Diabologic: Nanotech – Three Questions
by Frank Dolinar

"Any sufficiently advanced technology is indistinguishable from magic."
Arthur C. Clarke, Profiles of The Future, 1961 (Clarke's third law)

A few months ago, I promised (threatened?) to return to the topic of nanotechnology. It's time.

At the beginning of chapter 3 in his book Engines of Creation, Eric Drexler poses three questions about the development of nanotech: What is possible, what is achievable, and what is desirable?

I've quoted Drexler's answers to these questions below. He uses the terms "assembler" and "replicator", which I'll explain immediately following his answers.

"First, where hardware is concerned, natural law sets limits to the possible. Because assemblers will open a path to those limits, understanding assemblers is a key to understanding what is possible.

"Second, the principles of change and the facts of our present situation set limits to the achievable. Because evolving replicators will play a basic role, the principles of evolution are a key to understanding what will be achievable.

"As for what is desirable or undesirable, our differing dreams spur a quest for a future with room for diversity, while our shared fears spur a quest for a future of safety."

An "assembler" is expected to be a virus-sized robot programmed to manipulate small molecules – taken from reservoirs of standard molecules – and place them on a work surface with extremely high precision, i.e. to within a nanometer – approximately the size of a hydrogen atom. Even using molecular bricks, the result doesn't have to be tiny. It could be any size. Fabrication of the product would proceed rapidly because thousands (perhaps tens of thousands) of assemblers would work together.

A "replicator" is a special purpose assembler, designed to duplicate itself and all of its programming.

Drexler calls assemblers a breakthrough, which may well be a profound understatement. He goes on to say, *"assemblers will allow engineers to make whatever can be designed, sidestepping the traditional problems of materials and fabrication."* If we can produce a design that does not violate chemical and physical laws, and it can be built from standard molecules, then we can program assemblers to build it.

What does this mean in practical terms?

If we can build quality materials, objects, and devices inexpensively with essentially no waste, and do it anywhere that the requisite molecules are available, there will be a lot of changes – and the changes cut across lines of politics, economics, geography, and social strata.

Returning to the three questions, here are my answers.

What's possible?

Abundance, and a change in our thinking from a culture of scarcity to one where what we need is available to all. Computers that are smaller, faster, more powerful, fault tolerant, easier to use, cheaper, and much, much smarter. Inexpensive and remarkably safe space travel for anyone who wants to go. Advanced health care and medical technology that deals with disease by directly attacking invading pathogens, by repairing individual cells, and by enhancing our immune systems. Long life.

What's achievable?

As yet, we don't know. These emerging disciplines are for the most part still in the lab. But they require no new scientific breakthroughs, just evolution of our current technologies. The probable first areas of impact will be new materials, computers, and medical technology. I expect that we will achieve a great deal – and very likely beyond our wildest dreams.

What's desirable?

This is the hard question, much more difficult than the other two. How do we decide what is desirable, and for whom? What criteria do we use? When and how do we implement decisions? What is it going to cost? The debate is just beginning and it's going to be lively. I believe, however, that the benefits (for everyone) of a working nanotech will greatly outweigh the costs.

If this topic interests you, there's an abundance of information for the general reader at the website of the Foresight Nanotech Institute (http://www.foresight.org/nano/general.html).