The Computing Community Consortium: Self-Assessment and Annual Report

Version 18: July 27, 2009

This document serves both as an overall self-assessment of the Computing Community Consortium since its inception more than two years ago, and as an annual report for the most recent year.

1. History of the Computing Community Consortium

NSF issued Program Solicitation NSF 06-551 to establish the Computing Community Consortium in March 2006[1]. The Computing Research Association assembled a team to respond to this solicitation (see Appendix A). CRA's proposal[2] was selected for funding in October 2006.

The need for an open and inclusive bootstrapping process for the CCC required a cautious ramp-up: An Interim CCC Council was appointed by the proposal team in December 2006 (see Appendix B); Ed Lazowska was selected as Chair of the CCC Council through an open process in March 2007, and the membership of the inaugural CCC Council was selected through an open process and announced in June 2007 (see Appendix C). The first public activity of the CCC was a set of five plenary talks at the Federated Computing Research Conference during that month (see http://www.cra.org/ccc/fcrc/).

Since this launch we have been moving at a rapid pace. We have been clear from the start, though, that the CCC is an experiment – we are "learning by doing" on this project. This self-assessment is written two years into the effective life of the CCC, and is very much an assessment of a work-in-progress.

2. Purpose of the CCC

Section A.1 ("Motivation") of CRA's response to the CCC solicitation states:

The challenge for the Computing Community Consortium (CCC) is to catalyze the computing research community to debate longer range, more audacious research challenges; to build consensus around research visions; to articulate those research visions; to evolve the most promising visions toward clearly defined initiatives; and to work with funding organizations to move the challenges and visions toward funding initiatives.

---

[1] http://www.nsf.gov/pubs/2006/nsf06551/nsf06551.htm
[2] http://www.cra.org/ccc/docs/CCC.proposal.pdf

The NSF Cooperative Agreement governing the CCC[3] 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.*

At the time the CCC was first conceived by NSF, a significant motivation was to broaden research community engagement in the emerging GENI project. There has been an explicit progressive shift, though – visible in the text above from CRA's response to the CCC solicitation, in the text above from the Cooperative Agreement, and in our frequent discussions with NSF staff as we have progressed – toward a far broader agenda, captured in the "tag-line" on the CCC website[4]:

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

(We interpret this to include aspects of education, because education provides the pipeline for new researchers, and because computing research is increasingly important to success in educational endeavors.)

3. Structure of the CCC

The work of the CCC is carried out by a Council of 19 members (plus two ex officio members) on 3-year staggered terms selected through a CRA-led open process to reflect the breadth of the computing research community. (See Appendix C.)

The CCC 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 has a Chair, currently Ed Lazowska (University of Washington), which is a 50%-funded position, and a Vice Chair, currently Susan Graham (UC Berkeley). There is an Executive Director, currently Andy Bernat (CRA), also funded at up to 50%. A small number of staff members (e.g., a webmaster and a contract event organizer) are shared with CRA.

Council members assume specific responsibilities – for example, the shepherding of specific visioning exercises proposed by the research community. Coordination is maintained through bi-weekly one-hour teleconferences. Longer-range planning takes place at thrice-annual full-day meetings.

CCC leadership also has bi-weekly teleconferences with NSF staff, which alternate between CCC topics and NetSE (Network Science and Engineering) topics.

---

[3] http://www.cra.org/ccc/docs/ccc-term-conds.pdf
[4] http://www.cra.org/ccc/

4. Assessment criteria

Section G ("Measuring the Success of the CCC") of CRA's response to the CCC solicitation states:

> *We have five goals:*
>   1. *Bring the computing research community together to discuss, prioritize and 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 (1) and (3) turn into funded research programs and/or instruments.*
>   5. *Increase the excitement within computing research and use that excitement to attract students of both genders and all ethnic groups into computing research careers.*
>
> *Clearly, these are many-year processes. In the short term, we will know if CCC is succeeding if we are able to generate interest and participation in our preliminary visioning activities, particularly by researchers of stature. Progress here will tell us how to modify this process. Next, we will measure our success by whether we can successfully populate the Visioning Task Forces and, ultimately, the Initial Planning Groups. Each of these activities has concrete products to deliver to the CCC and community.*
>
> *Thus, our metrics are: populating the CCC, creating the staffing infrastructure, beginning the visioning process and continuing it, creating Visioning Task Forces, seeing them through to idea generation, creating Initial Planning Groups, seeing them through to report generation, working with NSF and other federal agencies to fund programs and instruments based upon these reports, and continuing to monitor the success of these new programs and instruments and of the field of computing research.*
>
> *It is important to note that ours is a shared responsibility – researchers need to see responses to their activities on behalf of the CCC. NSF and other funding agencies need to be responsive and ensure that the community efforts have real (monetary) impact.*

In our Strategic Plan, we added two goals to the list above:

>   0. *Establish the Computing Community Consortium as a widely accepted catalyst and voice for the computing research community.*
>   6. *Inculcate values of leadership and service in the computing research community – by example, by inclusion, and by mentoring.*

Our Strategic Plan identifies four highest-level strategies:

- *Be extremely open and inclusive in launching and in operating the Computing Community Consortium, so that it becomes widely accepted as a catalyst and voice for the computing research community:* The CCC must be viewed by the computing research community as "belonging to it" – as being not just "for" it, but "of" it.

- *Engage the computing research community:* Encourage computing researchers to envision more audacious research challenges. Build communities and evolve visions to achieve crisply defined initiatives with supporting research agendas. Inculcate values of leadership and service in the computing research community.

- *Engage funding agencies:* Work to align agency programs with emerging research visions.

- *Engage external communities:* Advance the perception of, and appreciation for, the challenges, accomplishments, and importance of the computing research field. Inspire students to choose to study computing.

Below, we enumerate specific accomplishments in each of these strategic areas. An overall assessment follows.

4a. Be extremely open and inclusive in launching and in operating the Computing Community Consortium, so that it becomes widely accepted as a catalyst and voice for the computing research community

- Successfully launched the organization through an open process that engaged a broad spectrum of the computing research community – with the goal of ensuring "community ownership" of the CCC. For example, more than 100 nominations were received for the inaugural CCC Council.

- Attracted a top tier Council. The membership of the CCC Council (see Appendix C) includes widely respected individuals from a broad range of institutions possessing expertise in a broad range of research areas.

- Successfully conceived and launched a number of activities. As an example, our "visioning workshop RFP" process (see http://www.cra.org/ccc/vision) was launched rapidly, and has been both agile (granting funding in as little as one week) and flexible (sometimes shepherding proposals extensively so as to increase the likelihood of success and to create a form of "apprentice system" that allows younger people writing these proposals to benefit from the experience of the members of the CCC Council). We have modified the RFP process as we have gained experience, to make it as smooth as possible for submitters while ensuring results for the research community.

- Quickly gained significant visibility, credibility, and stature within the computing research community. Examples appear in the next section.

- Successfully re-populated the Council when initial terms concluded; once again we had a highly positive response to the solicitation for nominations, and also among those who we invited to join the Council.

4b. Engage the computing research community

- The visioning workshop RFP process is our most visible activity. It has attracted a strong response from outstanding computing researchers. It has helped foster the formation of new research communities (e.g., the "Big-Data Computing Study Group"). It has allowed existing research communities to envision new directions (e.g., "From Internet to Robotics: The Next Transformative Technology"). We have solicited proposals in areas that we felt needed representation (e.g., "Information and Communication Technologies for Development: A New Grand Challenge for Computing Research"). We have been both agile (granting funding in as little as one week – e.g., "Visions for Theoretical Computer Science") and flexible (sometimes shepherding proposals extensively so as to increase the likelihood of success – e.g., "One Learning Community per Student: Global Resources for Online Education"). We have delivered solid, multi-reviewer feedback to all proposal authors. The results of these workshops have been made available via the web and blog to the entire computing research community. (See the CCC home page, http://www.cra.org/ccc/, for links to descriptive material related to these activities; a complete list appears in Appendix D.)

- We have engaged at a variety of different stages of "the visioning pipeline." At one extreme, in the case of "Information and Communication Technologies for Development," the researchers are seeking to identify a well-defined computing research agenda in a field of great social importance that has a clear "applications of IT" component but a less obvious "computing research" component. At the other extreme, in the case of "Cyber-Physical Systems," the researchers had been working with NSF and each other for a considerable period, and we engaged in order to broaden research community engagement and facilitate the establishment of links to other funding agencies and to industry. In a number of cases (for example, the "Big-Data Computing Study Group" and particularly "Cyber-Physical Systems"), CCC benefited by the pre-existence of groups of researchers that were already actively engaged in the visioning process. Even in these cases, our sense is that the increase in energy that CCC contributed was productive for the activity.

- An extensive set of talks and articles by a number of members of the Council that have *both* exposed the CCC *and* described the sorts of research visions that will define the future of our field. That is, these talks have delivered both information and inspiration. (See Appendix E and Appendix F.)

- The CCC website (http://www.cra.org/ccc/) has a significant amount of content, including material from the various visioning exercises.

- We launched a computing research visions blog (http://www.cccblog.org/) which has attracted a significant following. This success is due to the fact that we had a plan for generating interesting content. There was a particularly vibrant response to our solicitation

of nominations for "game-changing accomplishments of computing research in the past 20 years" (http://www.cccblog.org/2008/11/04/game-changing-advances-from-computing-research/).

- We launched the "Computing Research Highlight of the Week" (http://www.cra.org/ccc/rharchive). The idea is simple: highlight computing research press releases from universities across the nation. The goals are to draw attention to this exciting research, and to encourage universities to produce more, and more appropriate, press releases describing computing research breakthroughs. The early success of this project is indicated by the arrival of press releases from universities where the CCC Council has no direct contacts – word is getting out.

- Between two and four leading members of the computing research community have presented their own research visions at each meeting of the CCC Council – helping to ensure that the CCC Council is kept informed of trends and directions in a diverse set of fields, and also providing an opportunity for the CCC Council to directly engage research leaders in our mission. There have also been more concrete outcomes – for example, one presenter was connected by the Council with a member of the Presidential Transition Team to "pitch" his initiative, which seemed particularly likely to get traction. A list of these presentations appears in Appendix G.

- The "Computing Innovation Fellows" ("CIFellows") project (http://cifellows.org/), our most recent activity, has engaged a huge cross-section of the computing research community in the establishment of a trial postdoctoral program for the field, responding to the economic circumstances of 2009 that, in the absence of such a program, will cause many new Ph.D. recipients to abandon computing research.

- Many of these activities have been carried out in ways specifically designed to inculcate values of leadership and service in the computing research community. Specific examples include: a broad process for soliciting nominees for the CCC Council; a broad process for soliciting proposals for visioning exercise; extensive mentoring and "coaching" of teams submitting visioning proposals that were not ready to move forward; a broad process for identifying topics and speakers for the Library of Congress symposium; broad engagement of the community in all aspects of the CIFellows program; reaching well beyond CCC Council members and other "obvious suspects" in the preparation of materials for the Presidential Transition Team; presentations at CCC Council meetings by younger leaders of the computing research community.

4c. Engage funding agencies

- The "Big-Data Computing Study Group" workshops provide an excellent example of what can happen when the stars are aligned. CCC Council members and the leaders of these workshops worked with NSF and industry to achieve a number of positive outcomes: establishment of a community of users of data-intensive scalable computing (DISC); establishment of a community of researchers in DISC; the donation of DISC facilities by Google/IBM and by Yahoo!; an NSF-sponsored workshop to equip faculty to teach DISC;

the stimulation of other communities (e.g., the GRID folks) to move in the DISC direction and host symposia of their own. A "progress report" from November 2008 appears on the CCC website: http://www.cra.org/ccc/docs/CCC-Big-Data-update.pdf.

- We have served as an "agent" for NSF CISE in a number of circumstances – for example, the "Computer Science Outside the Box" workshop in November 2008 (which we co-sponsored, along with NSF CISE and CRA, and which we funded), and the "Advances in Computing Research: Reflections and Perspectives" conference held in March 2009. ("Computer Science Outside the Box" was a meeting of 45 leaders of major computing research organizations, focused on steps that might broaden the impact of the field; see http://cotb.si.umich.edu/ and http://www.cccblog.org/2008/11/12/computer-science-outside-the-box/. "Advances in Computing Research: Reflections and Perspective" highlighted a dozen "game-changing advances from computing research conducted in the past 20 years"; see http://www.cccblog.org/2008/11/04/game-changing-advances-from-computing-research/, http://www.cccblog.org/2008/11/30/game-changing-advances-from-computing-research-followup/, and http://www.cra.org/ccc/locsymposium.php, as well as Appendix E.)

- We "adopted" Cyber-Physical Systems as an exercise in learning how to facilitate interactions with non-NSF funding agencies (e.g., DoD and NIST), as well as how to build industry momentum to support new computing research thrusts. A second workshop, focused on engaging industry, has just been approved by the Council. (Overall, we have not made as much progress as we would have liked in engaging funding agencies other than NSF; this is an area that will receive increased attention going forward.)

- We collaborate closely with NSF CISE, the GENI Project Office, and the research community on evolving the Network Science and Engineering (NetSE) research agenda. This is discussed in a subsequent section.

- More broadly, we collaborate with NSF CISE on every aspect of our activities – this is a true Collaborative Agreement. We have bi-weekly scheduled teleconferences with NSF staff, and frequent *ad hoc* teleconferences on specific issues. We are extraordinarily grateful for the guidance that NSF staff provides, as well as for the opportunity to play a role in shaping initiatives of importance to the field.

4d. Engage external communities

- Our Library of Congress Symposium, "Computing Research that Changed the World: Reflections and Perspectives" (http://www.cra.org/ccc/locsymposium.php and Appendix E), provided excellent visibility for our field to Members of Congress and their staffers, as well as to representatives of a broad range of research funding agencies. As well, the outstanding talks from this event represent an excellent resource for the computing research community and others.

- One recent activity – an extremely intense one – has been to engage with members of the Presidential Transition Team to increase the likelihood that computing research and the infrastructure to support computing research receive appropriate prioritization by the new

administration, both in the stimulus package and in the FY10 and subsequent budgets. A set of essays produced under CCC leadership is available at http://www.cra.org/ccc/initiatives; all of these were provided to (*and actually read by!*) members of the transition team, and a number were forwarded for action (e.g., to OMB and to science agencies such as NIH). The fact that the CCC was in place and well-connected to leaders of the research community made it possible to do this on a very tight time schedule and to speak with the authority of a legitimate proxy for the computing research community. Time will tell the extent to which this effort will bear fruit.

- An outgrowth of our work with the Presidential Transition Team involved building a broad coalition to represent the nation's universities in the competition for broadband stimulus funds available through the Department of Commerce and the Department of Agriculture. CCC played the leadership role in building this coalition. The "Unleashing Waves of Innovation" white paper (http://www.cra.org/ccc/docs/init/Unleashing.pdf) appearing on our "Initiatives" web page is a product of this work.

- Two members of the CCC Council, Ed Lazowska and Fred Schneider, engaged a group of leading computer security researchers to communicate on behalf of the computing research community with the individual leading the "60 day review" of the nation's cybersecurity efforts conducted by the new Administration during Spring 2009. See *When the Country Called: How a Team of Academic Experts Contributed to the President's Cyberspace Review* (http://www.nsf.gov/news/news_summ.jsp?org=NSF&cntn_id=114867).

- Web initiatives such as the "Computing Research Highlight of the Week" (http://www.cra.org/ccc/rharchive), the CCC blog (http://www.cccblog.org/), the CCC website (http://www.cra.org/ccc/), and the Computing Research YouTube channel (http://www.youtube.com/computingresearch) are attempts to broaden the communities that are aware of the vibrancy of computing research.

- Plenary presentations at forums such as the Federated Computing Research Conference (with a very broad cross-section of computing researchers, including students), SIGCSE (with heavy attendance from computing educators and students), the CRA Conference at Snowbird (which attracts the heads of all of the nation's academic and industrial computing research organizations), the Grace Hopper Celebration of Women in Computing, and the Coalition to Diversify Computing similarly attempt to spread the word regarding the need for, and the potential for, the articulation of more audacious research visions for the field.

- CCC and CRA have jointly engaged Xenophon, a communications consulting firm, to advise us on ways to create a bolder public presence for the computing field.

5. GENI (the Global Environment for Network Innovations) and NetSE (Network Science and Engineering)

As we noted earlier, at the time the CCC was first conceived by NSF, a significant motivation was to broaden research community engagement in the emerging GENI project. However, GENI was not the core of our response to the solicitation, or of the Cooperative Agreement –

there was an explicit shift toward the broad agenda evidenced in the "tag-line" on the CCC website: "We support the computing research community in creating compelling research visions and the mechanisms to realize these visions."

Within that broad agenda, "helping NSF and the network science and engineering research community frame a compelling research agenda" remains an important task for the CCC. It has been a challenging task. Many factors have contributed to these challenges, some of them pre-dating the creation of the CCC. We will not delve into them here, but will instead focus on what we have accomplished with the NetSE effort:

- The CCC has worked in partnership with NSF, the research community, and the GENI Project Office to achieve a very significant metamorphosis in GENI/NetSE: from an effort to construct a massive instrument in support of research, to an effort to define and explore a broad spectrum of network science and engineering research topics, some of which are likely to require more modest instruments, and some of which will be focused on the innovations required to build the instruments themselves.

- At the July 2009 GENI Engineering Conference, the NetSE Council delivered the "NetSE Research Agenda" – http://www.cra.org/ccc/docs/NetSE-Research-Agenda.pdf. This document drew from the results of the CCC-sponsored workshops listed below and described at http://www.cra.org/ccc/netse:

  - Network Design and Societal Values
        September 24-25, 2008, Arlington, VA
        Chairs: David Clark (MIT) and Helen Nissenbaum (NYU)
  - Network Design in the NetSE Context
        August 17-18, 2008, Seattle, WA; drawing upon tremendous volumes of work carried
            out by the GENI Science Council and the GENI Planning Group
        Chairs: Ellen Zegura (Georgia Institute of Technology) and Aaron Falk (BBN
            Technologies)
  - Behavior, Computation, and Networks in Human Subject Experimentation
        July 31 - August 1, 2008, La Jolla, CA
        Chairs: Michael Kearns (University of Pennsylvania) and Colin Camerer (California
            Institute of Technology)
  - Network Science and Network Design
        July 29-30, 2008, Marina del Rey, CA
        Chairs: John Wroclawski (USC/ISI) and John Doyle (California Institute of
            Technology)
  - Theory of Networked Computation
        June 11, 2008, Boston, MA; drawing upon workshops held February 16-17, 2006,
            Princeton, NJ, and March 16-17, 2006, Berkeley, CA
        Chair: Joan Feigenbaum, Yale University

  We must now work to transition ownership of this activity to members of the appropriate research communities, remaining engaged to help these communities push forward their NetSE-related research agendas.

- The GENI Project Office[5], under the leadership of Chip Elliott, is doing an extraordinary job. The GPO has engaged a cohesive group of strong experimental networking researchers. Multiple coordinated prototyping efforts are underway. A key goal is to advance the experimental capabilities of the research community, both by engaging the community in the prototyping effort, and by placing tools and prototypes into open source and thus into the hands of others.

- The notion of "research-enabling" the networking infrastructure of the nation's research universities seems to have gathered considerable traction, and may be supported as part of the 2009 stimulus package; see http://www.cra.org/ccc/docs/init/Networking.pdf, http://www.cra.org/ccc/docs/init/Infrastructure.pdf, and http://www.cra.org/ccc/docs/init/Unleashing.pdf.

6. Gaps

There are several areas where we had hoped to accomplish more. We note some of those here:

- The pace of progress on GENI/NetSE has been disappointing, but not for lack of time and effort on the part of the CCC. This is a complicated endeavor of the sort the computing research community has not previously undertaken. It is a learn-by-doing effort, and the learning is taking time.

- We are in the early stages of establishing ties with funding agencies other than NSF. The changing of the guard at the dawn of the new administration provides an excellent opportunity to expand this effort. Our work thus far has mostly involved "educational discussions," particularly with NASA science leadership both at headquarters and in the research centers. We view this as a long-term proposition; many of the mission agencies have a different culture than NSF: somewhat more insular, and viewing "initiatives" as heavy-weight entities that take years to launch.

- While we have given several talks to international audiences, and participated in some international visioning exercises, this has not been a major priority for us. We consider this as perhaps an unavoidable gap – there is only so much that we can do. We have been seizing those opportunities that present themselves, however.

- We have not been particularly active on the education front, feeling that coverage of many dimensions of this critical issue has improved significantly in the past two years:

  - Organizations such as NCWIT (http://www.ncwit.org/) are assembling resources for K-12 outreach.
  - Jan Cuny at NSF is overseeing a well-conceived and well-orchestrated effort to revise the AP exam in computer science, and with it the high school computer science curriculum

---

[5] http://www.geni.net/

as well as university introductory courses. (We expect to work with Jan in building momentum for this once the curricular work is done by her group.)
- CRA has established a new education committee – an all-star group chaired by Andy van Dam (http://www.cra.org/vdam.pdf) – focused on undergraduate education in the field.
- At the graduate level, we co-organized the "Computer Science Outside the Box" workshop, where graduate education (e.g., depth vs. breadth) was a major theme (see http://www.cccblog.org/2008/11/12/computer-science-outside-the-box/); we need to be active in follow-up.

7. Overall assessment

The computing research community *needs* a Computing Community Consortium. The opportunity is enormous, and the impact of advances in computing on the nation's economy and our citizens' lives will continue to grow dramatically. Other research communities have developed the means to establish consensus and formulate national research agendas. We are at a point where the computing research community, too, is ready to assume more responsibility for its own success.

The computing research community differs from physical sciences, such as astronomy and physics, where the community gathers to prioritize research challenges because addressing each challenge requires extraordinarily expensive instruments. Computing research is different in two main ways. First, the majority of 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 Computing Community Consortium will be 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 CCC is complementary to organizations such as CRA, CSTB, the CISE Advisory Committee, AAAI, ACM, IEEE-CS, SIAM, and the Usenix Association. Indeed, many members of the CCC Council serve or have served with these organizations. These organizations continue to make a broad spectrum of significant contributions. What they lack, however, is the ability that the NSF has afforded, through CCC, to focus intensively on the critical issue of working with the computing research community and funding agencies to create compelling research visions and the mechanisms to realize these visions. The CCC is a catalyst serving the computing research community and NSF. Among the benefits that CCC offers, beyond the lists of specific accomplishments appearing earlier, are:

- A strong, diverse group of community members. Our community needs *somebody* to be working these issues. Who better?

- Speed and agility. We have provided support to visioning workshops in less than a week in two cases. We mounted an extraordinary effort to respond rapidly and thoroughly to requests from the Obama transition team. The CIFellows effort was conceived and launched in an astonishingly short period of time and has engaged more than 1,000 members of the 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 is unsure about its future direction.

- A vehicle or agent for NSF and, hopefully in the future, other agencies. "Computer Science Outside the Box," "Advances in Computing Research: Reflections and Perspectives," "Unleashing Waves of Innovation" (the broadband coalition), and the interactions regarding the 60-day cybersecurity review are good examples.

- The opportunity for frank discussions of important issue, because the Council's meetings are not public.

8. Specific metrics

Any reasonable assessment of the Computing Community Consortium, particularly in its early years, must be qualitative more than quantitative. In Section 8 of our Strategic Plan we say:

> *The truly important metrics are long-term ones – ones that are also subjective, difficult to assess, and not entirely subject to our direct control. Has the health and vibrancy of the field improved? Are our research visions expansive, inclusive, and far-sighted? Is interest in the field improving? Are the contributions and potential of computing research more widely understood? Are greater numbers of highly qualified researchers willing to accept leadership roles?*

The preceding sections of this Self Assessment are devoted to a qualitative assessment. Nonetheless, in Section 8 of our Strategic Plan we went on to say:

> *There are a set of quantifiable short-term indicators that we will track, however. These will be tracked by CRA's surveys/evaluation staff via appropriate measures.*

It is our intention, during the coming year, to hire a contract evaluator/assessor to carry out this assessment work in a methodical quantitative way. Our brief judgment of performance on the metrics outlined in the Strategic Plan appears below:

- *Breadth and depth of interest in the CCC Council, measured in terms of nominees and membership.*

We received more than 100 nominations for the original CCC Council, and a significant (although not so overwhelming) number for the first renewal of the Council. We have not had a single turndown of individuals who have been asked to join the Council.

- *Perception of the CCC effort by the research community: its value, its impact, its inclusiveness, etc.*

  We have only anecdotal evidence on this point – what we consider to be an extraordinary breadth and depth of participation in CCC activities. We will conduct an assessment.

- *Breadth and depth of interest in visioning workshops and activities, measured in terms of submissions, attendance, work products, general degree of research community participation.*

  See Appendix D and the associated web pages. Interest has been high and participation has been broad.

- *Interest in the results of the visioning activities as evidenced by researchers, funding agencies, and other parties.*

  As discussed earlier in this document, great interest has been demonstrated in a number of cases. We will conduct a formal assessment.

- *Specific followup clearly derived from initial visioning activities – for example, subsequent related activities, funded programs.*

  As discussed earlier in this document, there are cases of clear success, such as Big Data. Much more is in process.

- *Breadth and depth of interest in other CCC activities that may be initiated.*

  We have had huge interest in a number of activities. Looking at just the past six months, the transition team white papers, the Library of Congress symposium, and the CIFellows project all attracted broad interest and show clear signs of significant impact.

- *Quantity, quality, and effectiveness of CCC communication with the field: presentations, blogs, website, videos, etc.*

  Appendix E, Appendix F, Appendix G, and various earlier sections of this report enumerate a number of specific instances. We will quantify and assess these and others.

- *Quantity, quality, and effectiveness of CCC communication about the field: articles, white papers, presentations, events, etc.*

  Appendix E, Appendix F, and various earlier sections of this report enumerate various specific instances. Again, we will quantify and assess these and others.

- *Flexibility and agility, measured by the crafting of new forms of response when the community articulates a need for change.*

  We have had several strong successes here: in the past six months, for example, the transition team white papers, the Library of Congress symposium, the CIFellows program, and newly-launched initiatives on IT and Energy and on IT and Health.

- *Speed in initiating and/or responding to opportunities that appear to offer significant benefit to the field, as contrasted to the speed with which government agencies can act in similar situations.*

  The CIFellows program is a perfect example: less than 5 months elapsed from original concept to announcement of awards through a uniquely structured competition that attracted more than 1,200 prospective mentors and more than 500 applicants.

- *Specific assistance rendered by CCC to research sub-communities in establishing connections with funding agencies and with industry, measured by the creation of new funding programs.*

  As one example, we have assisted the cyber physical systems community in establishing connections with non-NSF government agencies, and with industry.

- *Success in delivering a NetSE Research Agenda, and general success of the GENI/NetSE initiative.*

  The NetSE Research Agenda has been delivered! See – http://www.cra.org/ccc/docs/NetSE-Research-Agenda.pdf.

- *Indicators of increasing willingness by researchers to provide leadership, e.g., to serve as mentors to younger researchers, to serve as program directors, etc.*

  We are not yet in a position to assess this – it's a long-term proposition.

- *Diversity of participation in all CCC activities.*

  As with all of these areas, a careful quantitative assessment is needed, but we have taken great pains to ensure inclusiveness in all of our activities, from constituting the CCC Council to selecting the CIFellows.

Again, it is our intention, during the coming year, to hire a contract evaluator/assessor to carry out assessment work in a methodical quantitative way. At the same time, we re-emphasize that any reasonable assessment of the Computing Community Consortium, particularly in its early years, must be qualitative more than quantitative.

9. Future directions

The period of this self-assessment covers the establishment of the CCC and its emergence as a going concern. In the coming period, the CCC will focus on consolidating the accomplishments noted above, while continuing to broaden participation by community leaders and exploring the frontiers of opportunity for the field. We will devote particular attention to shaping the insights of this learn-by-doing process into programmatic suggestions for NSF and other funding agencies.

Continuing to broaden the engagement of the computing research community in envisioning game-changing research initiatives is our number one goal. In speaking with strong researchers who have not participated in our activities, we hear the following points:

- The promise of CCC is a long-term one: build a community, define an agenda, pursue programmatic support. But with CISE funding rates in the 10%-20% range, DARPA missing-in-action, and industrial research support hard to come by, researchers are strapped for resources *now* – they are so busy scrambling for immediate funding that it is hard to find time to invest in the future.

- The activities of the CCC tend to benefit the computing research community as a whole, not the specific individuals who contribute their time to those activities. Why should one believe, for example, that those who contribute to defining the NetSE research agenda will reap rewards commensurate with their contributions? (There is considerable evidence to the contrary!)

- The lack of instrumentation / infrastructure / facilities is not perceived of as being as great a barrier to research success in our field as is lack of funding for people: faculty, postdocs, and graduate students. The successes of other fields (e.g., Physics and Astronomy) and the past successes and current foci of our field (supercomputer centers, GENI, Big Data Computing) are perceived as being about instrumentation / infrastructure / facilities rather than about people.

The imperatives for the CCC are clear – and consistent with our direction since our inception:

- The CCC should encourage the community to focus on a broad range of research visions, not just those requiring instrumentation / infrastructure / facilities.

- The CCC should help the community formulate these visions in ways that will make the pie larger, rather than merely adding to the demand placed on an existing pie that falls far short of meeting the opportunities for the field and for the nation.

- The CCC should attempt to achieve and demonstrate payoff for communitarian activities. (We note a key portion of Section G ("Measuring the Success of the CCC") of CRA's response to the CCC solicitation, quoted earlier: "It is important to note that ours is a shared responsibility – researchers need to see responses to their activities on behalf of the CCC. NSF and other funding agencies need to be responsive and ensure that the community efforts have real (monetary) impact."

- The CCC should strive to broaden engagement by selfless leaders of the field who will share their time and energy and ideas for the good of all.

There are a number of specific areas that we will attempt to "fine tune" in our second phase of operation:

- Increase workshop follow-up by workshop organizers, the CCC, and members of the computing research community, ensuring that workshop results are made available in a timely fashion to the entire computing research community, and focusing on translating research visions into funded initiatives with federal and corporate support.

- More generally, evaluate the success of the workshop process, and explore other mechanisms to "support the computing research community in creating compelling research visions and the mechanisms to realize these visions."

- Broaden ongoing conversations with representatives of funding agencies other that NSF – recognizing that this is a long-term proposition involving learning and flexibility on the part of all involved. DARPA, DoD more generally, and DoE (both the Office of Science and the Labs) should receive particular attention.

- Focus even more on visibility and on inclusiveness. CCC, like CRA, tends to be viewed as "elitist," despite significant attention to behaving otherwise. The CCC blog is one example of an effort at inclusiveness. We are highly attentive to the "openness" of visioning workshops. We need to find additional mechanisms.

- Continue our recent efforts to respond to requests from government officials for information about computing research, complementing the efforts of organizations such as CRA. Despite the state of the economy, we expect this activity to present significant opportunities for "growing the pie" during the next few years.

- Transition ownership of the NetSE activity to members of the appropriate research communities, remaining engaged to help these communities push forward their NetSE-related research agendas.

- Re-assess participation in issues related to computer science education, taking renewed stock of ongoing activities by our partner organizations.

- Re-assess goals and plans for incorporating non-U.S. interactions with the activities of the CCC.

- Devise and institute a process for encouraging active engagement by a greater proportion of Council members.

It is our honest assessment that, working with CISE and the computing research community, we have contributed in the past two years to a substantial "quickening of the pace" and "heightening of the visibility" of computing research. Specific examples from just the past six months include our work with the Presidential Transition Team, our efforts to build a coalition around the broadband stimulus, our coordination of community interaction with the individual leading the 60-day review of the nation's cybersecurity status, the Library of Congress symposium "Computing Research that Changed the World," and our creation of the Computing Innovation Fellows project – as well as the substantial progress of a number of our community-driven "visioning activities."

Many of these activities were only implicitly part of our "plan." Rather, they 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 – is critical to the success of the CCC.

Appendix A

Members of the team assembled by CRA to respond to the NSF CCC solicitation

Andrew Bernat, Computing Research Association
Randall Bryant, Carnegie Mellon University
Susan Graham, UC Berkeley
Anita Jones, University of Virginia
Richard Karp, UC Berkeley
Ken Kennedy, Rice University
Ed Lazowska, University of Washington
Peter Lee, Carnegie Mellon University
Dan Reed, University of North Carolina and CRA Board Chair
Wim Sweldens, Bell Laboratories
Jeffrey Vitter, Purdue University

Appendix B

Members of the Interim CCC Council (announced in December 2006)

Greg Andrews, University of Arizona *(member of the Office of the Chair)*
Bill Feiereisen, Los Alamos National Laboratory
Susan Graham, UC Berkeley *(member of the Office of the Chair)*
Jessica Hodgins, Carnegie Mellon University
John Hollerbach, University of Utah
Daniel Jackson, Massachusetts Institute of Technology
Anita Jones, University of Virginia *(member of the Office of the Chair)*
Richard Karp, UC Berkeley
Ken Kennedy, Rice University *(member of the Office of the Chair)*
John King, University of Michigan
Peter Kogge, Notre Dame University
Ed Lazowska, University of Washington *(member of the Office of the Chair)*
Ran Libeskind-Hadas, Harvey Mudd College *(member of the Office of the Chair)*
Dan Ling, Microsoft Corporation
Dan Reed, University of North Carolina and CRA Board Chair *(member of the Office of the Chair)*
Francis Sullivan, Institute for Defense Analysis
David Tennenhouse, A9
Ellen Zegura, Georgia Institute of Technology

Appendix C

Members of the inaugural CCC Council (announced in June 2007)

Greg Andrews, University of Arizona
Andrew Bernat, Computing Research Association *(ex officio)*
Bill Feiereisen, Lockheed Martin Corp.
Susan Graham, UC Berkeley *(vice chair)*
Anita Jones, University of Virginia
David Kaeli, Northeastern University
Richard Karp, UC Berkeley
John King, University of Michigan
Ed Lazowska, University of Washington *(chair)*
Peter Lee, Carnegie Mellon University
Andrew McCallum, University of Massachusetts – Amherst
Beth Mynatt, Georgia Institute of Technology
Dan Reed, Microsoft Research and CRA Board Chair *(ex officio)*
Fred Schneider, Cornell University
Robert Sproull, Sun Microsystems Laboratories
Karen Sutherland, Augsburg College
David Tennenhouse, New Venture Partners
David Waltz, Columbia University

Council rotation in Winter 2009

Rotate off
    Greg Andrews, University of Arizona
    Karen Sutherland, Augsburg College

Reappoint
    Anita Jones, University of Virginia
    Richard Karp, UC Berkeley
    Robert Sproull, Sun Microsystems Laboratories

Appoint
    Stephanie Forrest, University of New Mexico
    Chris Johnson, University of Utah
    M. Frans Kaashoek, Massachusetts Institute of Technology
    Ran Libeskind-Hadas, Harvey Mudd College
    Robin Murphy, Texas A&M University

Appendix D

CCC-sponsored visioning exercises

Efforts that are well underway
    Network Science and Engineering
        Chair: Ellen Zegura, Georgia Institute of Technology
    Cyber-Physical Systems
        Chair: Jack Stankovic, University of Virginia
    From Internet to Robotics: The Next Transformative Technology
        Chair: Henrik Christensen, Georgia Institute of Technology
    Big-Data Computing Study Group
        Chairs: Randall Bryant, Carnegie Mellon University, and Thomas Kwan, Yahoo!
    Visions for Theoretical Computer Science
        Chair: Richard Ladner, University of Washington

Efforts that are approved and currently launching
    One Learning Community per Student: Global Resources for Online Education
        Chair: Beverly Woolf, University of Massachusetts - Amherst
    System-level, Cross-layer Cooperation to Achieve Predictable Systems from Unpredictable
        Components
        Chairs: Nick Carter, Intel Corporation, Andre' DeHon, University of Pennsylvania, and
            Heather Quinn, Los Alamos National Laboratory
    Where Does Free/Open Source Software Fit into CISE Research?
        Chair: Walt Sacchi, UC Irvine
    Information and Communication Technologies for Global Development: A New Grand
        Challenge for Computing Research
        Chair: Tapan Parikh, UC Berkeley

Efforts that are still in the "coaching" process
    Advancing Computer Architecture Research
        Chairs: Josep Torrellas, University of Illinois, and Mark Oskin, University of
            Washington
    Evaluation of Research in Human-Level AI
        Chairs: John Laird, University of Michigan, and Pat Langley, Arizona State University

Efforts that were not moved forward
    Cyber Security with Apotropaic Language Technology
        Chair: Jordan Cohen, SRI International
    The Future of Social Computing Networks
        Chair: Subhash Kak, Oklahoma State University
    Computational Thinking Will Influence People's Lives in the Future
        Chair: Li Chen, University of the District of Columbia
    Creating Visions for Resilient Networking Research
        Chair: Deep Medhi, University of Missouri – Kansas City

The COMMONS Project: Cooperative Measurement and Modeling of Open Networked
    Systems
    Chair: K.C. Claffy, UC San Diego
Brain in a Bottle
    Chair: Seth Goldstein, Carnegie Mellon University

Appendix E

Talks and articles describing CCC and its activities

Andrew Bernat (CRA) and Dan Reed (University of North Carolina), "NSF Selects CRA to Create Computing Community Consortium; Effort Will Envision Major Research Opportunities," *Computing Research News*, November 2006.[6]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," Utrecht University (The Netherlands), December 2006.[7]

Bill Feiereisen (Lockheed Martin Corp.), "The Computing Community Consortium," 19th Open Grid Forum (Chapel Hill NC), January 2007.[8]

Ed Lazowska (University of Washington), "The Computing Community Consortium," NSF CISE Advisory Committee, May 2007.[9]

Ed Lazowska (University of Washington), "Computer Science: Past, Present and Future," Dertouzos Lecture, MIT Computer Science and Artificial Intelligence Laboratory, May 2007.[10]

Andrew Bernat (CRA) and Ed Lazowska (University of Washington), "The Computing Community Consortium – The Way Forward," *Computing Research News*, May 2007.[11]

Ed Lazowska (University of Washington), "Introducing the Computing Community Consortium," Plenary Talk, NSF RI PI Meeting (Boston MA), June 2007.[12]

Christos Papadimitriou (UC Berkeley), "The Algorithmic Lens: How the Computational Perspective is Transforming the Sciences," Plenary Talk, Federated Computing Research Conference (San Diego CA), June 2007 (preceded by Ed Lazowska (University of Washington), "Introducing the Computing Community Consortium").[13]

Bob Colwell (Intel, ret.), "Computer Architecture Futures 2007," Plenary Talk, Federated Computing Research Conference (San Diego CA), June 2007 (preceded by Ed Lazowska (University of Washington), "Introducing the Computing Community Consortium").[14]

Randal Bryant (Carnegie Mellon University), "Data-Intensive Scalable Computing: Taking Google-Style Computing Beyond Web Search," Plenary Talk, Federated Computing Research

---

[6] http://www.cra.org/CRN/articles/nov06/bernat.reed.html
[7] http://lazowska.cs.washington.edu/Bernat.CCC.pdf
[8] http://lazowska.cs.washington.edu/Feiereisen.CCC.OGF1.pdf
[9] http://lazowska.cs.washington.edu/ccc/Lazowska%20CCC%20for%20NSF.pdf
[10] http://lazowska.cs.washington.edu/Lazowska.CCC.MIT.pdf
[11] http://www.cra.org/CRN/articles/may07/bernat.lazowska.html
[12] http://lazowska.cs.washington.edu/Lazowska.CCC.NSFRI.pdf
[13] http://lazowska.cs.washington.edu/fcrc/Christos.FCRC.pdf
[14] http://lazowska.cs.washington.edu/fcrc/Colwell.FCRC.pdf

Conference (San Diego CA), June 2007 (preceded by Ed Lazowska (University of Washington), "Introducing the Computing Community Consortium").[15]

Scott Shenker (UC Berkeley), "We Dream of GENI: Exploring Radical Network Designs," Plenary Talk, Federated Computing Research Conference (San Diego CA), June 2007 (preceded by Ed Lazowska (University of Washington), "Introducing the Computing Community Consortium").[16]

Ed Lazowska (University of Washington), "Computer Science: Past, Present and Future," Plenary Talk, Federated Computing Research Conference (San Diego CA), June 2007.[17]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," University of Washington - Tacoma, July 2007.[7]

Bill Feiereisen (Lockheed Martin Corp.), "The Computing Community Consortium," Army Research Laboratory (Aberdeen MD), August 2007 (excerpt from a larger talk).[18]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," University of Massachusetts - Amherst, September 2007.[7]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," Worcester Polytechnic Institute, September 2007.[7]

Bill Feiereisen (Lockheed Martin Corp.), "The Computing Community Consortium," Swiss Federal Institute of Technology (Lausanne, Switzerland), October 2007 (excerpt from a larger talk).[19]

Ed Lazowska (University of Washington), "Computer Science: Past, Present and Future," Department of Computer Science & Engineering, University of Washington, October 2007.[20]

Beth Mynatt (Georgia Institute of Technology), "Research Visions in User Interfaces," 20th ACM Symposium on User Interface Software and Technology (UIST) (Newport RI), October 2007 (oral presentation).

Bill Feiereisen (Lockheed Martin Corp), "The Computing Community Consortium," 21st Open Grid Forum (Seattle WA), October 2007.[21]

Susan Graham (UC Berkeley) and Jennifer Rexford (Princeton University), "Introducing the Computing Community Consortium," Grace Hopper Celebration of Women in Computing (Orlando FL), October 2007.[22]

---

[15] http://lazowska.cs.washington.edu/fcrc/Bryant.FCRC.pdf
[16] http://lazowska.cs.washington.edu/fcrc/Shenker.FCRC.pdf
[17] http://lazowska.cs.washington.edu/fcrc/Lazowska.FCRC.pdf
[18] http://lazowska.cs.washington.edu/Feiereisen.CCC.ARO.pdf
[19] http://lazowska.cs.washington.edu/Feiereisen.CCC.EPFL.pdf
[20] http://lazowska.cs.washington.edu/Lazowska.CCC.UW.pdf
[21] http://lazowska.cs.washington.edu/Feiereisen.CCC.OGF2.pdf

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," University of Texas - Austin, October 2007.[7]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," Texas A&M University, October 2007.[7]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," University of Houston, October 2007.[7]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," Rice University, October 2007.[7]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," University of Nevada - Reno, November 2007.[7]

Ed Lazowska (University of Washington), "Computer Science: Past, Present and Future," Keynote Talk, NCWIT semiannual meeting (Seattle WA), November 2007.[23]

Bill Feiereisen (Lockheed Martin Corp), "Reminiscences of Collaboration with Ken Kennedy," Workshop in Memory of Ken Kennedy, Rice University, December 2007 (oral tribute).

"The Computing Community Consortium: Who, What, When, Where, Why, and How," *Computing Research News*, January 2008.[24]

Ed Lazowska (University of Washington), "The Computing Community Consortium: Stimulating Bigger Thinking," Computing Leadership Summit (Washington DC), February 2008.[25]

Ed Lazowska (University of Washington), "Computer Science: Past, Present and Future," Keynote Address, SIGCSE Annual Conference (Portland OR), March 2008.[26]

Andrew Bernat (CRA), "The Computing Community Consortium: Stimulating Bigger Thinking," Grand Challenges in Computing Research 2008 (London, England), March 2008.[27]

David Waltz (Columbia University), "The Computing Community Consortium," presentation to AAAI Strategic Planning Working Group (Palo Alto CA), March 2008 (oral presentation).

Ed Lazowska (University of Washington), "The Computing Community Consortium: Stimulating Bigger Thinking," CITI Distinguished Lecture Series, Rice University, April 2008.[28]

[22] http://www.cra.org/ccc/docs/graham.rexford.hopper.pdf
[23] http://lazowska.cs.washington.edu/Lazowska.CCC.NCWIT.pdf
[24] http://www.cra.org/CRN/articles/jan08/who.html
[25] http://www.cra.org/ccc/docs/Lazowska.CCC.08.pdf
[26] http://lazowska.cs.washington.edu/SIGCSE/slides.pdf
[27] http://www.cra.org/ccc/docs/19MAR08_UKCRC.pdf
[28] http://lazowska.cs.washington.edu/Lazowska.CCC.Rice.pdf

Bill Feiereisen (Lockheed Martin Corp.), "The Computing Community Consortium," European Union e-Infrastructure Reflection Group, Swiss Federal Institute of Technology (Zurich, Switzerland), April 2008.[29]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," University of Illinois - Urbana-Champaign, May 2008.[7]

Ed Lazowska (University of Washington), "The Computing Community Consortium: Stimulating Bigger Thinking," CCC Workshop on Visions for Theoretical Computer Science (Seattle WA), May 2008.[30]

David Kaeli (Northeastern University), "The Computing Community Consortium – Overview, and how you can be part of this community," CRA-W/CDC Systems Research Mentoring Workshop (Newark DE), June 2008.[31]

Ed Lazowska (University of Washington), Susan Graham (UC Berkeley), and Andrew Bernat (CRA), "The Computing Community Consortium: An Update," NSF CISE leadership (Arlington VA), July 2008.[32]

Ed Lazowska (University of Washington) and Susan Graham (UC Berkeley), "The Computing Community Consortium: Stimulating Bigger Thinking," Plenary Session, CRA Conference at Snowbird (Snowbird UT), July 2008.[33]

Richard Ladner (University of Washington), "Visions for Theoretical Computer Science," Plenary Session, CRA Conference at Snowbird (Snowbird UT), July 2008.[34]

Randal E. Bryant (Carnegie Mellon University), "Data-Intensive Scalable Computing," Plenary Session, CRA Conference at Snowbird (Snowbird UT), July 2008.[35]

Ellen Zegura (Georgia Institute of Technology), "Network Science and Engineering Update," Plenary Session, CRA Conference at Snowbird (Snowbird UT), July 2008.[36]

Chip Elliott (BBN Technologies), "GENI," Plenary Session, CRA Conference at Snowbird (Snowbird UT), July 2008.[37]

Ed Lazowska (University of Washington), "Envisioning the Future of Computing Research," invited "Viewpoint," *Communications of the ACM*, August 2008.[38]

---

[29] http://lazowska.cs.washington.edu/Feiereisen.CCC.Zurich.pdf
[30] http://www.cra.org/ccc/docs/CCC_for_Visioning_Groups.pdf
[31] http://lazowska.cs.washington.edu/Kaeli.CCC.pdf
[32] http://lazowska.cs.washington.edu/Lazowska.CCC.for.NSF.pdf
[33] http://lazowska.cs.washington.edu/snowbird08/CCC.pdf
[34] http://lazowska.cs.washington.edu/snowbird08/Theory.pdf
[35] http://lazowska.cs.washington.edu/snowbird08/DISC.pdf
[36] http://lazowska.cs.washington.edu/snowbird08/NetSE.pdf
[37] http://lazowska.cs.washington.edu/snowbird08/GENI.pdf

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," Edith Cowan University (Perth, Western Australia), August 2008.[7]

Andrew Bernat (CRA), "CRA and the Computing Community Consortium," University of Melbourne (Melbourne, Australia), September 2008.[7]

Beth Mynatt (Georgia Institute of Technology), "Research Visions in User Interfaces," 21st ACM Symposium on User Interface Software and Technology (UIST) (Monterey CA), October 2008 (oral presentation).

Ed Lazowska (University of Washington), "The Computing Community Consortium: Stimulating Bigger Thinking," GENI Engineering Conference (Palo Alto CA), October 2008.[39]

"CCC Update," *Computing Research News*, November 2008.[40]

Ed Lazowska (University of Washington), "IT R&D Issues and Priorities for the New Administration," NRC Computer Science & Telecommunications Board (Mountain View CA), January 2009.[41]

Ed Lazowska (University of Washington), "The Computing Community Consortium: An Update," CRA Computing Leadership Summit (Washington DC), February 2009.[42]

"CCC Update," *Computing Research News*, March 2009.[43]

Ellen Zegura, "What is a 'Better Internet'?," *Computing Research News*, March 2009.[44]

"Computing Research that Changed the World: Reflections and Perspectives," Library of Congress, March 2009.[45] (See Appendix E.)

Ed Lazowska (University of Washington), "The Computing Community Consortium: Stimulating Bigger Thinking," Tapia Conference Career Workshop (Portland OR), April 2009.[46]

Ed Lazowska (University of Washington), "eScience: Techniques and Technologies for 21st Century Discovery," Commission Meeting, Western Interstate Commission for Higher Education (Las Vegas NV), May 2009.[47]

---

[38] http://www.cra.org/ccc/docs/viewpoint-lazowska.pdf
[39] http://lazowska.cs.washington.edu/Lazowska.CCC.for.GEC.pdf
[40] http://www.cra.org/CRN/articles/nov08/CCC-Update.html
[41] http://lazowska.cs.washington.edu/CSTB2009.pdf
[42] http://lazowska.cs.washington.edu/Summit2009.pdf
[43] http://www.cra.org/CRN/articles/march09/CCC_Update.html
[44] http://www.cra.org/CRN/articles/march09/Zegura_Better_Internet.html
[45] http://www.cra.org/ccc/locsymposium.php
[46] http://www.cra.org/ccc/docs/Lazowska_Tapia_09.pdf
[47] http://lazowska.cs.washington.edu/wiche.pdf

"Computing Research that Changed the World," *Computing Research News*, May 2009.[48]

---

[48] http://www.cra.org/CRN/articles/may09/locsymposium.html

Appendix F

"Computing Research that Changed the World: Reflections and Perspectives"[49]

This invitation only symposium was organized by the Computing Community Consortium in collaboration with Congressman Bart Gordon (D-TN), Congressman Ralph Hall (R-TX), Congressman Daniel Lipinski (D-IL), Congressman Vern Ehlers (R-MI), Congressman Rush Holt (D-NJ) and Sen. Jay Rockefeller (D-WV). It was held in the Library of Congress on March 25, 2009.

The overall message of the symposium was that computing research has made game-changing advances in the last two decades, from which we can extract lessons for structuring future programs to sustain that track record.

The symposium had four sessions: "The Internet and the World Wide Web," "Evolving Foundations," "The Transformation of the Sciences via Computation," and "Computing Everywhere!" Each session included three talks and a short discussion that identified future challenges. These four sessions were followed by a discussion among all the speakers, with input from attendees, which framed a call-to-action for the future. The symposium concluded with a session providing the opportunity for informal interaction, as well as remarks from some of our Congressional guests, a brief summary of the highlights of the day, and several demonstrations. Talks and discussions were videotaped to make the symposium material broadly available.

Introductory Session: Changing the World
 Ed Lazowska (University of Washington), "Changing the World."[50]

Session 1: The Internet and the World Wide Web
 Alfred Spector (Google), "Why We're Able to Google."[51]
 Eric Brewer (UC Berkeley), "The Magic of the 'Cloud': Supercomputers for Everybody, Everywhere."[52]
 Luis von Ahn (Carnegie Mellon University), "Human Computation."[53]

Session 2: Evolving Foundations
 Barbara Liskov (Massachusetts Institute of Technology), "Security of Online Information."[54]
 Daphne Koller (Stanford University), "Learning to Improve Our Lives."[55]
 Jon Kleinberg (Cornell University), "Global Information Networks."[56]

---

[49] http://www.cra.org/ccc/locsymposium.php
[50] http://www.cra.org/ccc/docs/locslides/pdf/Intro_Lazowska.pdf
[51] http://www.cra.org/ccc/docs/locslides/pdf/S1_Spector.pdf
[52] http://www.cra.org/ccc/docs/locslides/pdf/S1_Brewer.pdf
[53] http://www.cra.org/ccc/docs/locslides/pdf/S1_LuisvonAhn.pdf
[54] http://www.cra.org/ccc/docs/locslides/pdf/S2_Liskov.pdf
[55] http://www.cra.org/ccc/docs/locslides/pdf/S2_Koller.pdf
[56] http://www.cra.org/ccc/docs/locslides/pdf/S2_Kleinberg.pdf

Session 3: The Transformation of the Sciences via Computation
　　　Larry Smarr (UC San Diego), "Supercomputers and Supernetworks are Transforming Research."[57]
　　　Chris Johnson (University of Utah), "Computing and Visualizing the Future of Medicine."[58]
　　　Gene Myers (Howard Hughes Medical Institute), "Zooming In On Life."[59]

Session 4: Computing Everywhere!
　　　Deborah Estrin (UCLA), "Sensing Everywhere!"[60]
　　　Pat Hanrahan (Stanford University), "Pixels Everywhere!"[61]
　　　Rodney Brooks (Massachusetts Institute of Technology), "Robots Everywhere!"[62]

---

[57] http://www.cra.org/ccc/docs/locslides/pdf/S3_Smarr.pdf
[58] http://www.cra.org/ccc/docs/locslides/pdf/S3_Johnson.pdf
[59] http://www.cra.org/ccc/docs/locslides/pdf/S3_Myers.pdf
[60] http://www.cra.org/ccc/docs/locslides/pdf/S4_Estrin.pdf
[61] http://www.cra.org/ccc/docs/locslides/pdf/S4_Hanrahan.pdf
[62] http://www.cra.org/ccc/docs/locslides/pdf/S4_Brooks.pdf

Appendix G

External speakers at meetings of the CCC Council

<u>November 2007</u>
    Research visions:
        Michael Kearns, University of Pennsylvania: New Research Directions in Computer
            Science, Economics, and Sociology
        Silvio Micali, MIT: Beyond Rational Security
        Andrew Moore, Google Pittsburgh: What if there are 10,000 2007-era Workstations per
            US Citizen in 2023?
    Other guests:
        Ellen Zegura, Georgia Institute of Technology and GENI Science Council Chair: GENI
            Science Council Update
        Jeannette Wing, NSF CISE: View and Role of CCC

<u>March 2008</u>
    Research visions:
        Joe Hellerstein, UC Berkeley: Industrial Revolution: Data ... and Software?
        Andrew Ng, Stanford University: Neuroscience-Informed Artificial Intelligence
        Dave Patterson, UC Berkeley: The Parallel Computing Challenge
        Fernando Pereira, University of Pennsylvania and Google: Natural Semantics
        Hal Varian, UC Berkeley and Google: How To Determine What's Important
    Other guests:
        Peter Harsha, CRA: Making the Funding Pie Larger

<u>July 2008</u>
    Research visions:
        Edward Felten, Princeton University: Research in Information Technology Policy
        Haym Hirsh, Rutgers University and NSF: Artificial, Natural, and Social Intelligence
    Other guests:
        Henry Kelly, Federation of American Scientists: Positioning Computing Research with
            the Next Administration
        Transitioning Successful Workshops into Funded Programs (panel discussion):
            Helen Gill, Program Director, Embedded and Hybrid Systems program, NSF CISE
                CNS
            Anita Jones, Lawrence R. Quarles Professor of Engineering and Applied Science,
                University of Virginia, and former Director of Defense Research and Engineering
            Carl Landwehr, Program Manager, Intelligence Advanced Research Projects Activity
            Peter Lyster, Program Director, Center for Bioinformatics and Computational
                Biology, NIH National Institute of General Medical Sciences
            Jack Stankovic, BP America Professor of Computer Science, University of Virginia,
                and Cyber-Physical Systems co-initiator
        Ellen Zegura, Georgia Institute of Technology and NetSE Council Chair: NetSE Council
            Activities

October 2008
    Research visions:
        Luis Barroso, Google: The Case for Energy-Proportional Computing
        Vladen Koltun, Stanford University: Computer Graphics as a Telecommunication
            Medium
        Mark Moir, Sun Microsystems: Challenges with Bootstrapping Transactional Memory
        Sebastian Thrun, Stanford University and Google: Information Technology and
            Transportation
    Other guests:
        Peter Harsha, CRA: Post-Election Strategy

March 2009
    Research visions:
        Prabhakar Raghavan, Yahoo!: Hard Science Problems at the Core of the Web
        John Tang, Microsoft Research: Social Media: Future or Fad in Supporting
            Collaboration?
        Drew Endy, Stanford: Computing the Future of Biology & Biotechnology
    Other guests:
        The state of networking research, NetSE, and GENI (presentations and discussion):
            Nick McKeown, Stanford: Stanford Clean Slate Program
            Chip Elliott, GENI Project Office: GENI
            Ellen Zegura, Georgia Institute of Technology and NetSE Council Chair (via
                teleconference): NetSE briefing

July 2009
    Other guests:
        Computing research and energy (presentation and discussion):
            Steve Koonin, Assistant Secretary for Science, U.S. Department of Energy
        Computing research and health care (presentation and discussion):
            Herb Lin, Chief Scientist, NRC Computer Science and Telecommunications Board
            Karin Remington, Director, NIGMS Center for Bioinformatics and Computational
                Biology
        Computing research and the Department of Defense (discussion):
            Zach Lemnios, Director, Defense Research and Engineering (DDR&E)
        NSF CISE update (discussion):
            Jeannette Wing, Assistant Director for CISE, NSF