

NEC Group's Approach to Embedded Software and Solutions

The age of embedded software has arrived, and with it has come the urgent demand for solutions for a variety of issues ranging from multifunction/large-scale development, more advanced functionality and reduction of development time and costs to multi-model development and higher quality assurance. This article will describe how the technological resources of the entire NEC Group collaborate as one to realize our basic policy for the provision of total solutions that address the abovementioned issues. In addition, we would like to focus on the fields of "embedded platforms" which are effective for problem solving, "embedded software components," and the "embedded software development environment," and introduce some of our cutting-edge solutions in these fields.

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1 Major Issues Surrounding the Development of Embedded Software

Embedded software is indispensable to the future of manufacturing, and in recent years, we have begun to witness its full-

fledged arrival. However, its arrival has been accompanied by numerous issues related to its development.

Based on the results of research conducted by the Ministry of Economy, Trade and Industry, **Fig. 1** provides a simple chart of prominent trends in embedded software development and iden-

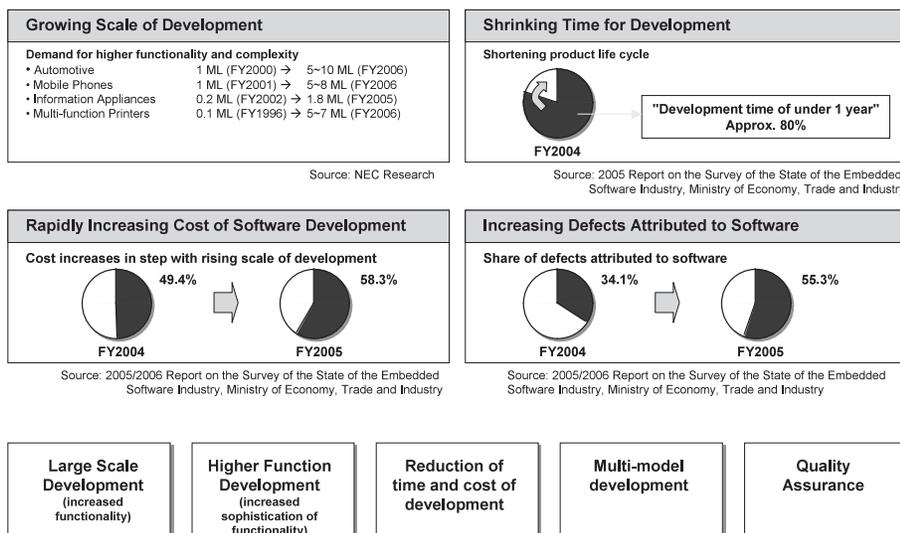
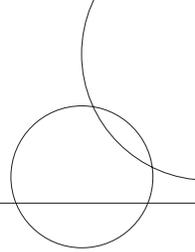


Fig. 1 Issues related to embedded software development.



tifies related issues to be overcome. Out of the necessity to respond to the growing diversity and sophistication of user needs, the “manufacturer” customers who supply the majority of embedded devices for everything from automobiles and mobile phones to information appliances and multifunction printers are coming to grips with a variety of issues as they move forward with the development of embedded software which is an essential element in embedded devices. Listed here and illustrated in the chart in Fig. 1 are those issues for which customers are demanding effective solutions.

- 1) Development of large-scale software rich in functionality
- 2) Development of software with advanced functions
- 3) Reduction of time and cost required for software development
- 4) Development of software for multi-model products
- 5) Quality assurance of software development

In addition, the development of increasingly sophisticated technologies for the creation of embedded software is demanded to satisfy conditions and factors arising from other aspects of embedded devices including the evolving usage environment.

However, among all the conditions, there is one that we must always be kept in mind and absolutely satisfied: the safety and security of the users. Not only are embedded devices an integral part of our life, they are encountered and operated by all kinds of people from pre-schoolers who are not yet adept at device operation to the elderly. Accordingly the level of safety required of embedded devices is extremely high. It is for this reason that assurance of functional safety and the underlying product quality must be given the highest level of attention in embedded software development. Functional safety and the other condi-

tions that must be kept in mind in embedded software development are listed below:

- 1) Absolute assurance of user safety/security.
- 2) Intuitive interactive human-device interface that can be used by any user (even a complete novice).
- 3) Full exploitation of the high performance produced by the integration of hardware and software to provide the user with smooth responsive operation.
- 4) Restrictions on required memory capacity through reduction of the number of hardware components arising from the necessity to reduce the size and cost of devices.
- 5) Adoption of development methodologies and a quality assurance management measures that prevent repair costs resulting from defective product that are found after large-volume shipments.

2 NEC Approach

2.1 NEC Charts a Course to Embedded Solutions

As described in the previous section, NEC is fully leveraging the know-how and technological assets accumulated by the entire NEC Group in order to contribute to the solution of the diverse issues related to the development of embedded software which is continuing to increase in scale. As shown in Fig. 2, we are undertaking a variety of activities with the aim of providing our customers with outsourcing of the development process to optimize their manufacturing.

The four domains for which NEC provides total solutions are

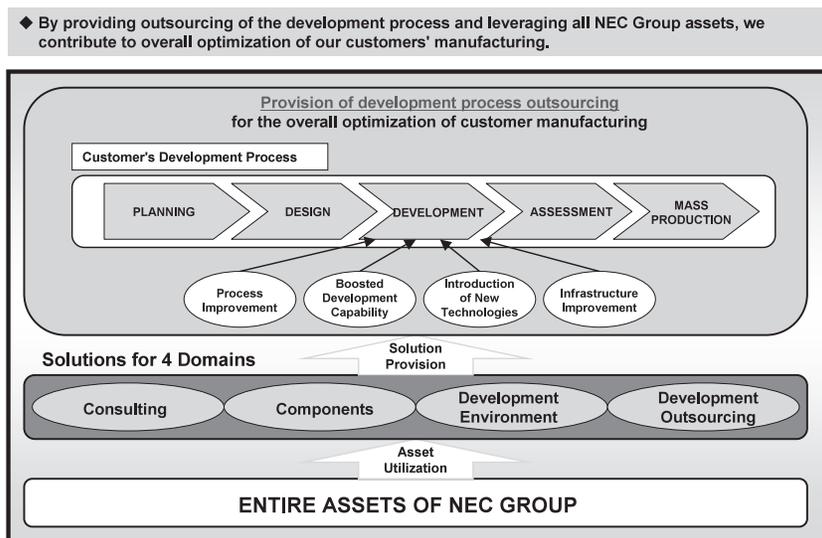


Fig. 2 NEC's approach to embedded solutions.

shown in Fig. 2 and listed below:

(1) Consulting Solutions

Provision of consulting services from the perspective of the customer.

- 1) Embedded device/software architecture design/verification consulting
- 2) Development process building/improvement/deployment consulting
- 3) Education/training for personnel, skill reinforcement and support for securing qualifications/licensing.

(2) Component Solutions

Provision of hardware/software components to realize the construction of product platforms, increased functionality, and higher-level functions.

- 1) Semiconductors (processors, LSI, etc.)
- 2) CPU, OS, peripheral circuits, driver-equipped control board
- 3) Software components (platform/telecommunications user interface, multimedia processing, server interfacing, etc.)

(3) Development Environment Solutions

Provision of development environment tools to enhance both development efficiency and product quality.

- 1) Development support tools
- 2) Development management tools

(4) Development Outsourcing Solutions

Provision of development outsourcing services that leverage NEC large-scale system development know-how.

- 1) Hardware development/verification outsourcing
- 2) Software development/verification outsourcing

2.2 Strengthening Integration with the Domain of Semiconductors

When we consider embedded devices, it goes without saying that the semiconductor is foundation of the architecture. In order to satisfy growing demand for ultra miniaturization in recent years, the SoC (System on a Chip), which is the integration of all required components of a computer or system in a single integrated circuit, is becoming an increasingly vital component. Moreover, more and more customers desire solutions that unify semiconductor and software solutions based on a semiconductor menu that has an appropriate answer for each condition of the embedded device from its application to its function and performance. The entire NEC Group including NEC Electronics shall be accelerating efforts to offer a comprehensive “Device x Software” menu to respond to this urgent demand.

2.3 Linking with the IT & Network Domains

As shown in Fig. 3, embedded devices and software will play an indispensable role as user terminals for the Next Generation Network (NGN), which will provide the foundation for the Ubiquitous Society of tomorrow. Through various integration activities including server integration and network integration, and while identifying and improving required functionality and shaping them in the form of embedded software components, NEC is diligently pressing forward with activities to make the diverse and superlative services of NGN available to millions of users via embedded devices and software.

2.4 “One NEC” - Working as One to Reach Our Objective

In April 2005, NEC established the Embedded Solutions Business Promotion (ESBP) Division. This division is charged with playing the central role in maximizing the synergies of the various business units involved in embedded solutions throughout the NEC Group, and unifying their efforts to present the customer with “One NEC.” As shown in Fig. 4, one role of the ESBP division is to act as a producer that coordinates the activities of the concerned business units in responding to the needs of various processes surrounding the customer and promoting the smooth flow and execution of all concerned NEC activities. The other role is to generate business through the encounter of customers with NEC solutions.

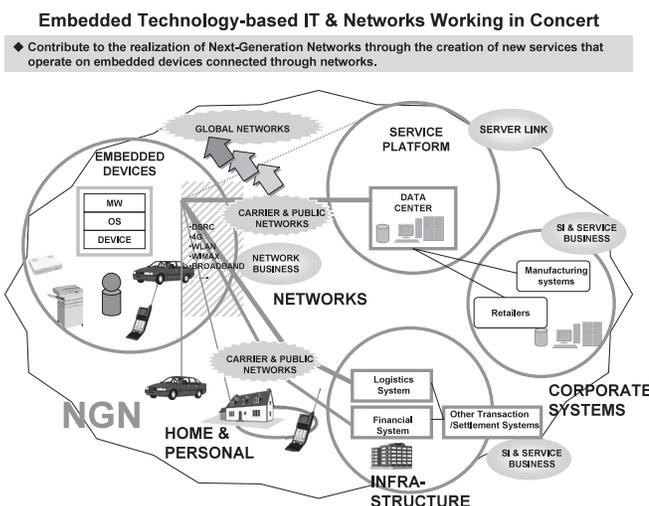


Fig. 3 Embedded technology-based IT & networks working in concert.

Role of the Embedded Solutions Business Promotion Division

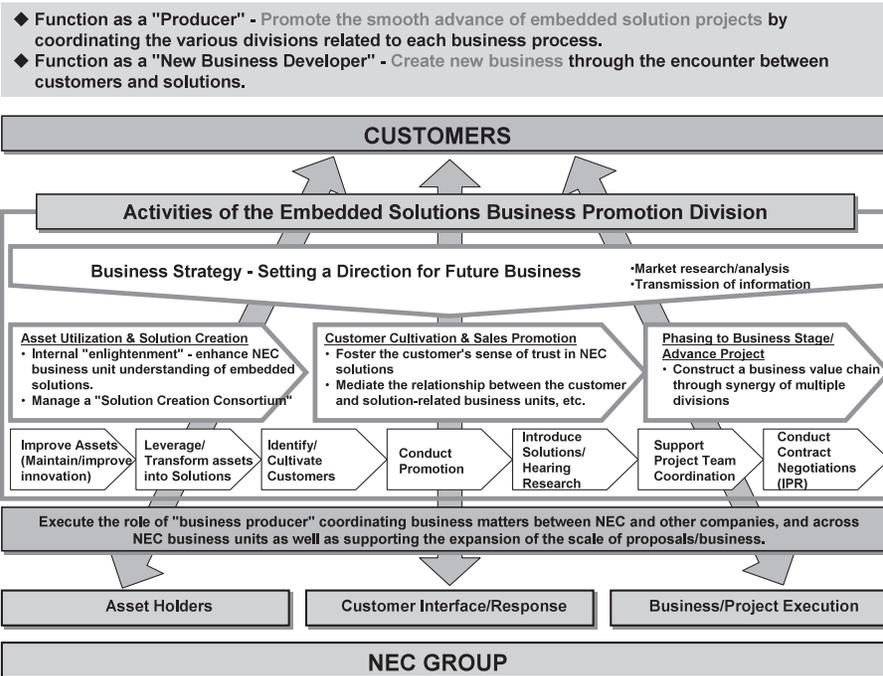


Fig. 4 Role of the Embedded Solutions Business Promotion Division.

3 The Structure and Outline of This Special Issue

The opening section described how NEC aims to solve the diverse issues related to the development of embedded software which is growing ever larger in scale. In the second section, the focus shifted to two of the four solution domains: “Software Component Solutions” and “Development Environment Solutions,” and touched on the following 3 themes:

- 1) Embedded platforms
- 2) Image/audio processing component solutions
- 3) Embedded software development environment solutions

In the following, the positioning and a description of solutions based on each of these themes will be provided.

3.1 Embedded Platforms

As mentioned in the first section, embedded software development is confronting various issues including the “trend toward larger scale,” “demand for reduction in time and cost for development,” “multi-model development” and “higher quality assurance.” In order to overcome these challenges, it has become increasingly important to establish a platform of common

elements by specifying a standard software structure that can be used into the future, and then taking the applications that operate on the platform and making them into components that can be plugged into individual models as needed.

In this special issue, we would like to introduce the following three solutions for these issues – solutions that we believe will serve as increasingly important embedded platforms in the future.

- 1) With the aim of providing the optimal platform for embedded devices, NEC Electronics Corp. offers not only LSI but also the “open platformOVIA” (Open, Value Interface for your Applications) – an embedded software deployment and reuse platform that includes operating systems, middleware, device drivers and other basic software components that work with a wide range of compliant chips, also possesses a standard interface for multimedia processing.
- 2) “Multi-core processor for embedded applications” satisfies the growing need for higher functionality, performance and reliability. Also the packaging of “Dual OS operation” enhances information processing performance and development productivity.
- 3) Built on a base that provides a friendly user interface that enables any user to operate the embedded device, Robot-type Integrated UI Platform makes a determination based on the integrated input from multiple sensors and then shifts to the

optimal action.

3.2 Image/Audio Processing Component Solutions

As examples of component software that will contribute to overcoming the embedded software development issues of the “trend toward larger scale (increased multifunctionality)” and “more sophisticated/advanced functions,” this special issue would like to introduce the following two solutions which are effective for image and audio processing.

- 1) “Similar Image Search/Duplicate Photo Assessment Solution” enables functions such as searching for photos that are similar to a user-specified photo by calculating the degree of similarity between the photos based on distinctive visual traits extracted from the photo with image analysis.
- 2) “Non-linear echo cancellation technology for comfortable hands-free communications with compact devices” uses newly developed nonlinear-type frequency band processing technology to enable natural and comfortable hands-free communications with compact devices without a headset.

3.3 Embedded Software Development Environment Solutions

Tapping its extensive experience and technology in the field of large-scale software development, NEC has developed tools to respond to the embedded software development issues of “development time and cost reduction” and “higher quality assurance,” which were outlined in the first section. Below we would like to introduce two solutions to meet these challenges.

- 1) Powered by NEC technology, “mevalet” is a performance measurement and analysis tool that plays a big role in identifying bottlenecks and solving the performance issues that are always present in the development of embedded software.
- 2) Employing formal methods, VARVEL is a powerful C language assessment tool that performs static and comprehensive assessment of source programs written in C language using a type of formal method called model examination technology, enabling identification of difficult-to-find inherent bugs with actual operational testing and evaluation.

4 Conclusion

In the preceding sections, we have laid out the current state of issues confronting embedded software development, explained our corporate roadmap to building the solutions to solve them, and introduced some of our cutting-edge solutions that are paving the way for the future.

In order to solve the problems surrounding the development of embedded software which has already become an integral

part of the environment in which we live, and which is sure to play an increasingly important role and will be required in huge quantities, NEC Group has committed its vast resources and going forward with diverse activities with the aim of providing more effective solutions.