Computing Community Consortium
Strategic Plan

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1. Vision

Today, many important facts about information technology have become widely accepted: that advances in information technology are transforming all aspects of our lives; that advances in information technology drive our economy; that advances in information technology enable innovation in all other fields; that leadership in information technology is essential to the nation.

It is less widely accepted, though, that Federally-sponsored research (as opposed to corporate R&D) provides the foundation for progress. And there is even greater debate concerning the opportunity for continued innovation, and the role that advances in information technology will play in addressing the societal grand challenges of the 21st century – challenges that will catalyze research investment and public support, and that will attract the best and brightest minds of a new generation.

Additionally, the "instrumentation-driven" processes that motivate prioritization in some other fields do not generalize to computing research, where instrumentation tends to be more easily affordable. The dominant need in our field is not for an ordered list of research priorities, but rather for a mechanism to drive, catalyze and otherwise advance the speed at which challenges are defined and addressed, and to clearly link these challenges to major societal agendas.

Our field must come together to engage in a continuous, effective, inclusive process of envisioning, articulating and pursuing compelling research goals, coupled with education that attracts new generations of students to the field. This is the vision that stimulated the creation of the Computing Community Consortium:

> *The computing research community will come together to engage in a continuous, effective, inclusive process of envisioning, articulating and pursuing compelling research goals, coupled with education that attracts new generations of students to the field.*

2. Mission

That the doubts described in the previous section exist is clear demonstration of the need for a Computing Community Consortium. The opportunities for our field – and the responsibilities of our field – are unparalleled. One need only look at the National Academy of Engineering's 14 "Grand Challenges for Engineering" for the 21st century (http://www.engineeringchallenges.org/) to see the role that advances in information technology *must play* in the years to come.

The mission of the Computing Community Consortium was stated clearly in CRA's response[1] to NSF's Computing Community Consortium Program Solicitation[2]:

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.

This was amplified in the NSF Cooperative Agreement governing the CCC[3]:

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.

These statements define the mission of the CCC.

3. Goals

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 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.*

To these, we would now add two others:

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.*

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[1] http://www.cra.org/ccc/docs/CCC.proposal.pdf, Section A.1 ("Motivation")
[2] http://www.nsf.gov/pubs/2006/nsf06551/nsf06551.htm
[3] http://www.cra.org/ccc/docs/ccc-term-conds.pdf

To elaborate a bit on the intention of each of these goals:

- The computing research community must do a better job in the future than we have in the past of envisioning longer range, more audacious research challenges. We must frame our research in these terms, and also in the context of societal grand challenges that will catalyze broad-based research investment and public support and that will attract the best and brightest minds of a new generation. This is goal 3.

- This sort of vision cannot be "imposed from the top." Rather, we must create a climate within the broad computing research community that makes it organic. We must increase the extent to which we work together as a community to envision our future research needs and thrusts. This is goal 1.

- We must gain support for initiatives by communicating the excitement and potential of our field to our colleagues in other fields, to policymakers, and to the public. This is goal 2.

- More audacious thinking, framing our research in the context of societal grand challenges, and communicating the excitement and potential of our field will lay the foundation upon which, with additional effort, we can build a greater level of research funding, allowing us to fulfill our potential and continue to change the world. This is goal 4.

- The increased vigor of the field, properly communicated, will attract the best and brightest minds of a new generation, regardless of gender, ethnicity, etc. This is goal 5.

- All of this takes work – individuals throughout the research community who are willing to lead and to serve, for the benefit of the community as a whole. Values of leadership and service can be inculcated through inclusion and mentoring. This is goal 6.

- Finally, in order to be effective, the Computing Community Consortium must be accepted by the computing research community as "belonging to it" – as being not just "for" the computing research community, but "of" it. The launch (as well as the ongoing operation) of the CCC must be carried out with great attention to this issue, or the CCC will fail due to lack of community support. This is goal 0.

All but goal 0 are long-term goals. They are difficult to measure, and they are not entirely under our control, but we embrace them as the appropriate goals for the CCC, working in partnership with others.

4. Strategies

We have four highest-level strategies to achieve these goals, and many sub-strategies:

1. *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.
   a. Create initial community ownership of the CCC by establishing an inaugural CCC Council through an open and inclusive process. Seek a Council that – subject to the limits on its size – represents the diversity of the computing research field.
   b. Bring leaders of the field together in various forums to devise shared goals and messages, to encourage leadership and service, and to generally engage them in the mission of the CCC.
   c. Create diverse vehicles for communication with the broad computing research community, and for allowing members of the community to communicate with one another.

2. *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.
   a. Invigorate the broad computing research community by reminding them in specific terms of the extraordinary contributions that our field has made, and of the instrumental role that we must play in tackling the societal grand challenges of the 21st century.
   b. Inspire the broad computing research community to envision and articulate longer-range, more audacious research challenges by exposing them to appropriate efforts already underway.
   c. Embrace those efforts that are already underway, for three reasons: to assist and amplify them, to gain early experience with all stages of "the visioning pipeline," and to create a sense of momentum.
   d. Create specific mechanisms for various sub-communities to come together and engage in the research visioning process; publicize the results of these efforts to inspire other sub-communities.
   e. Utilize diverse vehicles for communication with the broad computing research community, and for allowing members of the community to communicate with one another.
   f. Engage a broad swath of the computing research community in the activities of CCC.
   g. Demonstrate agility, flexibility, and speed.

3. *Engage funding agencies:* Work to align agency programs with emerging research visions.
   a. Assist sub-communities in engaging funding agencies and industry in support of their research visions.
   b. Lead in the initiation of specific programs that are perceived as being of broad value to the computing research field and to the nation.
   c. Keep abreast of European and Asian research programs and the visions motivating them; be alert for new ideas and mutually beneficial collaboration opportunities.

4. *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.

a. Communicate the potential of our field to policymakers – the potential of the field as a whole, and the potential of specific research and infrastructure initiatives.
b. Use our field's role in tackling societal grand challenges as a "hook" to engage the best and brightest of the next generation of students.
c. In cooperation with other organizations, devise and embark upon a program of public communication regarding the excitement of our field – including intellectual excitement, the excitement of contributing to the vibrancy of many industry sectors, and the excitement of changing the world and how people live their lives.

The table below maps these strategies and sub-strategies onto our goals:

Strategies	Goal 0	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6
1a	x	x					x
1b	x	x	x	x		x	x
1c	x	x				x	
2a	x		x	x		x	
2b		x		x		x	
2c	x	x		x	x	x	
2d		x		x		x	x
2e		x		x		x	
2f		x		x		x	x
2g		x		x		x	
3a			x	x	x		
3b			x	x	x	x	x
3c			x	x	x		
4a			x		x	x	
4b			x			x	
4c			x		x	x	

5. Implementation

Here we discuss various ideas for implementing each of the four highest-level strategies presented above. 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.

In accordance with the Cooperative Agreement, an Implementation Plan will be provided annually; the ideas here set the context.

- *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.

o Establish a broadly-advertised, truly open process for bootstrapping the initial CCC Council, so that the computing research community does not view CCC as "an insiders' undertaking."
o Be highly attentive to diversity of all kinds (institutional, research area, gender, etc.) in the composition of the Council.
o At the same time, ensure that the Council is broadly viewed as "top tier," so that members of the community will "take CCC seriously."
o Undertake significant outreach to ensure "launch visibility" – public talks, publications, use of CRA communication channels, etc.
o Extensively advertise the community-based "visioning activities" described in our proposal in order to attract attention and participation.

- *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.
  o In presentations and publications, emphasize the extraordinary contributions of computing research, and our role in tackling the societal grand challenges of the 21st century. Create a sense of vision and a sense of accomplishment.
  o Ensure that the "visioning activity process" is truly open and inclusive and supportive. Be agile and flexible. Provide feedback and assistance to all who submit proposals. Work with proposers to help them succeed, rather than acting as "referees."
  o Be attentive to the quality and diversity of leadership and participation in visioning activities – ensure openness.
  o Be attentive to the "breadth of coverage" of these efforts – seek to drive forward all areas of computing research.
  o Make interim and final work products of all visioning workshops available to the broad research community via the CCC website, so that all may benefit from, and be inspired by, these ideas. Seek concrete outcomes and recommendations.
  o Ensure that appropriate potential funders participate in each visioning activity, to increase the likelihood of uptake.
  o Remain engaged with visioning communities to actively assist them in transitioning their visions into funded programs.
  o Solicit certain visioning activities, and "adopt" some that are already underway, in order to achieve some early successes that will build credibility and expertise.
  o Create a "computing research visions blog" as a forum for discussion of topics of interest to the research community *other than* funding opportunities and research policy. (NSF and other agencies do a fine job of publicizing funding opportunities. The CRA and ACM public policy blogs do fine jobs of covering that topic.)
  o Create a mechanism for drawing attention to computing research advances of broad appeal.
  o Engage members of the research community directly in the activities of the CCC, for example by including them in CCC Council meetings to discuss research visions. This will serve the dual role of informing these individuals about the activities of the CCC, and exposing members of the CCC Council to the research directions being contemplated by leaders of the field.

o Be attuned to specific needs of the research community that may arise periodically, and for those that are of significant importance, be prepared to either respond directly, team with others to respond, or hand off to another organization. Be agile, flexible, and responsive.

- *Engage funding agencies:* Work to align agency programs with emerging research visions.
  o Establish working relationships with leaders of various computing research funding agencies.
  o Create mechanisms to assist sub-communities in engaging funding agencies and industry in support of their research visions, building upon *ad hoc* efforts to create persistent and scalable approaches. Actively assist visioning communities in transitioning their visions into funded programs.
  o Be aggressively responsive to requests from funding agencies for assistance of any form – assistance in shaping programs, assistance in representing the community or in bringing it together, assistance in explaining the role of computing research to other constituencies.
  o Envision and create forums where the accomplishments and potential of computing research can be presented to appropriate influential audiences.
  o Selectively interact with international research planning organizations; exchange ideas and seek opportunities for mutually advantageous collaboration.

- *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.
  o Engage a communications consulting firm to explore mechanisms to improve the visibility and perception of computing research.
  o Produce materials that highlight the impact of computing research on the economy, on research in other disciplines, on societal grand challenges, and on modern life.
  o Utilize communication vehicles that are more modern than the web – for example, YouTube and blogs.
  o Work with government policymakers to help them recognize the role of computing research in tackling the grand challenges that they face.
  o Work with industry on those research visioning activities where industrial R&D closely tracks academic research. Industry is very special for our field – physics and astronomy have scant counterparts.
  o Create events that bring the outstanding results and outstanding potential of computing research to the attention of broad influential audiences.

6. Strategies and implementation related to GENI and NetSE

We recognize our obligation to the community and to NSF regarding the GENI (Global Environment for Network Innovations) effort. At the time the CCC was first conceived by NSF, a significant motivation was to broaden research community engagement in the emerging GENI project. GENI was not the core of our response to the solicitation, or of the Cooperative Agreement. However, within the broad agenda set forth above in our "Vision," "Mission," and

"Goals," an important task for CCC is helping NSF and the broad Network Science and Engineering (NetSE) research community frame a compelling research agenda.

Rightly or wrongly, GENI was widely viewed as an effort to justify the construction of a very expensive monolithic instrument in support of networking research. It was necessary to re-position GENI in several ways:

- Articulate a broad research agenda for Network Science and Engineering (NetSE), significant aspects of which will be experimental.

- Derive instrumentation requirements from the research agenda.

- Recognize that one "uber-instrument" is less likely to meet the needs of the research community than are several more modest and specialized instruments, and that research innovations will be required to build the instruments themselves.

- Conduct prototyping efforts, both to assess technical approaches and to build the capacity of the research community to conduct experimental research.

These activities must be carried out primarily by the NetSE research community, the GENI Project Office, and the NSF, with the help and support of the CCC. It is the first bullet above – articulating the research agenda – in which CCC has the most important role. The strategies and implementation steps related to this goal are:

- *Place GENI in context:*
  o Actively describe the NetSE vision to members of the broad computing research community.
  o Actively explain the role of the GENI Project Office in the context of NetSE.
  o Support the GENI Project Office in advancing the capabilities of the computing research community to carry out experimental networking research and to build necessary research tools and instruments; also support the GENI Project Office in placing these activities in the context of the broad NetSE research agenda.
  o Work closely with the GENI Project Office and with NSF to ensure coordination in messaging.

- *Deliver a NetSE Research Plan that reflects the best thinking of the network science and engineering research community:* This plan must reflect the full breadth of network science and engineering, and its formulation must have engaged all of these communities.
  o Create a NetSE Council with appropriately broad representation
  o Assist the NetSE Council in convening workshops in the various NetSE theme areas, to outline key research opportunities and challenges in those areas.
  o Assist the NetSE Council in creating a Research Plan that represents the thinking in evidence at these workshops.
  o Assist the GENI Project Office in deriving instrumentation requirements from the Research Plan.

o Work to achieve community acceptance of the NetSE Research Plan and the GPO instrumentation requirements.

7. Management

As outlined in our proposal and alluded to above, administratively the CCC is a standing committee of the Computing Research Association. CCC's work is carried out by a broadly-representative Council appointed by CRA (in cooperation with NSF, of course). The Council has a Chair, which is a 50%-funded position, and a Vice Chair. There is an Executive Director, 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.

The engagement of Council members will be encouraged in several ways:

- Bi-weekly one-hour teleconferences.
- Thrice-annual full-day meetings for longer-range planning.
- Assignment of specific major responsibilities – leadership of significant CCC initiatives, such as the visioning activity process.
- Assignment of specific minor responsibilities – such as serving as the liaison to a specific visioning activity.

It is important to acknowledge that the need for openness and inclusiveness – for breadth of participation – can be at odds with the goal of having every Council member be an equal and active contributor. Similarly, the need for our visioning exercises to be open and inclusive means that we cannot guarantee that all will be successful, although we certainly take it as our obligation to do everything reasonable to help each activity succeed. With specific reference to GENI/NetSE, we cannot "force" the network science and engineering research community to produce a coherent, compelling, comprehensive research agenda – but we will actively help.

We will have bi-weekly teleconferences with NSF staff to ensure coordination.

8. Assessment

The "Goals" cited in Section 3 of this document appeared in Section G of CRA's response to the CCC solicitation, which was entitled "Measuring the Success of the CCC." There, the enumeration of the goals was followed by this text:

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.

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?

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. These indicators include:

- Breadth and depth of interest in the CCC Council, measured in terms of nominees and membership.
- Perception of the CCC effort by the research community: its value, its impact, its inclusiveness, etc.
- Breadth and depth of interest in visioning workshops and activities, measured in terms of submissions, attendance, work products, general degree of research community participation.
- Interest in the results of the visioning activities as evidenced by researchers, funding agencies, and other parties.
- Specific followup clearly derived from initial visioning activities – for example, subsequent related activities, funded programs.
- Breadth and depth of interest in other CCC activities that may be initiated.
- Quantity, quality, and effectiveness of CCC communication *with* the field: presentations, blogs, website, videos, etc.
- Quantity, quality, and effectiveness of CCC communication *about* the field: articles, white papers, presentations, events, etc.
- Flexibility and agility, measured by the crafting of new forms of response when the community articulates a need for change.
- 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.
- 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.
- Success in delivering a NetSE Research Plan, and general success of the GENI/NetSE initiative.

- Indicators of increasing willingness by researchers to provide leadership, e.g., to serve as mentors to younger researchers, to serve as program directors, etc.
- Diversity of participation in all CCC activities.

9. Summary

The Computing Community Consortium is a grand experiment in moving the computing research community toward the vision of a continuous, effective, inclusive process of envisioning, articulating and pursuing compelling research goals, coupled with education that attracts new generations of students to the field.

In pursuit of this vision and mission we have set forth specific goals, strategies, and implementation steps. We reiterate, though, that the CCC *is* an experiment: we are "learning by doing." We will need to continuously assess and adapt. Agility, flexibility, and speed will be of central importance.

We commit ourselves to this experiment because we view it as tremendously important to the future vitality of the field.