# What's Next in C&C Innovation

Today three decades after NEC first put forward its C&C concept, our society is undergoing rapid change and facing a multitude of challenges ranging from environmental issues and the aging population combined with a falling birth rate to increasing globalization, all against the background of our steady advance toward the reality of the Ubiquitous Society. What will the next 10 to 30 years bring? And what course will C&C technology take in the years to come? This spirited exchange among our distinguished panel members explored the optimum overall structure for a system that integrates people, society and information systems, and examined how people and systems can be symbiotically organized in a way that gives birth to new value.

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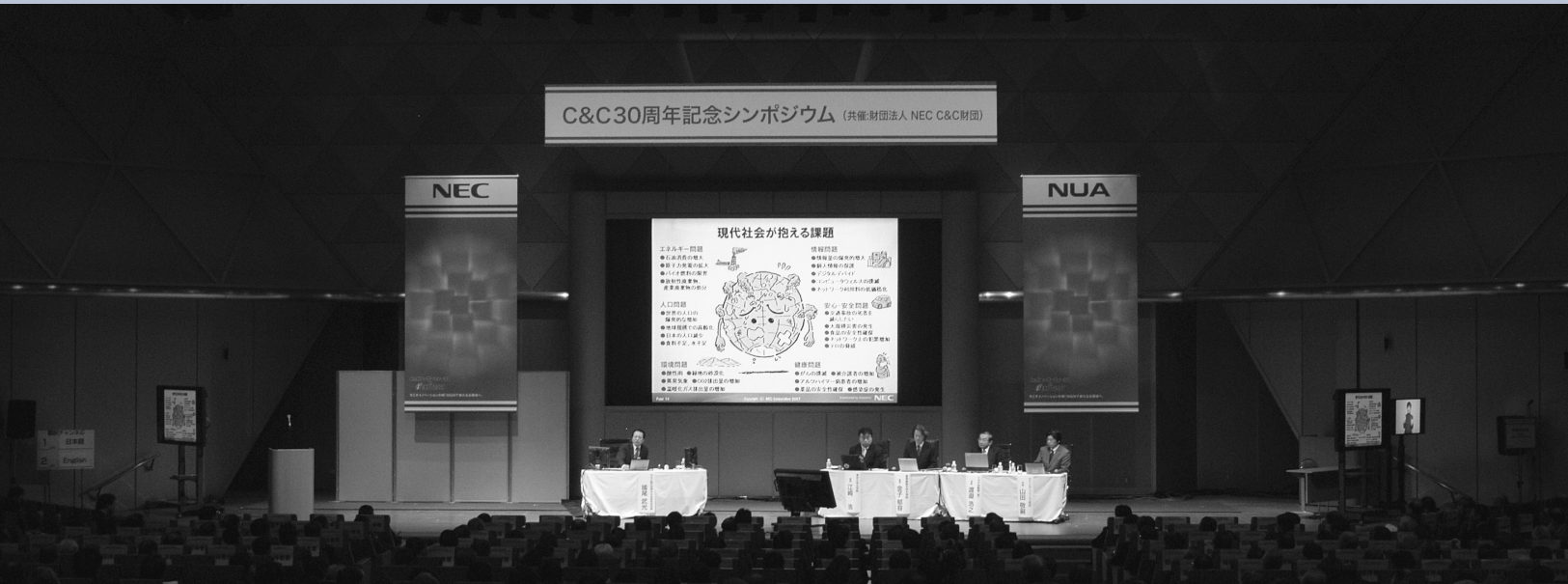
Hiroshi Esaki
Professor, Graduate School of Information Science and Technology, the University of Tokyo

Engaged in research into the next-generation Internet architecture.

Actively involved in numerous organizations including ISOC BOT (Director, Internet Society), JPNIC (Deputy Director), etc. as one of the leaders driving the advance of Internet technology in Japan.

Ikuyo Kaneko
Professor, Graduate School of Media and Governance, Keio University

Area of special expertise including information organization theory and network theory. Served on committees for the Ministry of Internal Affairs and Communications and the Ministry of Education, Culture, Sports, Science and Technology, as Chairman of the Keio Yochisha Elementary School, and as a commentator for the NTV program "Bankisha!" Drawing on such rich experience, he is shaping the development of Information Society theory.

Hiroyuki Watanabe
Senior Technical Executive, Toyota Motor Corporation

As the face of Toyota technology, contributed diverse automotive-related information technology proposals in fields ranging from ITS and ETC to DSRC, and serves as member of the executive committee of the Council on Competitiveness - Nippon. Also very active in various environmental protection programs including serving as the chairman of the Shirakawa-Go Nature Coexistence Forum.

Keiji Yamada
General Manager, C&C Innovation Research Laboratories, NEC Corporation

Specializes in pattern recognition and media/information-related fields. Leads research and development in information-communications technologies that are driving the vision of ubiquitous information systems, universal communications and other elements that will be a part of our future. Serves as the director of C&C research which aims at shaping the society of 30 years hence.

Takemitsu Kunio (Panel Discussion Coordinator)
Associate Senior Vice President and Executive General Manager of Central Research Laboratories, NEC Corporation

Pursued research and development in silicon LSI technologies (large-capacity DRAM, 3D LSI, non-volatile memory). Currently applying his experience to oversee all aspects of NEC research and development activities.
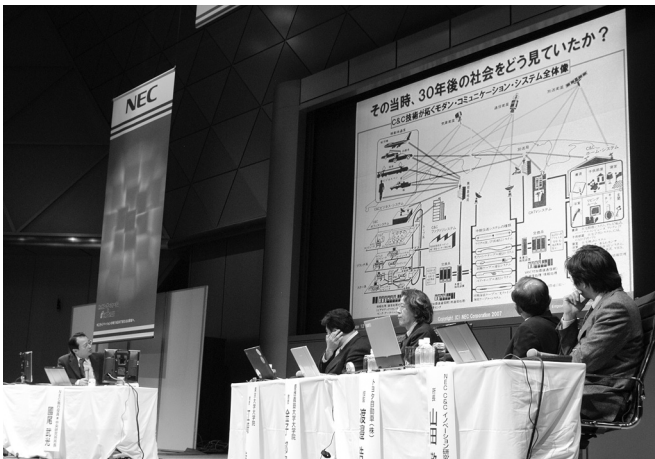
What will happen to our society?
What directions will technology take in the future?

Kunio: On the occasion of the 30th anniversary of NEC's declaration of our C&C concept, I would like to consider what the next 30 years of innovation will bring, and ask our distinguished panel members to explore two aspects of this question: "what will be the shape of our society" and "what course will technology take." Allow me to open discussion by first taking a brief look at how we envisaged "C&C" 30 years ago. It all began with a speech at that time by our then-chairman Koji Kobayashi who remarked, "early in the 21st Century, it will be possible to talk and see between any persons, at any time, at any place on the earth, and that this will require an integration of technologies for communications, computers, and television." In his speech, he foresaw the integration of computer, device and telecommunications technologies through the advance of digital and system technologies. However, at that time, his vision did not include the subsequent advent of the Internet and its widespread adoption. A little later, a very detailed sketch of the shape of the "Modern Communication System" was revealed, and it described the "Anytime, Anywhere and with Anyone" Ubiquitous Society in which systems are an integral part. It was not the description of a total society facing a wide array of challenges and problems. Today as we consider what the next 30 years will be like, I would like to ask you to think about and discuss what will happen to our society and what issues will be faced. Presently there are a variety of problems including

energy, population and the environment as well as safety and security issues, and there do not appear to be any simple solutions. From each of your unique perspectives of expertise, I would like to ask you to talk about "what will happen to our society."

A look at the merits and demerits of motorization

Watanabe: Currently almost all of the world envisaged by former chairman Kobayashi is a reality. I cannot help but admire his insight. Though I do not believe I can foresee the future with such accuracy, I will begin by reviewing the issues confronting our current automotive society, and attempt to draw a picture of what the future should be like. From a historical perspective, the automobile has evolved from a mode of transportation for people and goods and become personal space that is capable of travel, and it has contributed to the enhancement our lives and culture, and to huge strides made by our industries. On the other hand, it has also introduced society to the problem of traffic congestion and the tragedy of traffic fatalities. Moreover, it is one of the prime causes of the environmental and energy problems that we face. CO_2 emissions are one of the factors contributing to global warming. Out of the total volume of emissions from man-made sources, the transportation industry bears a very large responsibility, accounting for a 23% share. As was described in Vice President Al Gore's report on global scale climate change caused by global warming, we are witnessing the

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disappearance of glaciers in Greenland, South Pacific islands including Tuvalu in danger of submergence, and other phenomena of serious consequence. Regarding energy, it is predicted that petroleum production will peak in 2037. While we must devote our efforts toward the development of bio fuels; if we consider the sustainability of our forests, we realize that there is a quantitative limit. The energy that powers the automobile of tomorrow will shift from today's fossil fuels such as petroleum to electric power (including electricity to make hydrogen fuel) and bio energy. However, when we consider the conflict with food supply and the destruction of our forests, bio fuels will only be able to meet about 20% of our needs. Therefore, I believe that the car of the future will evolve in the direction of electric power, electric hybrids and hydrogen hybrids. In addition in the case of Japan, there is one more very serious issue. From the year 2000 to 2030, Japan's working age population will decrease by 20 million. Currently we are already facing a shortage of human resources, and I believe that attention should be placed on this growing gap between the decreasing segment of the population that supports Japanese industry which includes development engineers, and our high expectations for the future of our industry.

Digital information networks that make dreams come true

Esaki: C&C stands for computers and communications, but I believe that computers and communications have, in a way, already become linked together though there is not yet a total fusion. The next 30 years as the true fusion of digital technology and communications occurs will see advances with people in the spotlight. If we look back over the past 30 years, the dreams of the man in the street were to own things like a color TV, an air conditioner and a car, while our children dreamed of flying cars, superhuman powers, invisibility, the "door to anywhere", "bamboo copters"[*1] and immortality - concepts that break the barriers of space-time, defy the laws of physics, and transcend the limits of life and human knowledge. Among these dreams, there are also visions of viruses in the human body where desperate battles are fought on a micro scale, and science fiction battles. In 10 to 30 years from now, some of these dreams may actually be realized. Already we can do things like watch TV on

our mobile phones and carry translation devices in our pocket. As for dreams that transcend the laws of physics, I think their realization will take a different form than in the past because technologies that replace "things" with information, transform information into digital data, and network these data will develop at dizzying pace in the year to come. For example, the utilization of a ubiquity of sensors could be likened to the function of an invisible man. The dream of immortality may come true in the form of embedding copies of memories and knowledge in cyborgs. I would like to believe that the C&C of 30 years from now to transcend the laws of physics that we learned in high school.

Next, according to the social system theory of Shumpei Kumon (professor of Tama University), networks are equated with the democratization of information, encompassing everything from political activism to economic activities, and it appears that they are developing in the direction of democratization of knowledge-centric activities. Already in networks like mixi and Second Life, we can see this challenge being met, indicating a shift to a paradigm of sharing of information, with everyone putting out their knowledge and engaging in creative activities.

[*1] The "door to anywhere" and the "bamboo copter" are science fiction gadgets introduced by the Doraemon, the robotic cat from the future in the iconic Japanese manga and anime series.

For better quality of life (QoL)

Yamada: Today I would like to speak to you not as an employee of NEC. First of all, regarding the "C&C" of the past, this described a technology trend that advanced along the axes of digitalization and systemization. I have been thinking about what comes next for C&C and what issues it will tackle. By about 2017, we should see widespread deployment of "dependable" autonomous information-communications networks and information system ubiquity contributing to social growth. However, when we consider the long-term view of how society will transform in the next half century, I believe there will be a dramatic change beginning around the year 2035. Petroleum consumption will soar to 5.4 billion tons, and the gap between consumption and production will rapidly widen. Japan's share of global GDP, which is currently about 13%, will decline to about 10%, and our standing in the world will shrink. The global population will reach 8.2 billion, and the impact of worsening global warming will be more evident. Around the year 2060, Japan's position in the world will become even smaller. It is forecast that our GDP will only be about 10% of the combined GDPs of India and China. It is against this background that Japan and the other developed nations of the work will undergo a dramatic change in their sense of values for living. There will be an ardent desire for improved quality of life (QoL), for peace of mind supported by an enhanced sense of safety and security, and in our Graying Society, there will be strong demand for support that will enable senior citizens to pursue autonomous and fulfilled lives. There will be changes in the working population as well. A working lifestyle that transcends traditional corporate frameworks and national borders will be routine. However, the elevation of overall social QoL is not a simple thing to achieve. We are approaching a limit to global economic growth. Environmental and energy issues are presenting a bottleneck to growth, and the advance of globalization may further erode trust in conventional social institutions and systems. Diversified lifestyles by self-autonomous individuals encourage the flattening of social and organizational structures, and at the same time, there will be rediscovery of the attraction of local areas based on their unique qualities as thinking, not on a nation by nation basic, but on a global scale becomes commonplace. There is simply no other way forward. This concept for a "global government" may be fundamental.

C&C Innovation as a means to enrich social capital

Kaneko: I originally specialized in computer science. My thoughts began turning to the question of the network society about 12 years ago at the time of the Great Hanshin-Awaji Earthquake. In a major disaster, it is not only the inability of mass communications to provide sufficient information, but also the necessity to communicate information about the constantly changing circumstances to specific concerned individuals or to the general public. Flyers or bulletin boards at evacuation centers are not enough to meet this need. At the time of the Hanshin quake, though the Internet was not yet in widespread use, personal computer communications were already playing a role. I used Internet net news and constructed a system for sharing content from several major commercial personal computer communications services including PCVAN, which was provided by NEC, and used these resources as a network to mutually link the disaster victims with volunteers from around the nation. As demonstrated by this example, information networks have an important aspect of "connecting" people. "Connecting" gives birth to empathy and may even provide people with something to live for. On the other hand, with every family member possessing a mobile phone and watching TV separately on such private devices, the hours spent together as a family grow fewer. This is

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Panel Discussion Coordinator : Takemitsu Kunio

one example of how information networks are "disconnecting" people, and it is an aspect of networks that we must be wary of. Today our Network Society is empowering individuals and expanding the scope of their field of activities. As this situation progresses, we are also seeing excessive competition and increasing overemphasis on self-responsibility that are evident in the emergence of a society that is increasingly divided. "Innovation" has both a technical and a social aspect, but I believe that the building of social systems that can derive maximum benefit from the true power of information networks to "connect people" is vital mission of social innovation. Without the fulfillment of this mission, the technological innovations that is achieved will wind up with weak connections, cause anxiety rather inspire confidence, and – to a use terminology that recently become quite popular - degrade "social capital," which is the social assets generated by connecting people. From these observations, I believe that C&C Innovation is about promoting both empathy and self-reliance, and creating a society rich in social capital.

Realizing a "sustainable" mobile society

Kunio: We have heard a diversity of views rich in insights from our 4 panelists. Next, I would like to ask for opinions on "how technology will develop or should develop" in order to realize the societies you have discussed or to solve various issues that will be confronted in the future.

Watanabe: Earlier I spoke about the urgency of promoting the widespread adoption of electric-powered hybrid cars. I apologize

for a bit of advertising, but I would really like everyone to experience firsthand the powerful and smooth drivability of my company's Prius, Lexus and other high environmental performance automobiles. However, the kind of innovation demanded by the mobile society of tomorrow is not just about hybrids. For example, the movement toward ubiquity is bringing increased incorporation of information and communications technology in transportation. Imagine leaving your car in front of the station, and having it automatically park itself. When you return, you use your ubiquitous communicator to call your car, and it appears right before you. That is just one of many ideas. The magical cloud used by Monkey King Sun Wukong for transport in Chinese fables has been called the ideal to which the automobile should aspire, but will the time ever come when such a dream is fully realized. Also currently sold automobiles are adopting new autonomous safety technologies such as pre-crash safety, radar cruise control, and lane keeping, and we can already imagine the advent of a car that is truly an "auto with human touch" mobile with the robot-like abilities to recognize its surroundings, make judgments and operate autonomously. Of course, support for communications between vehicles, between the road and the vehicle, and between people and the vehicle is a premise.

In addition, I believe that science and technology that connects both the hearts and minds of people and supports a higher quality of life will evolve further. Innovation that is focused solely on the technology will not produce results. Take for example, how we use the same vehicle for the suburban family drive and for commuting and shopping by a single person. It seems a bit odd. Or the illogical operation of large-scale buses that may carry only a few people. And then there is transportation for distances of about 2 km, for which the bicycle or the world of personal mobility are possibilities. Solutions for these matters must also take into consideration social innovation and evolution as it relates to the "traffic demand management" that achieves vehicle diversification and using vehicles according to the task or adapting lifestyle to meet the circumstances, the evolution of technology that connects vehicles, and consideration of how roads and cities should be integrated. In the end, discussions should extend into matters such as what people think about transportation and even cultural reform. Only then can we enjoy a sustainable and mobile society that integrally connects people

and lifestyles with the city and infrastructure and truly enriches life. And the nucleus of that society will be new "C&C" technology.

The true fusion of "C&C" technology

Esaki: Concerning the future direction of technology, the question is what should we young engineers be thinking about. And, as was raised in today's discussion, we must communicate the responsibility to contribute to the earth itself in the pursuit of our activities. Next we must not blindly follow the opinions of those in authority. I say this because those in authority know too much about too many things, and can only plot a course along those parameters, which prevents the conception of innovative ideas. Another point concerns knowledge and resources, and the importance of making breakthroughs through the collaboration of all. In order to support such a model, I believe that we will need an approach that encourages exploiting any and all means of communications, and a global-scale network that draws on the sharing of diverse technological contributions. For example, in regions where there is no telecommunications infrastructure, rather than laying of new optical fiber, I think we can consider using a vehicle equipped with batteries and a computer. Finally a word about the dream technology of Doraemon. The next-generation of truly converged C&C technology will demand unique people with a quality of creativity that can realize those dreams in novel forms leveraging information networks.

Creation of the "Co-Mobility Society"

Kaneko: Recently I have been devoting efforts to two interesting research projects. One is the "Tosho-gai" System Project (Navigative City of Books Project). R&D for this project is being undertaken by Keio University, Hokkaido University, Kyoto University and other institutions under the sponsorship of the National Institute of Information and Communications Technology (NICT). This project facilitates the exploration of the interrelationships of diversity of meanings and context of wisdom possessed by books - the knowledge assets of human endeavor by their electronic expression as a "city"

(three-dimensional information space) using networks. By forging new connections between books, between books and readers and between readers, this project attaches importance to the aspects of significance, sensibility, allegory, topos (literally "place"), memory, and channel. I believe that this represents one direction of development for information networks of the future. The other research project is called "Creating the Co-Mobility Society." "Co-Mobility" is an invented word that combines "communications" and "mobility." It is about the creation of a society that enriches human interaction, facilitates diverse connections anytime, and is high in social capital. Involving community research, technological research in innovative mobility systems that empower people with the freedom of convenient and safe mobility, and research in the related social system aspects, this interdisciplinary project is a proposal for a vision of society that integrates real life and information spaces with new mobility. Funded by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT), this project is being undertaken by Keio University in partnership with NEC and other leading companies. In the "Co-Mobility Society," children will be able to remotely drive their parents to the hospital. With a single telephone, an unmanned electric-powered vehicle will bring products and other foods to your home directly from the shopping quarter. Supported by constant monitoring of weather and traffic conditions, school buses will also be remotely operated. These are just a few examples of what the advent of this society means. A social infrastructure such as shown in **Fig. 1** below will support the seamless integration of technological and social innovations.
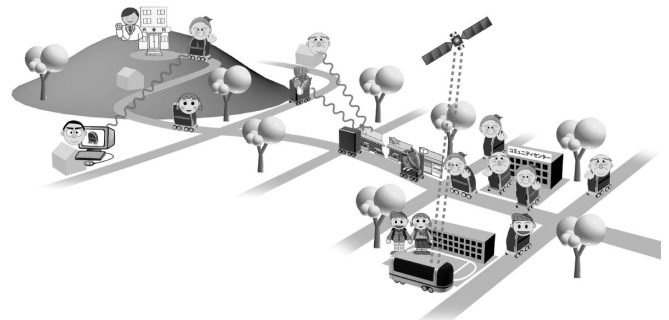

Fig. 1 "Co-Mobility".

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Yamada: In the first half of this discussion, I painted a rather negative picture of the prospects for society in the future, but in this second half, I would like to share my thoughts on the technological solutions to the many issues that will be faced.

The keyword to describe the direction of technological advances is "Quality of Life" (QoL). When I say QoL, I not only refer to individual QoL, but also include the Society QoL within the scope of my discussion. While "C&C" of the past developed along the axes of systemization and digitalization, I believe that the "C&C" of the future will advance along the axis of symbiosis/co-creation that is responsive to diversification and complexity and the axis of intelligence that can deal with the unknown environments to be faced. The products of this development could include, for example, an information terminal equipped with all the functions necessary to provide optimum support for both work and daily life. If we look at just the facet of work life, it is necessary to have an "Open Co-Creation System" that enables each individual to tap the power of experts on a global scale, transcending corporate and organizational boundaries. This "Co-Creation System" should support the day-to-day life of people as a function for dealing with special situations as they occur - in a casual and ad hoc fashion. Serving to disseminate, expand and share knowledge,

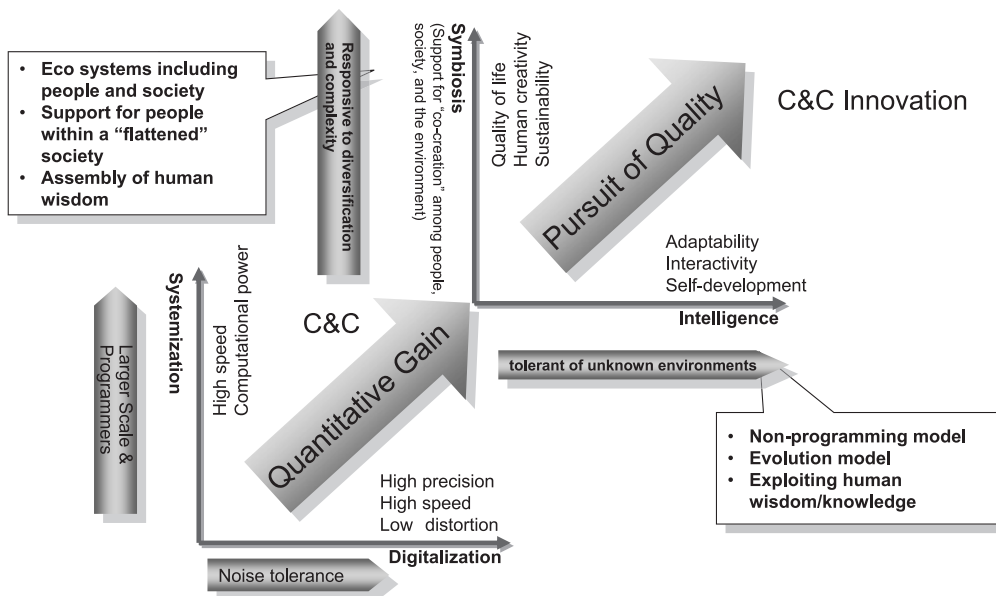## ● Technological development model shifts from the pursuit of quantity to quality.

Fig. 2 Technological directions to promote C&C innovation.

this system will function as a tool for problem solving on a global scale. It may even lead to the formation of a global government. But the important thing to remember is that people play the starring role in this system. And there will be a shift from the technology of the past, which has sought advances measured quantitatively, to technology that pursues qualitative improvements (See **Fig. 2**).

Kunio: Thanks to the valuable insights shared by everyone on the panel, I think we have a glimpse of what society will look like 30 years from now and the direction of technological development. Though it is extremely difficult to summarize the content of today's discussions, I believe that we can extract common concepts and key words: the "C&C" of future will connect people with people and people with things; change

society qualitatively; and collect and connect knowledge. Our staff members have been working behind the scenes of today's panel discussion and carefully following the course of the discussions. They have somehow condensed the essence of "Future Directions for C&C Innovation" in a single-page memorandum that I would like to present to you as a summation of our discussions. Thank you very much for your attention.