Targets of COE regarding terabit information Nano-electronics

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● University requirements to lead in Nano-electronics

The synthesis of fundamental theories and principles regarding physical phenomena, physics, materials science, and Nano-technology with electronics will provide highly functional systems and equipment of measurable benefit to the quality of human life and society as a whole; this is the pivotal point that connects technology and society. The application of advanced electronics technology facilitates the development of computers, communication networks, and robots as part of the social infrastructure. Such infrastructure will produce new methods for medical treatment, electronic commerce, digital government, and increase safety, and will contribute to the future prosperity of society as a whole. We aim to develop practical science and innovative technologies to make a valuable contribution to improving the quality of human life.

At COE, the basic subjects of study are electronics, electrical engineering, basic physics, materials science, information engineering, computer science, and software science. Comprehensive ability is required to achieve useful results, as such innovations are attained by unification of knowledge from a wide range of areas. To date, Japanese universities have not been able to demonstrate their academic ability in this regard, tending instead to limit themselves to specific academic areas without having a global point of view. This is the major weak point of universities in Japan.

● New paradigm inspired by life science

There are three major elements of information processing in electronics: (1) arithmetic operation and judgment, (2) memory and learning, and (3) communication and data transfer. Although a great deal of progress has been made in the field of semiconductor memory, the problem of how best to utilize the huge memory capacity now available to us remains. How do we memorize people's face and objects? Although this question has yet to be resolved, it is clear that we do not simply analyze and recognize the characteristics of pictures. In addition to images, we use other elements to memorize such information. Moreover, it seems that the patterns are distributed to various parts of the brain. Although living systems use slow neural network devices, *i.e.* , the cells of the brain, which are unreliable because of sensitivity to changes in environment or noise, they achieve a sufficient level of information processing capability. This strategy has been utilized based on the results obtained by various methods using super parallel

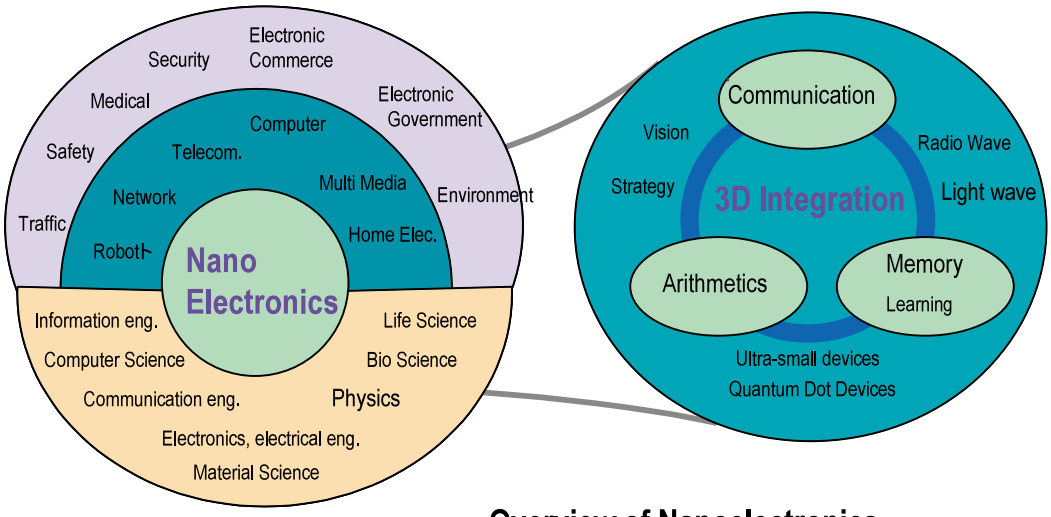
processing. This was most suitable for use of the huge number of neurons in living systems. To mimic the processes occurring in living systems, it is important to establish functions for the collection and processing of the distributed information and to make global judgments. The bottleneck is the communication capability within and between the chips.

● How to solve communication bottlenecks

Technology to carry out wireless communications between and within the chips has been developed at the COE. This enables connection through multiple chips and new three-dimensional integration without requiring accurate processing of via wires. Integration technology, to integrate both wireless and optical interconnection, will be realized by fusion of device modeling and process technology. We will build further knowledge and strategies by realizing highly parallel processing and conduct research into processing by integration of efficient circuit and modeling technology with algorithms reflecting living systems. The ultimate aim of this research is the realization of a brain like processing system.

● Another aim of COE is the development of talented researchers and engineers

Practical education in research and development will bring up highly capable human resources. Our objectives also include the training of doctorate researchers and leaders working in interdisciplinary fields. The development of the next generation of leaders with a wide-ranging point of view requires changing the traditional education system. It is necessary to replace the closed environment under a single professor with a more open research environment in which guidance is provided by multiple supervisors, and students are exposed to a variety of ideas and encouraged to develop their own.



Overview of Nanoelectronics