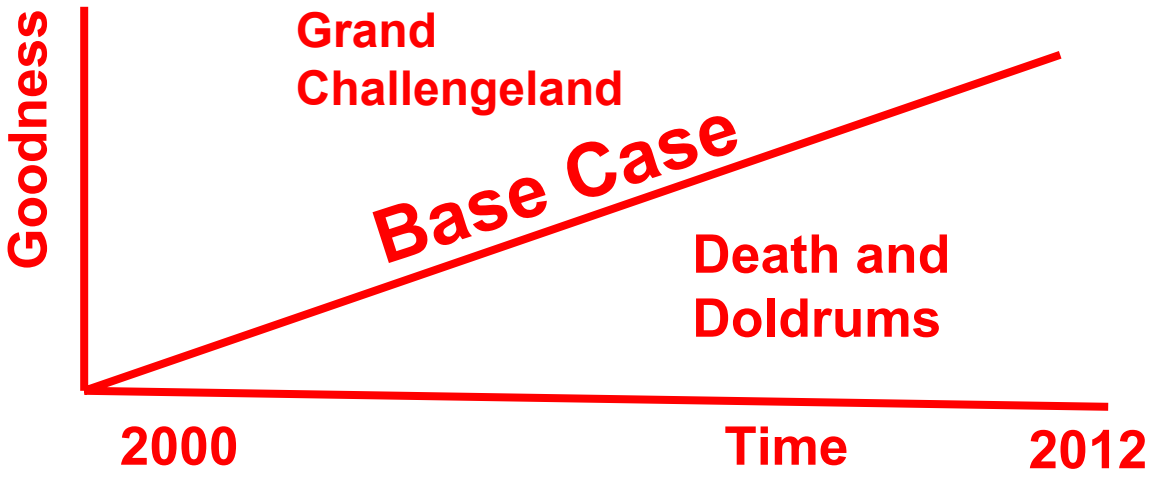
No challenge, decade outlook. Industry's evolutionary path *¿Que sera sera*



Computing Research Association Grand Challenges

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The “base case”: A standard for and basis for planning “Grand Challenges”

The hardware platforms, networks, interfaces, and programming environments for applications that will be built in 2012, *with only modest R&D*, is posited as a “base case” prediction, *using computing’s 30-50 year evolution*. In essence, it is “what is likely to be”.

This base case was constructed to act both as a standard to measure and base for CRA Grand Challenges. It also includes risks that may inhibit the base formation and any other GCs.

It doesn’t include applications that might drive a GC, and low level in nature versus potential apps.

In a decade… the evolution (outline

- The political environment
- Platforms we are likely to get, have, or get on which apps are built
- Each decade a new nets/platforms/interface occurs
- The environments to support possible apps
- Impediments that could thwart the evolution
- R & D challenges

The political environment c2002-2012

- Entering the Millennial generation (cf 1920s) The 4th Turning, Strauss & Howe. Theory of four 20 year, recurring, cyclic generations.
- 2005 ± 2: “total war” or “great crisis” occurs marked by mass destruction, war, bio, terrorism, etc.
- Second “9/11” event creates a clear and sustained wartime economy

In a decade, the evolution:

We can count on:

- **Moore's Law provides ≈50-100x performance, const. $ 20% $ decrease/year => ½ per 5 years**
- **Paper quality screens on watch, tablets… walls**
- **Terabyte personal stores => personal db managers**
- **Murphy's Law continues with larger and more complex systems, requiring better fundamental understanding**
- **Astronomical sized, by current standards, databases!**
- **DSL wired, 3-4G/802.11$_j$ nets (>10 Mbps) access**
- **Personal authentication to access anything of value**
- **Ubiquity rivaling the telephone.**
  - **Challenge: An instrument to supplant the phone?**
  - **Challenge: Affordability for everyone <$1500/year**
- **Network Services: Finally computers can use|access the web. "It's the Internet, Stupid."**
  - **Enabler of intra-, extra-, inter-net commerce**
  - **Finally EDI/Exchanges/Markets**

In a decade, the evolution:

We are likely to “have”

- 120M computers/yr.
  - increasing with decreasing price. 2x / -50%
  - X% are discarded. Result is 1 Billion.
- Smaller personals w/phones… video @PDA $
- Adequate speech communication for commands, dictation, note taking, segmenting/indexing video
- Vision capable of tracking each individual in a relatively large crowd. With identity, then the location of everyone is known.

Inevitable wireless nets… body, home, …x-area nets will create new opportunities

- Need to construct these environment of platforms, networking protocols, and programming environments for each kind
- Each net has to research its own sensor/effector structure as f(application)
- Taxonomy includes these alternative dimensions:
  - master|slave vs. distributed;
  - permanent|dynamic
  - indoor|outdoor;
  - size and spatial diameter;
  - bandwidth and performance;
  - sensor/effector types;
  - security and noise immunity;

Decade out (cont'd)

We are likely to "get":

- CaA/VS (Computer aided A/V sensing aka surveillance) aided by a new level of radio-linked networks
- Personal location tracking in many environments
- Sensing and non-sensing rooms with "total recall" of everything it saw and heard

Several platform/net classes form:

- Wireless, sensor-effector nets enable a variety of apps
  - On body monitoring/stimulation/x-delivery
  - Building sensing of everything (cf. CaA/VS)
  - Outdoor sensing/surveillance of everything
  - (Sensors/effectors/platforms are the apps!)
  - Serendipity: new platform/net/interface

New environments can support a wide range of new apps

- Continued evolution of personal monitoring and assistance for health and personal care of all ages
- Personal platforms that provide “total recall” that will assist (25% of population) solving problems
- Platforms for changing education will be available. Limiters: Authoring tools & standards; content
- Transforming the scientific infrastructure is possible
  - petabyte databases, petaflops performance
  - shared data notebooks across instruments and labs
  - new ways of performing experiments and
  - new ways of programming/visualizing and storing data.
- Serendipity: Something really new, like we get every decade but didn’t predict, will occur.

The worst case impediment!

Economy continues to worsen

<u>No investment for:</u>

1. **IT. Industry cannot sustain Moore's Law**
2. **Startups for new computer classes cannot form.**

Impediments: The exogenous constraints “challenge”

- Intellectual Property: providing sufficiently secure payment and protection paralleling the “atoms” world is required
  - Books/e-books, CDs/songs, video, software are jeopardized and these industries collapse
- Accessibility and protection of one’s personal information, enabling commerce…healthcare
- Personal & organizational inertia brought about by:
  - Accelerated backlash/resistance of “automation” in services industries by “depression economy” e.g. healthcare thwarts growth and change
  - loss of privacy
- Incumbent ILECs thwart 4G/802$_j$ build out
- CS Research is dominated by Government Agenda!!! Universities develop weapons instead of ideas.
- Continued, muddling wartime economy.
- Legacy apps & data inhibit new platforms and apps
- NO “converged”, consumer priced, high-bandwidth, net *O(10-100 Mbps)*
- Lack of the ubiquity (i.e. telephone) on ww basis with divergent standards

R & D Challenges

- Engineering, evolutionary construction, and non-trivial maintenance of billions of node, fractal nets ranging from the space, continent, campus, local, … to in-body nets
- Increasing information flows & vast sea of data
  - Large disks everywhere!
    personal to large servers across all apps
  - Akin to the vast tape libraries that are never read (bit rot)
- A modern, healthcare system that anyone would be OK or unafraid of being admitted into.
  Cf. islands (incompatible systems) of automation and instruments floating on a sea of paper moved around by people who maintain a bloated and inefficient “services” industry/economy.