Future Brief
A Publication of New Global Initiatives, Inc.

www.futurebrief.com

Turn About Is VERY Fair Play

Jeffrey R. Harrow
Principal Technologist, The Harrow Group

In The Last Episode...

The decades of the 70s, 80s, and 90s experienced a "Convergence" that radically transformed society - it was the coming together of the "4 Cs" - **C**omputing, **C**ommunications, **C**ontent, and **C**onsumer electronics.

This was the melding of previously separate disciplines that yielded the then-unimaginable technological marvels that we take for granted every day: the Internet; personal computers; domestic and international long distance rates that have become dirt cheap (four cents per minute from Spain to the U.S. as I write this); pervasive inexpensive pocket cell phones; Digital Video Recorders; pocket music players that can hold vast music collections; plus innumerable more examples of the "magic" around us that have simply faded into the background. These decades of the "4 Cs convergence" has compressed more change in business processes and personal lifestyle than perhaps all of the changes wrought during the preceding century.

But the "4 Cs convergence" is only a hint of what's next on our agenda; its fruits are now sparking yet *another* convergence - one that promises, over the next two decades, to relegate the impact of the "4 Cs convergence" to but a footnote in the history of technology. These new changes will again, but far more so, transform every aspect of how we work, how we live, and how we play.

Size Does Matter.

In the '60s, engineers began designing electronic devices with a few individual transistors, each in a silver can the size of a pencil eraser (remember the four, five, and six transistor radios of the day?)

Then, each transistor cost about *fifty-pennies.*

Forty-five years later, one chip the size of your thumbnail *contains more than 200-million transistors, and each transistor costs less than "twenty five, 100 thousandths" of one penny!* (Oh, if automobiles only followed such a trend...)

Unsurprisingly, using a few of these millions-of-transistors highly complex and capable chips instead of individual transistors, engineers now routinely design products that do millions of times the work of products that were built with a few individual transistors. In effect, today's engineers build with vastly more complex "Lego blocks," so what they design is far more capable. Given that the complexity (and hence capability) of our chips continues to rise, each new generation of products proves to be that much more capable. And they will continue to astound us all.

To a large extent, these new advances will be driven, not simply by "traditional" advances in electronics, physics, etc., but by completely *new* potentials resulting from a convergence of another kind, called "**NBIC**" - the coming together of the previously disparate fields of **N**anotechnology, **B**iology and medicine, **I**nformation sciences, and **C**ognitive sciences.

How might this occur? To get an idea let's take a glance into just one element of the NBIC convergence - the "B."

"Biology & medicine."

The same exponential growth of **I**nformation technology that keeps kids occupied on long trips without the "how many states' license plates can you find" games of old, has also empowered research in many areas of biology and medicine, with some already-startling results:

- We've mapped the human genome years faster than expected;
- we now have early "laboratories on a chip" that will enable previously complex and expensive medical tests to be accomplished inexpensively and very quickly right in your doctor's office;
- scientists have begun unlocking the secrets of "proteomics," the study of the incredibly complex three-dimensional folding of proteins within and on the surface of cells that is a significant element of the processes of life;

Future Brief
A Publication of New Global Initiatives, Inc.

www.futurebrief.com

- functional MRI advances are demonstrating the ability to determine a person's reaction to a picture of a product -- or to the picture of a political candidate. Baylor University is already ascertaining subjects' reactions to products such as Coca Cola and Pepsi, leading to the new term "neuromarketing." Perhaps even more interesting, UCLA's Drs. Freedman & Iacoboni expect that "*fMRI -- will be a campaign staple four years from now!*" as it gauges peoples' reactions to candidates, and even to their campaign ads.
- Plus far more...

All of these new insights promise improved medical and wellness and psychological capabilities at least as significant as the introductions of penicillin, commonplace open heart surgery, and vaccines that have already rid the world of some crippling and lethal diseases.

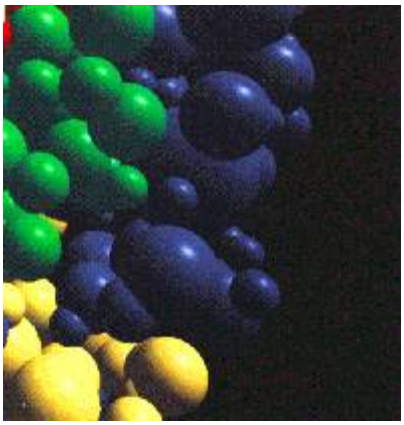
Turn-About Is VERY Fair Play!

The benefits of NBIC research don't flow in only one direction (from **I**nformation technology -TO- **B**iology and medicine, in this case); most importantly they synergize *ACROSS EVERY ELEMENT* of NBIC!

For example, one recent cross-discipline advance comes from "Technion-Israel Institute of Technology" where Prof. Yuval Shoham and his team used their knowledge of biology, spurred by advanced computing and nanoimaging techniques, to create a biological DNA plus enzyme device -- a biological computer -- that performs:

"...as many as a billion different programs simultaneously."

This biological computer is rather more capable than its predecessor's record of 765 simultaneous programs -- in fact 1,307,189-times more capable, which is dramatic in anyone's book.



But don't junk your current computers yet, because these biological computers, as we currently envision them, seem destined for certain very specialized tasks that benefit from incredible parallel computing power:

"Current computers consist of metal, plastic, wires and transistors. The manner in which they process information is called linear because they conduct one computation at a time.

In the latest generation of computers, biological molecules replace all the components. One advantage of these biomolecular computers over linear computers is their ability to simultaneously carry out an enormous number of complex operations."

Specialized Abilities Are The "Key."

Biomolecular massive parallel processing probably won't be helpful for word processing, but things could be quite different for tasks such as cryptography.

Future Brief
A Publication of New Global Initiatives, Inc.

www.futurebrief.com

Many of today's cryptographic systems rely on the fact that some mathematical processes, especially those involving prime numbers, can be performed with relatively little effort in *one* direction (encrypting a message), but require a massive (typically unavailable) amount of computing power and time when going in the *other* direction (decrypting) if the message's "key" is not known.

Of course cryptography, like so many other things that fall prey to our exponentially growing technologies, is in a constant game of "technological escalatio" -- each significant increase in computing power renders what were the "ultimate codes" of the day seemingly transparent. Imagine how easily today's computers can decrypt most of the best codes used during World War II. Now, add a billion parallel processes, and these biological computers seem tailor-made to, again, force cryptography to new heights.

(And I do have to wonder if massive parallel processing might change the rules for forecasting stock market trends, horse race results, or...)

Just The Beginning!

So - ever-more powerful computers have enabled scientists to better-understand the secrets of DNA and other elements of life, which have turned around to provide computing with never-anticipated advances! This is a simple example of how and why the convergence of NBIC, especially when all four fields are involved in cross-pollinating each other, will make the last decades' technological improvements seem insignificant by comparison. It's also an example of why funding NBIC research is a must-do task. This would be a terrible area for us to fall behind...

Fasten your seat belts -- we *ARE* going to need them!

This essay is original and was specifically prepared for publication at Future Brief. A brief biography of Jeff Harrow can be found at our main Commentary page. Other essays written by Jeff Harrow can be found at his web site. Jeff receives e-mail at jeff@theharrowgroup.com. Other websites are welcome to link to this essay, with proper credit given to Future Brief and Mr. Harrow. This page will remain posted on the Internet indefinitely at this web address to provide a stable page for those linking to it.

Please feel free to share the PDF with others who may be interested. To hear about future **Commentary** essays, take a few seconds to read about Daily Brief, one of the "briefest" Internet updates offered anywhere.