Epilogue

Twenty years have passed since studies began in the late 1980s on information processing technologies "inspired by life." This book discusses various approaches to research that produce useful ideas "inspired by life," with the goal of designing and constructing future information communication systems.

Chapter 1, "Reconsidering information and communications technology from life," discusses our knowledge of brain functions and the evolution of life, mining this knowledge for insights into the superb functions of life forms and their possible application to the design of information processing systems and information communication systems capable of solving real-world problems. Chapter 2, "Research trends of molecular communication technology," argues for the possibility of information communication systems based on molecules, harnessing the inherent functions of life forms at the molecular level. Chapter 3, "Artificial chemistry and molecular networks," and Chap. 4, "Signal transduction in biological systems and its possible use in computation and communication systems," discuss the design of information and communication system based on molecules, and shows the possibilities applicable to real-world problems. Chapter 5, "For deeper understanding," shows the original ideas for the deeper understanding of life and nature, and explains the examples of application for real-world using complex networks.

As discussed in this book, research "inspired by life" represents a new paradigm, fully worthy of the term "paradigm shift" coined by Thomas Kuhn to describe revolutions in the history of science and technology and marking an epochal transition of the highest significance. If we penetrate into the process of "bio-evolution," which surpasses human wisdom (once again, let me remind readers that even human wisdom is a product of bio-evolution), we may develop a powerful wellspring of ideas for designing and constructing the future information and communication society.

Here's a prediction of how research on information and communications technologies inspired by life will proceed over the next several decades.

According to *The Singularity is Near: When Humans Transcend Biology*[1] by Ray Kurzweil, paradigm shifts (technological innovations) have emerged at accelerating rates in recent years, while information technology capabilities (cost performance, speed, capacity, bandwidth) grow at exponential rates, even faster than that forecast by Moore's Law.

The Moore's Law is an empirical law which Gordon Moore, who is a co-founder of Intel Corp., advocated in 1965 on the US Electronics Journal. That says, "integration density of transistors become twofold every 18–24 months. Even at present, this empirical law is still valid after more than forty years. However, he himself said, "this law would not last forever, and I think its limitation would come about ten or fifteen years later."

One of the ultimate goals of brain science is to create an "artificial brain." Forecasts call for the "reverse engineering of the brain" to result in human intelligence software by 2045 or so. Integrated with concurrent "GNR" (G: genetics, N: nanotechnology, R: robotics) breakthroughs taking place, these cutting-edge technologies will lead in several decades to revolutionary technologies well beyond our imagination. Kurzweil, an inventor and the well-known person who exactly predicted the age of Internet, explains the existence of "*The singularity* (technological innovations)," and pointed out in his book that the advent of the singularity will come within the 21st century, or in the year of 2050, after 40 years from now, at the earliest (See footnote 1).

In this future, humans will become qualitatively different entities, embarking on a new stage of human evolution. It requires a vivid imagination to envision the actual technologies that will be available, but in view of the scale and nature of the effects of scientific and technological revolutions on human civilization, these technologies will doubtlessly have both bright and dark aspects. We must consider not just scientific and technological progress, but the social impact of such progress, including ethical issues, as we pursue our research and development.

Lastly, we conclude this book by expecting the readers who read this book to produce many fruitful technologies which will contribute to the GNR or BIN (B: Biotechnology or Brain technology, I: Informatics, N: Nanotechnology and Network technology) breakthroughs for creating the 21st century.

[1] Ray Kurzweil, "The Singularity is Near: When Humans Transcend Biology," Viking Adult, 2005.

Index