5 through all 4 Strategies.
- A series of workshops that yielded a *Network Science and Engineering (NetSE) Research Agenda* – a contribution to the re-orientation of the GENI Project[29]. Early on, CCC gave voice to the computing research community, saying that our community did not need the GENI instrument as it had been envisioned. This activity should be thought of as engagement of the computing research community, and of policymakers – primarily it supports Goals 0, 1, 2, 3, 4, and 6 through Strategies 1, 2, and 3.
- Major national multi-agency workshops on *Discovery and Innovation in Health IT*[30] and on *The Role of Information Sciences and Engineering on Sustainability*.[31] These differ from community visioning activities in that CCC takes end-to-end responsibility. The goal of these workshops is two-way communication: exposing both the computing research community and the relevant Federal agencies to the benefits of collaboration. These activities should be thought of as engagement of the computing research community, and of policymakers, and advancing the computing research agenda – they support all 6 Goals through all 4 Strategies.

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[23] http://www.cra.org/ccc/locsymposium.php
[24] http://www.cifellows.org/
[25] http://cifellows.org/network/agenda/
[26] http://archive.cra.org/CRN/articles/nov09/cifxflow.html
[27] http://www.cra.org/resources/crn-archive-view-detail/cross_flow_among_the_2010_computing_innovation_fellows/
[28] http://www.cccblog.org/2009/08/28/landmark-contributions-by-students-in-computer-science/
[29] http://www.cra.org/ccc/netse.php
[30] http://www.cra.org/ccc/healthit.php
[31] http://cra.org/ccc/seesit

- A community-wide discussion of the role of postdoctoral programs in our field, currently underway – a discussion initiated by the CCC but carried out under the CRA banner in order to emphasize that the discussion is broader than the CIFellows Project. This activity should be thought of as outreach to, engagement of, and strengthening the computing research community – primarily it supports Goals 0 and 1 through Strategies 1 and 2.
- The recent assessment by the President's Council of Advisors on Science and Technology (PCAST) of the 14-agency, $4.3 billion Federal Networking and Information Technology Research and Development (NITRD) Program – *Designing a Digital Future: Federally Funded Research and Development in Networking and Information Technology*[32]. A huge proportion of the work was done by five members of the CCC Council who were appointed to the 14-member PCAST NITRD Working Group, and the final report drew heavily upon their understanding of the computing research landscape developed through their CCC involvement, as well as upon various CCC visioning activities, White Papers, and workshops. The PCAST NITRD report is a blueprint for the direction of our field, and will be used extensively by the CCC and others over the next few years in shaping the future of computing research. This activity should be thought of as engagement of the computing research community, and of policymakers (because the visions of the role of computing research embodied in the report involve communication in both directions) – primarily it supports Goals 2, 3, and 4 through Strategies 2, 3, and 4.

Many of the CCC's highest impact activities could not have been explicitly planned in advance. The CCC is an organization to which the computing research community can turn, and to which Federal officials can turn, when opportunities and needs arise. This role as an agile resource able to provide on-demand responses to policymakers – which involves a great deal of anticipation, preparation, and readiness on our part – is of extraordinary value and impact.

The bottom line, to date: Our view

Three and a half years after its launch, the Computing Community Consortium is well on the way to establishing itself as an effective leadership organization for the computing research community. Members of that community; leaders and staffers of research funding organizations; and Federal policymakers, from the White House on down; all turn to the CCC with increasing regularity.

Our definition of leadership focuses on *catalyzing* or *galvanizing*. This goes far beyond facilitating, but it stops short of dictating. The CCC does not "decide for" the computing research community; we do not believe that the computing research community needs to set priorities or, in most cases, to speak with one voice. The community *does* need a catalyst, and it needs an independent voice that recognizes the diversity of ways in which the community is positioned to make meaningful contributions to the nation – a collective voice of the community, independent of any one funding agency.

Nowhere is this philosophy more evident than in our approach to visioning, where our work ranges from supporting community-initiated visioning activities; to shaping and polishing activities that have been brought forward in rough, preliminary form; to stimulating groups of researchers to launch activities; to writing White Papers that are aimed as much at the computing research community as at policymakers; to organizing workshops that bring computing researchers together with researchers from other fields (e.g., health care, energy/sustainability), serving both an outreach and an "inreach" function; to driving the activities of the PCAST NITRD Working Group, which has re-positioned the role of computing research. Our point-of-view, in all of this, is clear: America's most important priorities cannot be achieved without fundamental advances in computing research. The CCC provides leadership and voice for the computing research community.

[32] http://cra.org/nitrd/

In addition to establishing itself as an effective leadership entity for the computing research community, the CCC has matured as an organization. The CCC was launched with organizational leadership that was distributed and interim – an "office of the Chair" and an "interim Council" – due to the need for an open process to identify permanent leadership, coupled with a challenging interface with the CRA Board. Even once the organizational leadership had stabilized, difficulty in recruiting a suitable Director forced CRA Executive Director Andy Bernat to take on the task, borrowing time from his CRA responsibilities. Activities moved forward sporadically – performance was not predictable. Today, the CCC has a 50%-time Chair (Ed Lazowska), a 25%-time Vice Chair (Susan Graham), a full-time Director (Erwin Gianchandani), and a seasoned Council. With each organizational change, the level and consistency of energy going into CCC activities has increased. Concurrently, engagement has broadened. The CCC was created by the NSF, but today has increasingly close ties to other agencies, such as DARPA, the Department of Energy, and HHS. The CCC has had presentations and conversations with the DoE Under Secretary for Science, the Acting Associate Director for the Office of Advanced Scientific Computing Research, and the Principal Deputy Assistant Secretary for the Office of Energy Efficiency and Renewable Energy. It has worked with the Department of Health and Human Services, first by co-funding of the *Discovery and Innovation in Health IT* workshop through the Office of the National Coordinator for Health IT, the National Library of Medicine, and the Agency for Healthcare Research and Quality, and subsequently by numerous other interactions. Ties with the White House (OSTP, PCAST) and with Congress are extremely strong. Industry and various professional societies have co-funded and actively participated in a number of our visioning exercises.

The bottom line, to date: External evidence

In the Introduction, we stated:

> *We believe that the CCC, during the founding years of its existence, has had a significant positive impact on the status, direction, and prospects of the computing research community. … We believe that the opportunities in the coming years are every bit as great. We believe that the CCC is an investment that will continue to pay off handsomely for the field, and for the nation.*

That view is supported by formal and informal assessments by a wide variety of stakeholders. Tom Kalil, Deputy Director for Policy in the White House Office of Science and Technology Policy (OSTP), has discussed the CCC and its activities on a number of occasions. Writing in his official capacity on the OSTP Blog in June 2010, Kalil said in a post entitled *Setting the 21st Century Research Agenda*[33]:

> *One of my goals at OSTP is to reduce the time between when the research community identifies potentially high-impact ideas and when these ideas are embraced and implemented by Federal science agencies …*
>
> *There is a variety of mechanisms through which the research community can participate in agenda-setting. One model I have found to be very valuable is exemplified by the Computing Community Consortium (CCC). Launched in 2007 … the CCC has played an important role in identifying and promoting exciting "visions" for the future of Information Technology (IT) research – ideas that have the potential to attract the best and brightest to the field, drive economic growth, and address national challenges in areas such as health, energy, and education.*
>
> *In late 2008, for example, the CCC mobilized some of the top researchers in the IT field to write (in less than two weeks!) short papers for the Obama transition team on topics such as e-Science,*

[33] http://www.whitehouse.gov/blog/2010/06/02/setting-21st-century-research-agenda

quantum computing, and the future of DARPA. The CCC has also organized workshops to develop detailed research roadmaps in areas such as robotics, data-intensive computing, and health information technology. These papers and workshop reports have had a clear influence on Administration budget and recruiting decisions and have already sparked collaborations between government, industry, and academia. The agility and flexibility of the CCC is particularly important for a field like IT, which changes rapidly and has such a profound impact on science and engineering, the economy, and our society.

I believe there is a strong case for replicating the CCC model in other areas of research. These efforts …would undoubtedly strengthen the ability of the United States to identify and support transformative research.

The Reverse Site Visit Review Panel that assessed the CCC in February 2010 concluded[34]:

The CCC provides vital national functions. It successfully helps policy-makers understand the role of computing research in progressing important societal issues. It helps develop new leaders in the computing research community. It accelerates the pace of the computing and information sciences by convening appropriate internal communities and encouraging them to set appropriately ambitious goals. The reviewers note the success of the CCC white papers, the huge interest in the Computing Innovation Fellows program from both faculty members and applicants, and the CCC's close and useful connections with the National Science Foundation … The unanimous consensus of the panel is that the CCC is an excellent project that has huge potential payoff not only to the computing research community but to all of science.

In early 2010, the CCC also engaged SRI International to conduct a third-party assessment of the CCC.[35] A particularly interesting result, in the context of considering a renewal of the CCC, was the response of a broad cross-section of the computing research community (more than 700 respondents, none of whom had personally participated in CCC activities, and more than 1/3 of whom, although they had received funding from NSF CISE, were not in academic departments of Computer Science or Computer Engineering) to a question regarding the need for an organization that pursues the CCC's goals – shown in the table on the next page. (Response to a similar question by nearly 100 members of the computing research community who *had* personally participated in one or more CCC activities was even more overwhelmingly positive.) Coming from a community with a well-documented penchant for circling the wagons and firing inward, this is a remarkable endorsement of the CCC's goals – a clear statement of the computing research community's appreciation of the need for an organization pursuing these goals.

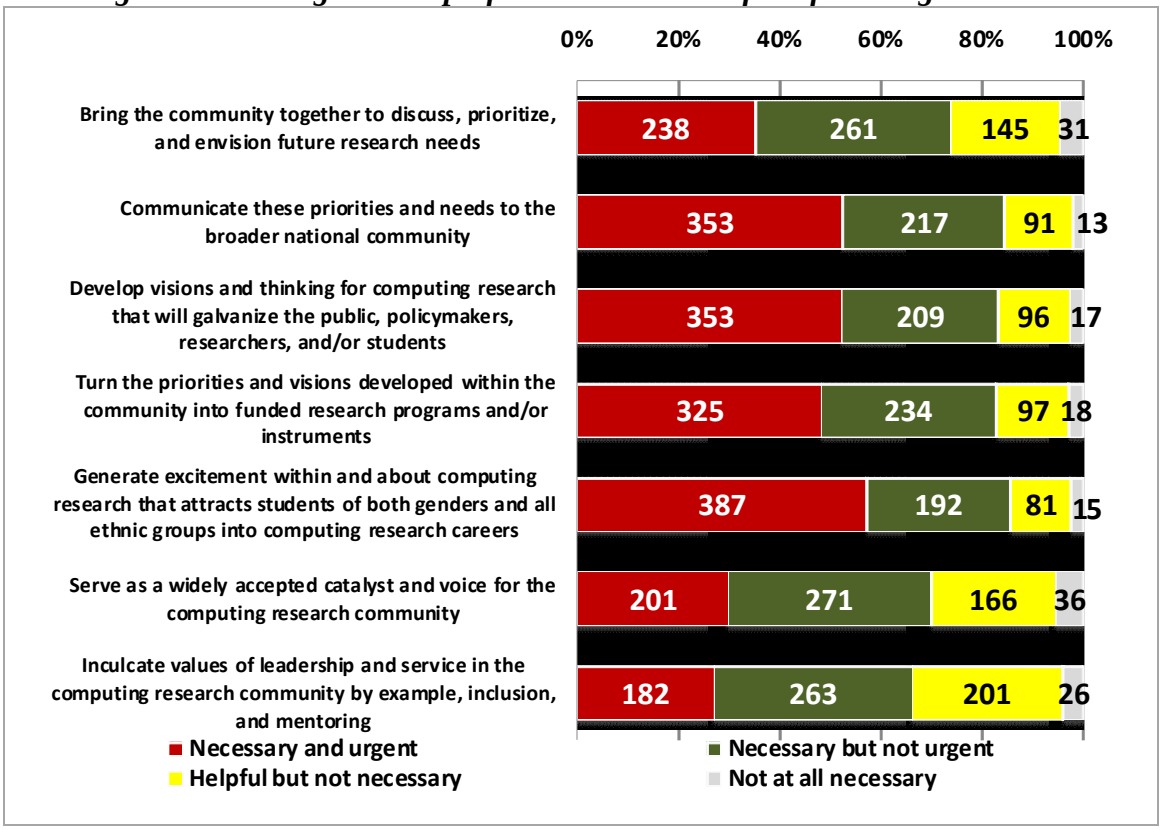
The next phase

The Computing Community Consortium is engaged in an exciting, essential, and high leverage mission. The various elements of this mission – the goals of the CCC – are viewed as necessary and even urgent by the computing research community. The CCC is unique – its role is complementary to those of its sister organizations such as CSTB, the CISE AC, PCAST, ACM, and IEEE.

The CCC has been presented with many opportunities, and has faced various challenges, as it has grown over the past 3.5 years. These experiences, coupled with the immensely valuable input from the Reverse Site Visit and SRI International teams, have served to inform our planning for the future. The feedback we have received shows that our strategies are fundamentally sound. Our keys to success will continue to serve us well.

[34] http://www.cra.org/ccc/docs/CCC_RSV_FinalReport_February2010.pdf
[35] http://www.cra.org/ccc/docs/CCC_SRI_Evaluation_March2011.pdf

How necessary is it to have within the U.S. computing research community an organization designated to perform one or more of the following activities?



We intend to continue those activities that have worked well, such as visioning workshops, events that coalesce emerging areas, and agile response to requests from government groups and individuals. (As noted earlier, the strong convening power of the CCC – our ability to marshal expertise from the community, especially on short notice – is particularly unique, is of particular importance, and enables us to have particular impact.) In the subsections below, we describe certain areas that will receive special emphasis as the CCC moves forward, areas of non-emphasis, and specific actions that we are taking in response to input from the Reverse Site Visit and SRI International assessments.

Areas of particular emphasis

Below are some areas that will receive particular emphasis as the CCC moves forward:

Exercise even greater leadership in advancing visionary research agendas for the field: We do this through a variety of mechanisms: community visioning activities, sessions at major conferences that explore out-of-the-box research ideas, White Papers, workshops, and the PCAST NITRD report. The conference sessions, a relatively recent experiment, have been assessed as a success and will be continued. The White Papers, originally thought of as a one-time Presidential transition team activity, have become an ongoing activity, for example with our recent series on the role of data analytics in a wide range of fields. We have put procedures into place to ensure follow-through on community visioning activities, beyond the completion of a White Paper describing the vision toward a funded research program – the success of the robotics roadmap provided a template for a similar exercise currently being carried out for learning technology, which will be further replicated. Through our activities to date, we are in a position to identify overlaps and gaps. We will continue to be active here – in soliciting proposals

from the computing research community, in working with the proposers to shape and strengthen the activities they propose, in interacting extensively with sub-communities, and in developing activities in key areas. Nor do we consider the job complete when the vision has been described. One important, related goal for the future, arising out of the SRI assessment, will be to clarify that visioning is multi-faceted, and includes all the activities described herein.

Broaden connections between the computing research field and other fields and their relevant Federal agencies: We have established an excellent foundation for this effort through our recent workshops on *Discovery and Innovation in Health IT* and *The Role of Information Sciences and Engineering on Sustainability*, through our community visioning activity on learning technology, and through the PCAST NITRD report (which positioned computing research at the center of achieving essentially all of the Nation's priorities). Ultimately, these connections are created by personal interactions and extensive discussion. Our plan is to add several standing committees to the CCC Council that will focus on areas such as IT and Health, IT and Energy, and IT and Education, with the charter of building solid and durable ties to the relevant Federal agencies in each area – which includes educating these communities and agencies about the role of computing research, and educating computing researchers about the opportunities in these fields and about the requirements for successfully working with these agencies. Our improved follow-through on community visioning activities will provide additional opportunities. The hiring last spring of a full-time Director based in Washington DC is having significant impact.

Work even harder at leadership development within the computing research community: We will provide even more extensive mentoring for those who lead our community visioning activities. We have already begun inviting successful leaders of these activities to join the CCC Council (Josep Torrellas, who joined the Council in January 2011, was previously co-PI of the Advancing Computer Architecture Research visioning activity), and will expand this effort. Stimulated by Tom Kalil, we plan to hold a *Frontiers of Computing* workshop (named by analogy to the NAE *Frontiers of Engineering* program) bringing together a small number of the most visionary mid-career researchers from across the full breadth of the field, to establish connections, envision the future, and groom leaders; this will become a regular event if successful. Additionally, we have designed a trial offering of a daylong Leadership and Science Policy Institute (LSPI), which also will become a regular event if successful. The goal of the LSPI is to educate a small cadre of mid-career computing researchers who aspire to policy roles in the computing research community, offering them the opportunity to learn how science policy in the U.S. is formulated, and how program priorities are established. We expect that graduates of the LSPI would immediately be well prepared for activities such as working directly with funding agency personnel to create new initiatives, serving as members of Federal advisory committees, and participating as witnesses at Congressional hearings. Taught by seasoned science policy veterans, topics will range from a primer on the mechanics of the legislative process, to interacting with agencies and advisory committees, to the role of Federal support of computing research. As a final point, we note that the CCC Council itself represents an important vehicle for leadership development. The Council is diverse with respect to subfield, age, nature of institution, gender, etc.; through regular rotation of Council members there is renewal and also growth in the number of individuals with the seasoning that service on the CCC Council provides.

Develop a more effective communications strategy: Jointly with CRA, we experimented with engaging a communications consulting firm. This experiment yielded mixed results – fine for some things (obtaining press exposure, generating brochures about computing research in the context of national priorities), not helpful with others (communication with policymakers and with the computing research community, owing to the domain knowledge required). It is our intention to bring a full-time communications person onto our Washington DC staff – a younger individual who either has or can develop sufficient computing domain expertise to take the lead in preparing online and hard copy materials for policymakers and the computing research community. Additionally, we plan to repeat events analogous to the Library of Congress Symposium – major events with significant visibility and with long-term collateral. And we are

considering a workshop analogous to the Leadership and Science Policy Institute described above, but focused on communicating computing research to the news media and the general public; prior NSF-AAAS joint workshops on this topic serve as a model[36]. Finally, we are about to launch an experiment with micro-grants to members of the community (at all levels, i.e., faculty, graduate students, undergraduates) for producing short compelling videos of computing research that we will then distribute broadly; we don't expect every one of these videos to amass wide viewership, but even having a small percentage of the videos going viral has the potential to markedly advance the perception of computing research among members of the public, including, importantly, prospective computer science students.

Continue to be extremely responsive to requests from the White House and Federal agencies. Ties established in the course of the PCAST NITRD report have opened a number of very high bandwidth channels to the top policymakers in the Federal government; utilizing these channels (and responding to requests that arrive over them) will be a major thrust during the coming year. Not every interaction pays off. But we must be there, for the computing research community and for the nation.

Broaden the leadership of the CCC itself: Many important steps have been taken. The position of the Vice Chair was formalized last year, and the role was funded (at a 25% level). An outstanding full-time Director was recruited last spring. The establishment of committees with specific responsibilities within the CCC Council will create greater opportunities for leadership among Council members. We will establish a leadership transition plan: we will formalize the Chair position as a 5-year term with the possibility of 2-year renewals, effective October 1 2012; the decision regarding a possible renewal will be made 9 months in advance of the expiration of a term, allowing ample time to bring an outstanding new individual on board who can allocate 50% time to the job. (In other words, a decision regarding a possible 2-year renewal of Lazowska's term will be made on January 1 2012.)

Areas of non-emphasis

There also are activities that we will *not* pursue systematically. For example:

International activities: We recognize the importance of global engagement, and we will certainly participate in key international activities that come to us (for example, Susan Graham's role in a recent NSF/OECD Workshop on Building a Smarter Health and Wellness Future[37,38]). However, there is simply too much to do in catalyzing and galvanizing the computing research community domestically; the CCC can participate as appropriate internationally, but cannot take on a leadership role.

K-12 education: This is crucially important, and we have contributed – for example, by ensuring that Computer Science was positioned as a fundamental aspect of STEM in the PCAST Educational Technology and NITRD reports. However, ACM, CRA, NCWIT, and NSF are all active here. We are hugely supportive (particularly of CS Principles and CS 10K), but it cannot be a focus for the CCC.

External assessments, our actions, and influence on proposed plans

As noted earlier, there have been two major assessments of the CCC during the founding years of its existence: a Reverse Site Visit conducted during winter 2010, and a study by SRI International conducted principally during summer and fall 2010. While each of these assessments had a positive bottom line, each also identified areas where attention would increase the effectiveness of the CCC. We review the recommendations of these assessments and our past and future actions here.

[36] http://www.nsf.gov/events/event_summ.jsp?cntn_id=117845&WT.mc_id=USNSF_13
[37] http://www.cccblog.org/2011/03/03/recapping-the-recent-oecd-nsf-workshop-on-smart-health/
[38] http://www.nsf.gov/cise/smarthealth/

Our written response[39] to the Reverse Site Visit (RSV) report[40] describes three categories of takeaways from the process: issues that we were aware of as we entered into the process, issues that were discussed during our interaction with the RSV panel, and issues that were highlighted in the RSV report.

In the first category – issues that we were aware of as we entered into the process:

- *Drive forward the formal assessment of CCC and CIFellows.* We have worked closely with SRI over the past year, and we feel that their report contains useful data, insights, and recommendations.
- *Assimilate Erwin Gianchandani as a full-time staff Director.* The CCC leadership team – Lazowska, Graham, and Bernat – has worked closely with Gianchandani to assimilate him into the role. He is now overseeing day-to-day operations, planning and running biweekly conference calls and Council meetings, monitoring the visioning activities, and assisting with outreach – to the community, Federal agencies, etc. The SRI assessment makes clear the positive impact that Gianchandani is having on the effectiveness of the CCC.
- *Formalize and budget the Vice Chair position.* In July 2010, we formalized the Vice Chair position with NSF, providing the Vice Chair with quarter-time support. The budget accompanying this proposal includes this position.
- *Take advantage of Peter Lee and Regina Dugan to re-build the community's relationship with DARPA.* Unfortunately, Lee left DARPA in July, shortly after the Reverse Site Visit, and the agency is again in transition. However, we are continuing to focus on engaging DARPA.
- *Establish the role of computing research in biomedicine and health care; strengthen ties to NIH/HHS.* Following up on the *Discovery and Innovation in Health IT* workshop and the hiring of Gianchandani (who worked on *Smart Health and Wellbeing* at NSF), we are establishing links throughout HHS, including the Office of National Coordinator for Health IT (ONC), National Library of Medicine (NLM), National Institute of Biomedical Imaging and Bioengineering (NIBIB), etc.
- *Establish the role of computing research in the nation's energy future; strengthen ties to DoE.* As a result of our ongoing dialogue with CISE leadership, the CCC was asked to run a workshop on *The Role of Information Sciences and Engineering on Sustainability* in February 2011. This workshop considered sustainability broadly, touching on a wide range of application domains, including energy, transportation, the electric grid, etc. Key figures from DoE, ARPA-E (the Advanced Research Projects Agency-Energy), and NIST participated, helping to forge ties with these agencies on this subject. We are preparing a report summarizing the key themes that emerged from this workshop – and we are interacting with the agencies, including DoE.
- *Identify younger thought leaders and recruit them to the CCC Council and other CCC activities.* Several recent Council meetings have included discussions of this topic, and, as described previously, a number of proposed activities attempt to focus on identifying and recruiting younger thought leaders. One idea was to use the visioning activities as a mechanism for identifying and grooming future leaders – SRI suggested this independently as well – and we are now beginning to do that.
- *Provide more comprehensive guidance and follow-through for community visioning exercises.* As a result of the Reverse Site Visit, the CCC Council developed a document titled, *Finding and Advancing Visions in Computer Science & Engineering*[41], in which we specifically describe how to communicate and move forward the visions at the funding agency level. Several leaders of visioning activities have participated in post-workshop discussions with the CCC Council.
- *Increase focus on dissemination/communication.* The hiring of Gianchandani has resulted in a renewed focus on dissemination/communication. Activity on the blog and other social media has dramatically increased; we have worked more closely with a communications firm we previously

[39] http://www.cra.org/ccc/docs/CCC_RSV_Response_March2010.pdf
[40] http://www.cra.org/ccc/docs/CCC_RSV_FinalReport_February2010.pdf
[41] http://cra.org/ccc/advancing.vision.php.

contracted, Xenophon Strategies, though this continues to yield mixed results (mainly, we believe, because Xenophon does not possess advanced domain knowledge); we have developed resources such as the URO-Zone for attracting undergraduate students into computing research; and, as noted above, we are proposing to hire a full-time communications staffer, which we anticipate will be far more effective than outsourcing to Xenophon.

In the second category – issues that were discussed during our interaction with the RSV panel:

- *Take great care with the external evaluation being handled by SRI to ensure that it correctly measures what is important rather than what is easy to count.* The SRI assessment required a great deal of work on our part, but we feel that, in the end, it has been constructive and helpful.
- *Attempt to increase agency understanding of the importance of computing to their missions by working to get computing researchers onto their many advisory committees.* The CCC Council has discussed this issue and will take it on as a serious effort. Meanwhile, Ed Lazowska has been appointed to the Department of Energy's newly formed Energy Efficiency and Renewable Energy Advisory Committee.
- *Strive towards the articulation of truly innovative/far out/audacious research goals through a variety of mechanisms:*
  - *Encourage leading conferences to run "far-out ideas" sessions.*
  - *Encourage major subfields to emulate the database community, in periodically enumerating "five topics about which enough papers have been written" and "five topics about which we should see more papers."*

  The first is underway, as noted previously. The second has not been tackled, but we plan to revisit it.
- *Work to disseminate appropriate CCC materials (for example, the Library of Congress Symposium) to undergraduates.* The URO-Zone website is a step in this direction; ACM has been helpful in communicating this website to, and drawing attention from, its many student chapters. We must enhance the website, and develop mechanisms to make it vibrant and interactive. Improved dissemination of materials is part of our communications plan going forward.
- *Develop a process for getting traction for the results of the visioning exercises.* As noted above, we have developed a best practices document derived from interviews with the leaders of a number of our visioning exercises, and we are putting these best practices into action.
- *Extract lessons learned in order to figure out what makes visioning activities successful (or not).* We have initiated a practice of inviting the leaders of visioning activities to discuss their work at CCC Council meetings; these discussions involve not only the technical aspects of the activities, but also the mechanics. Three teams of visioning exercise leaders led sessions at the most recent CCC Council meeting. We have also broadened our understanding about what constitutes success.

In the third category – issues that were highlighted in the RSV report:

- *Focus on connections … between our internal computing research community and external parties who need to better understand the role of computing research in solving their problems.* We understand the critical importance of this issue. It was highlighted in the *Areas of particular emphasis* subsection above. The PITAC NITRD report represents a major step in this direction.
- *Consider pulling together the grand challenges that emerge from the various visioning groups and issue a "blue book" on the grand challenges in computer science.* This is the one recommendation of the Reverse Site Visit committee with which we took exception. Our rationale is described in detail in our response to the RSV report[42]. In a nutshell, we believe in letting 1000 flowers bloom, as long as none of the flowers are weeds. One of the hallmarks of our field has been innovation – major new directions arising as byproducts of research in other topics. It is important to maintain the flexibility

[42] http://www.cra.org/ccc/docs/CCC_RSV_Response_March2010.pdf

that has enabled those efforts to flourish. We believe wholeheartedly in communication. We just don't think that a "blue book" of grand challenges in computing is the way to go about this.

- *Seek cross-agency funding for CCC.* It is our view that it is appropriate for NSF to provide core funding for the CCC for now, and for other agencies and industry to provide funding for specific activities. We have taken a number of steps to secure non-NSF funding of this sort for specific activities (e.g., workshops): from Yahoo! for Big Data; from NIH, ONC, the Agency for Healthcare Research and Quality (AHRQ), and NIST, as well as the American Medical Informatics Association (AMIA), for Health IT; and from Canada's GRAND Initiative and ACM SIGCHI for Interactive Technologies. We will focus even more strongly on this in the future.
- *Take advantage of the SRI evaluation to further energize and drive mindshare for CCC and its mission as well as better understand how the community views CCC and its accomplishments. Request separate reports for the CCC and CIFellows.* We did indeed separate the CCC assessment from the CIFellows assessment. (The latter has not yet been delivered; it is promised imminently.)
- *Translate visioning into crisp and understandable research agendas that are linked to mission agency agendas.* We are making progress here. With the help of OSTP, the National Robotics Initiative is being embraced by a number of agencies. We are attempting to achieve the same result with the roadmap derived from our Learning Technology visioning exercise. Our recent workshops on *Discovery and Innovation in Health IT* and *The Role of Information Sciences and Engineering on Sustainability* have similar cross-agency promise. For example, the Health IT effort contributed to an NSF CISE *Smarter Health and Wellbeing* solicitation[43] and informed the ONC SHARP solicitation
- *Don't forget to bring along the needed basic research.* We understand this sensitivity. Our philosophy is clearly articulated in the PCAST NITRD report, where a frequently recurring sentence is "Transforming X requires fundamental advances in NIT" (where X is health care, energy, transportation, national security, discovery in science and engineering, education, digital democracy).
- *Groom the next set of CCC leadership.* We addressed this issue above. Progress is being made on a number of fronts.

SRI International spent much of 2010 conducting a formative evaluation of the CCC, seeking to understand what the organization has accomplished to date and to identify specific opportunities for improvement. In the final report dated December 2010 (but received in final form in March 2011[44]), SRI focuses primarily on findings, but also proffers several recommendations, summarized below:

- *One of the most problematic aspects of this evaluation was that the CCC lacks a clear, explicit definition of its primary output -- new "research visions." The qualitative data in particular show that there is some ambiguity among stakeholders over what a vision should contain, and what impact it can be expected to have. Providing greater clarity about what does or does not constitute a "research vision" would help an assessing if the visioning activities produce their intended outputs, which in turn would aid in linking those outputs to tangible (and possibly intangible) outcomes.* There are many outcomes from the visioning activities, not all of which were anticipated when CCC started. Some of those activities make progress in growing a new research community, as the SRI quotations about new collaborations indicate. Some of them bring multiple communities together, as in the health IT, sustainability, and interactive technologies workshops, thereby stimulating new innovative research. Some of them crystallize and sharpen the understanding of a problem area and articulate a coherent research plan, as in the robotics effort. That kind of outcome most closely mirrors the notion of a research vision, but more broadly, any activity that stimulates novel and innovative research or that moves a traditional subfield in promising new directions is visionary for the field. Funding opportunities are one tangible measure of success of visioning activities. New conferences and

[43] http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503556
[44] http://cra.org/ccc/docs/CCC_SRI_evaluation_December2010.pdf

publication venues are another. Surprising new research results and the migration of some of them to products are another tangible measure, although one that might take longer to occur.

- *The CCC also may benefit from diversifying its sources of funding and its interactions with research sponsors.* We have addressed this point previously – we are actively working on this.
- *The survey data and interviews show that the computing research community sees public outreach regarding the value of its research as a top priority. Therefore, outreach and education (regarding the future of computing research) should be a key part of the CCC's agenda for the future.* We agree completely, and we have incorporated improved public outreach into our communications plan.
- *A final key area of concern is the CCC's succession strategy … The CCC Council has brought in more junior faculty as members to promote their standing as potential future leaders in the computing research community, but there is opportunity for the CCC to address this issue more systematically. The survey data show that the CCC can encourage greater interest and service to the community through its visioning activities as well.* We have addressed this point above.

Summary

The computing research community *needs* a Computing Community Consortium, and (judging from the SRI assessment) the community *recognizes* this need.

It is our view that, working with CISE and other agencies, the computing research community, and White House policymakers, we have contributed to a substantial quickening of the pace and heightening of the visibility of computing research. The need and the opportunity continue to be enormous, and the impact of advances in computing on the nation's economy and our citizens' lives will continue to grow dramatically, particularly since the Administration is focused on national priorities such as health and wellbeing, energy and sustainability, and education, all of which require fundamental advances in computing research.

Among the benefits that the CCC offers, beyond the specific accomplishments and future plans just described, are:

- A strong, diverse group of community members. Our community needs *somebody* to be working these issues.
- Speed and agility. We have provided support to visioning workshops in less than a week in several cases. We mounted an extraordinary effort to respond rapidly and thoroughly to requests from the 2008 Presidential transition team. The first round of the CIFellows project was conceived and launched in an astonishingly short period of time and engaged more than 1,000 members of the computing research community.
- Extensive coaching, shepherding, and matchmaking to groups who submit visioning proposals to us. Our goal is to figure out how to create successful efforts, by helping to forge a promising plan, an appropriate team, and helpful connections.
- A stimulus for the community. Several of the successful visioning workshops simply would not have taken place without CCC impetus.
- Help to re-focus existing subfields, as well as catalyze the formation of new ones. Our robotics effort is a good example – a subfield that has been highly successful but unsure about its future direction, now rejuvenated by a National Robotics Initiative.
- A place to turn – a vehicle or agent for the NSF, OSTP, and, increasingly, other agencies.
- The opportunity for frank discussions of key issues, since the Council's meetings are not public.

It is too early to tell whether the CCC should be permanent. It is clear, however, that it should continue at present. The CCC is an investment that will continue to pay off in important ways for the field, and for the nation.

Budget Justification

The CCC was originally funded at a rate of approximately $2 million per year for a period of three years. Expenditures fell below expectations during the ramp-up phase, allowing for four years of operation under a one-year no-cost extension of the original award. As the organization matured and as activities increased, the expenditure rate approached the originally anticipated $2 million per year level. Given the nature and goals of the CCC, we expect to continue at this expenditure rate, adjusted for inflation if that becomes necessary.

Key components of the proposed budget are highlighted below:

Personnel

- Senior personnel
  - The CCC Council Chair (currently Ed Lazowska) and Vice Chair (currently Susan Graham) will continue to spend roughly 50% time and 25% time, respectively, on CCC duties. A certain amount of this effort involves management, oversight, and direction of CCC activities through strategic planning for the CCC; coordination with the CRA Board (including CRA Board Chair and Executive Director), with the CCC staff Director and Council members, and with the NSF; and management and execution of ongoing CCC activities. The vast majority of this effort, though, involves direct engagement in carrying out the mission of the CCC: interaction with the computing research community; interaction with Federal policymakers at all levels; leadership of activities; etc. In other words, this is not management overhead – it is direct engagement in carrying out the mission of the CCC, at a level far beyond that which would be possible on a volunteer basis.
  - The CRA Executive Director (currently Andrew Bernat) will continue to serve in *ex officio* capacity on the Council, making sure all operations flow smoothly and correctly. We anticipate 20% effort on the part of the CRA Executive Director to fulfill these responsibilities.
  - The full-time staff Director of the CCC (currently Erwin Gianchandani) will continue to manage all day-to-day aspects of the CCC, guide visioning activities, serve on multiple subcommittees, and coordinate our messaging for funding agencies and policymakers through participation in the preparation of White Papers and visioning activity report-outs.
- Other personnel
  - CRA's Government Affairs team (currently Peter Harsha and Melissa Norr) will continue to support the project by providing policy analysis for matters relating to the computing research community. They will be critically involved in broadening connections to Federal agencies and Congress; in leadership development within the community (e.g., through an active role in organizing and running the LSPI described above); and in helping to formulate a more effective communications strategy (also described above). We anticipate roughly 40% effort on the part of the senior member of the team (currently Harsha) and 25% on the part of the junior member of the team (currently Norr).
  - CRA's IT manager (currently Kapil Patnaik) will continue to support the project (approximately 40% effort) by maintaining the CCC's web-related media, including website and blog, activity pages, etc.
  - A new dedicated, full-time Administrative Assistant – reporting to the staff Director – will expand the duties of the current CRA Administrative Assistant, who has handled all administrative and logistical matters requested to date, such as compiling booklets with agendas, bios, etc., for meetings, planning for Council meetings, etc. The activities of the CCC have increased to the point where this investment is necessary.
  - A new full-time Communications Fellow will also be hired, replacing our less-than-fully-successful outsourcing to Xenophon Strategies. Under the staff Director's mentorship, this person

will develop sufficient computing domain expertise to take the lead in preparing online and hard copy materials for policymakers and the computing research community.

- Fringe benefits
  - These are charged at the CRA average rate of 32%.

Travel

- We are providing for expenses for travel of core program staff, including, notably, Gianchandani and Bernat. Travel will include trips to computing research conferences and workshops, academic departments and industrial research labs to describe the CCC and its goals and activities.

Participant support

- We are providing for travel and subsistence of CCC Council members – as well as invited speakers and guests – to three face-to-face meetings per year at locations around the country.
- We are also providing for travel and subsistence – including airfare, hotel stays, and meals and incidentals – for participants of the following CCC-funded activities:
  - Visioning activities (at an anticipated rate of four 75-person workshops per year);
  - Ten Research Frontiers session winners per year (specifically, travel awards for first-, second-, and third-place finishers in each of these sessions);
  - An annual Library of Congress Symposium-like event;
  - The Leadership and Science Policy Institute (anticipated to take place once every year);
  - A workshop on communicating science (anticipated to take place once every year);
  - A Frontiers of Computing activity (anticipated to take place every year); and
  - Strengthening and building connections with policy makers/funding agents through face-to-face visits by members of the CCC and the broader computing research community.

  (See the proposal for details of each of these planned activities.)
- Note: In keeping with Federal rules, no alcohol will be covered with Federal funds.

Other direct costs

- We are estimating costs for standard office supplies as well as specialized materials and supplies for the various CCC activities, including program books, other handouts, flip charts and markers, printing, and A/V equipment, to name a few.

The central resources required for the CCC will continue to reside within the offices of the CRA in Washington, DC. However, expansion of facilities will be required as CCC increases the CRA office staffing, with the hiring of a dedicated Administrative Assistant and Communications Fellow. Similarly, office equipment will need to be enhanced. However, all can be accommodated within the fiscal constraints of this proposal.

As noted in our original proposal, the CCC involves a number of activities and includes a large number of participants. To date, the policy leadership has successfully taken place in a distributed fashion via regular teleconferences among the CCC Council members and via regular face-to-face meetings held at locations throughout the country; we expect this to continue. Moreover, CRA has extensive experience at organizing and staffing such meetings, and at reimbursing participants in a timely fashion.