Information Technology Map and IT Road Map (First Half of Fiscal 2005)

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In the midst of rapid development of information technology (IT), the environment surrounding IT, which includes broadband networks, mobile terminal devices and information devices, has also been increasingly changing. In order for a business enterprise to make a suitable IT investment, it is necessary to understand the objective positioning of the technology that is usable at present. At the same time, it must map out a technical strategy that predicts the trend of the important technology available in the future. Nomura Research Institute, Ltd. (NRI) names such activity "IT navigation." Since 2001, we have been creating the information technology map and the IT road map as part of this activity.

Keywords: Information technology map, IT road map, smart card, SAM

1 Information Technology Map

The information technology map is designed to provide guidelines for activities in making the best use of each type of information technology. This map provides a bird's-eye view of numerous information technologies that are currently available and objectively positions these technologies.

Figure 1 defines the fields used in the information technology map. The horizontal axis of the map categorizes the technologies according to purpose and user. Specifically, it is roughly divided into three fields: "development technology" such as development tools; "infrastructure technology" that is used as infrastructure without relying on applications; and "user technology" that is used as functions at the level of user applications. The vertical axis shows the maturity of the technology. It is divided into three fields: the "advanced field," which includes technologies that are used in projects requiring state-of-the-art technology; the "core field," which includes technologies commonly used in many projects; and the "legacy field," which includes matured technologies with few technological changes. Generally, a technology appears from the advanced field in the upper portion of the map and gradually moves down to the legacy field in the lower portion.

Figure 2 is an information technology map that was created in the first half of fiscal year 2005. Each point indicated on the map corresponds to a single technology. Names of some of the technologies that have recently seen some changes are plotted on the map as representative technologies. Technologies marked with an arrow are those that have greatly advanced in maturity in the past six months. They are "open source development environments," "open source DBMS," "XML databases," "blade servers," "Linux servers," and "single sign-on." The arrows indicate the extent of changes in maturity; the starting point of an arrow represents the maturity of a technology six months ago, and its ending point represents the current maturity. Because these technologies, which have greatly advanced in maturity in

Figure 1. Field Definition for Information Technology Map

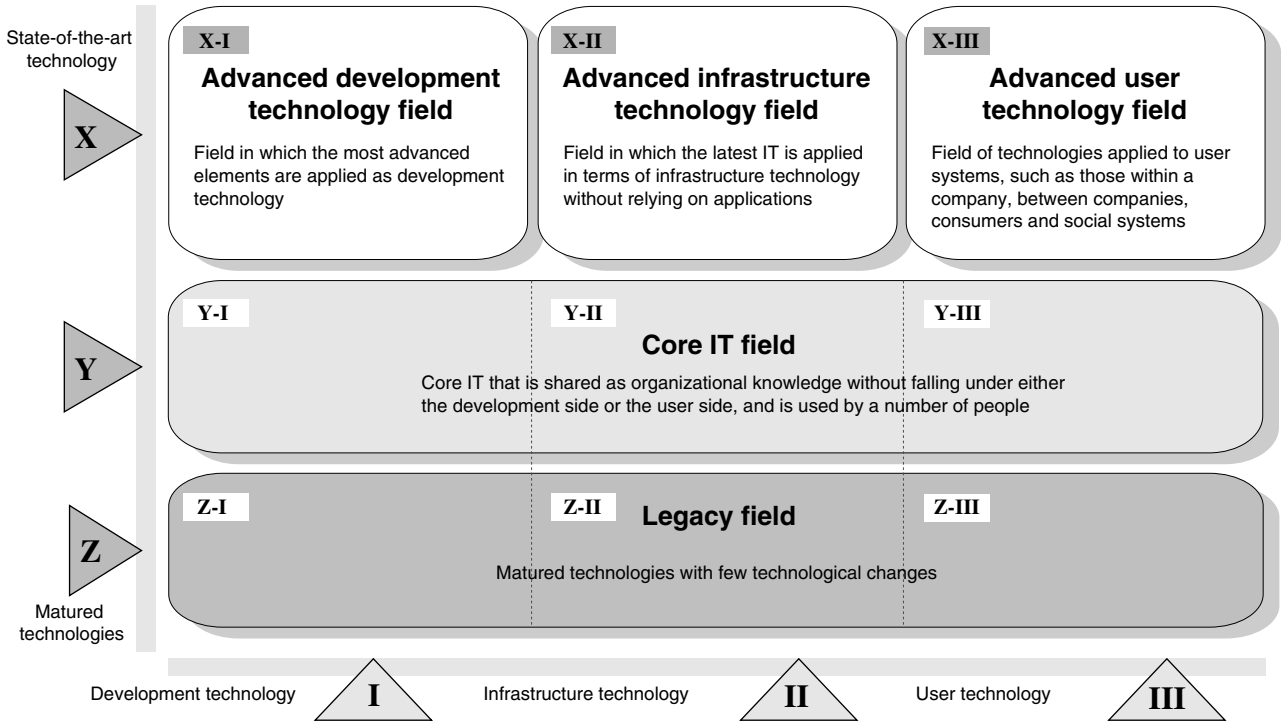
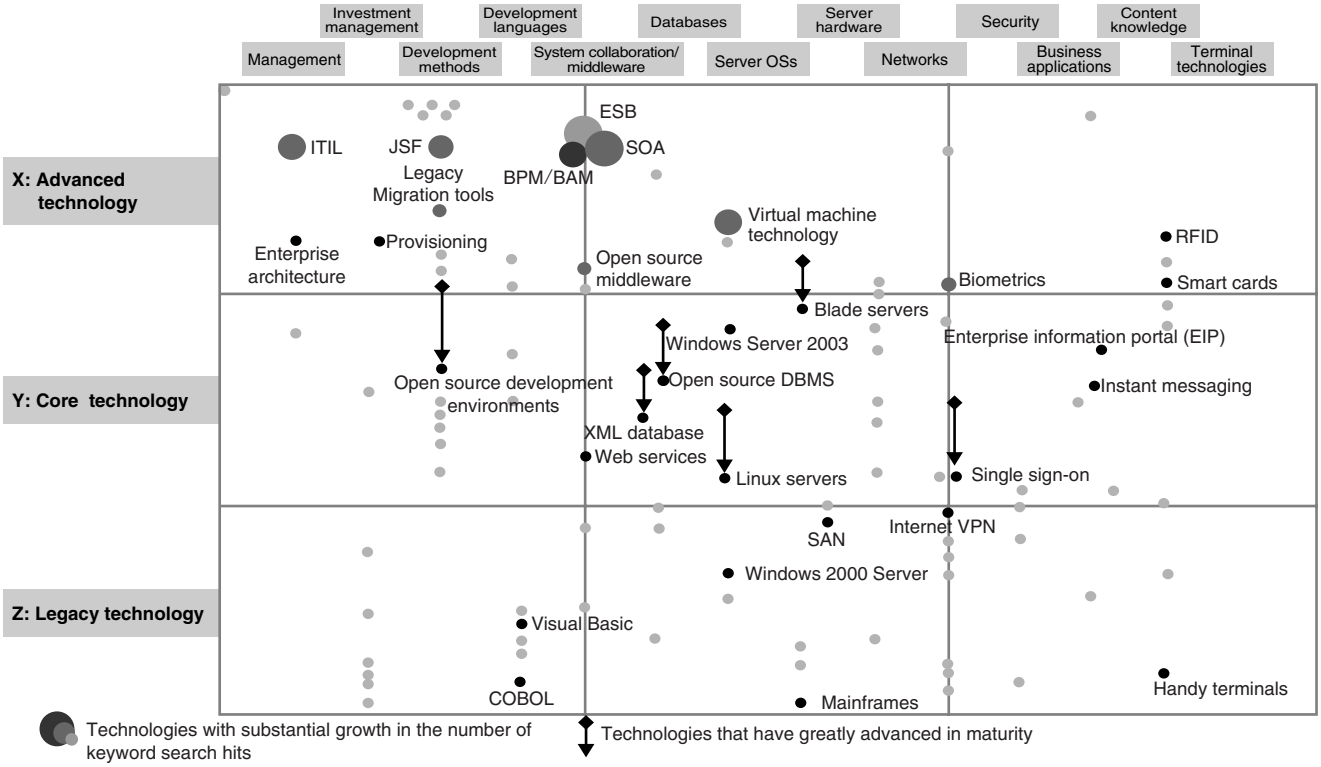


Figure 2. Information Technology Map



the past six months, are already widely distributed and can be used on a stable basis, they can also be actively employed in mission critical fields. ITIL (Information Technology Infrastructure Library), legacy migration tools, JSF, BPM/BAM, ESB, SOA, open source middleware and virtual machine technology are technologies that have seen substantial growth in the number of hits in keyword searches of magazines such as those published by Nikkei BP and are receiving increased attention. As for those technologies, a constant monitoring of trends or acquisitions through in-house R&D activities and/or verification tests must be considered according to the maturity of technologies.

This information technology map is not a mere framework proposed by NRI. The fact that the Japan Information Technology Services Industry Association (JISA) adopted the map last year as a methodology for technology evaluation and its research result appeared in *Nikkei Computer* illustrates its widespread use and increasingly heightened recognition.

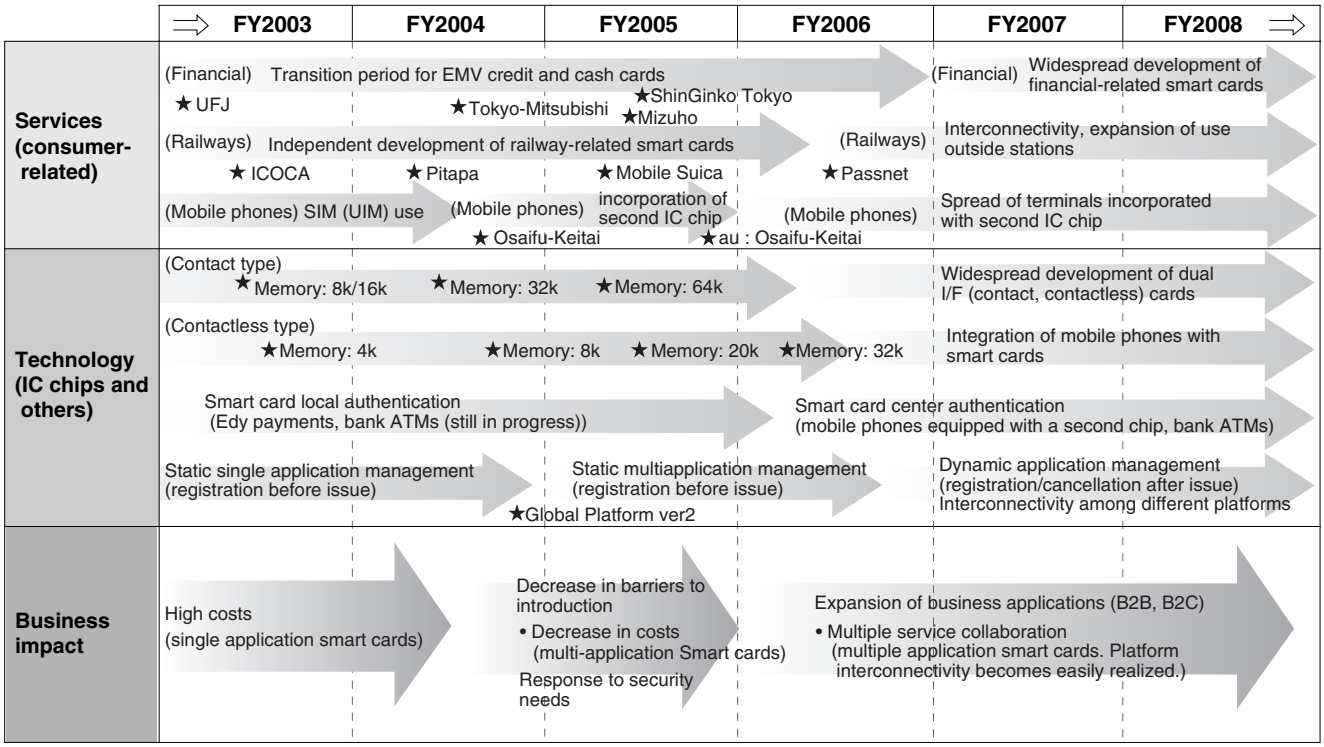
2 IT Road Map

The IT road map is designed to support client companies and NRI Group companies in making decisions on IT strategies by establishing a highly precise view of each technology field up to five years in the future. NRI is continuously creating road maps for technology fields that are expected to play important roles in the future. This paper introduces the trends of smart cards and information search technology from among those technologies.

1 Road Map for Smart Cards

Figure 3 is a road map for smart cards. This paper examines smart cards with a view to outlining their technology, current services and future development.

Figure 3. Road Map for Smart Cards



(1) What is a Smart Card?

Smart cards are cards approximately the same size as cash cards with IC chips embedded to record various kinds of information.

Smart cards can be categorized into two types: contact smart cards and contactless smart cards, depending on the communications system. Contact smart cards have a metal terminal on the card surface; the supply of electric power to the IC chip and communication with the card reader are carried out through this terminal. Contactless smart cards have a built-in antenna; the electric power for driving the IC chip is generated by electromagnetic induction with radio frequencies from the card reader. After calculations are performed in the card, information is transmitted to the card reader via radio frequencies. EMV credit cards and ETC (electric toll collection: a system to collect tolls automatically from passing cars) adopt contact smart cards, and the JR East's Suica adopts a contactless smart card. Contactless smart cards are further divided into three types depending on the communications protocol and transmission speed. Figure 4 shows the types and examples of smart cards being distributed in the current market.

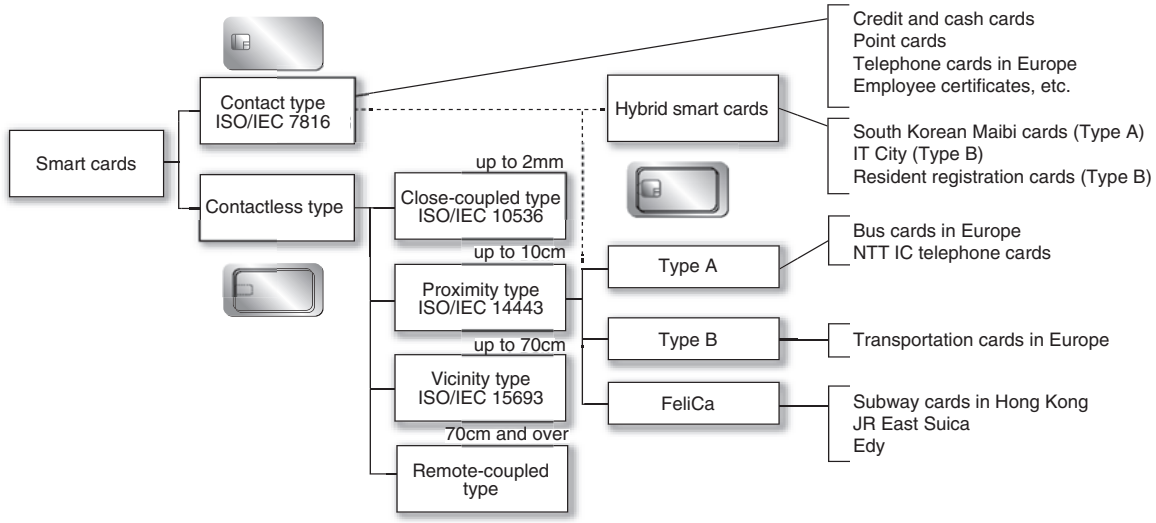
Producing a counterfeit smart card is technically difficult as information is recorded on an IC chip. A smart card has various merits owing to its ability to perform communication utilizing the calculation function of the IC chip, such as being able to perform high security encrypted transmissions and to record more information than a magnetic card.

(2) Market Driven by the Financial and Transportation Sectors

The use of smart cards is increasingly widespread in the financial sector (i.e., EMV credit cards) and transportation sector (i.e., boarding passes).

In the financial sector, industry groups have been exploring a shift to EMV credit cards since the 1990s as a technology to prevent the unauthorized use of credit cards. EMV credit cards have been widely distributed in Japan since 2003. Other representative examples of smart cards includes the Edy, electronic money, which started service in 2001, and cash cards issued by the Bank of Tokyo-Mitsubishi and Mizuho Bank that

Figure 4. Various IC Cards



are equipped with a biometrics function as a measure against skimming losses.

In the transportation sector, major railway companies have begun to use contactless smart cards, such as JR East's Suica, JR West's ICOCA, and Surutto KANSAI's PiTaPa.

In addition, in the government sector, the resident registration card that municipal governments began issuing to applicants in August 2003 uses smart card technology.

(3) Trends in the Smart Card Industry

Industry movement has accelerated along with the expansion of smart card services. For example, with a target set at regional banks, NTT Data offers a service for issuing smart cards while Dai Nippon Printing provides outsourcing services related to the management of issuing smart cards, such as changing the settings of smart card contents via the Internet. In addition, boarding passes and the Edy, electronic money, use FeliCa, which is a contactless smart card technology system developed by Sony. With regard to FeliCa, Sony, JR East and NTT DoCoMo have invested in the founding of a FeliCa Network to promote incorporation of FeliCa into mobile phones.

(4) Changes in Smart Card-Related Technologies

As seen above, various applications that were previously offered independently are now beginning to be incorporated into a single card along with the spread of smart cards used in the financial and transportation sectors. The technology of platforms supporting smart cards and services is changing.

a. Changes in Smart Cards

Suica is capable of incorporating multiple functions, such as electronic money information, seat reservation information, and credit card information, in addition to commuter pass information. The Edy can also incorporate ID information (or employee certificate information) for entering and exiting office buildings, in addition to electronic money information, in a single card. As for smart cards themselves, dual interface cards, combination cards and others supporting the different communications systems of contact and contactless smart cards have emerged for accomplishing the services of different companies in a single card. The Super IC Card offered by the Bank of Tokyo-Mitsubishi, which includes the Edy and the JAL IC Card offered by Japan Airlines, are examples.

In addition, smart cards are making new advances as a result of integration with mobile phones. NTT DoCoMo has already offered its terminal under the name "Osaifu-Keitai." "Osaifu-Keitai" refers to mobile phones equipped with a contactless smart card for useful online functions/services such as electronic money, credit card payments, electronic ticketing, memberships, and more. Other major communications carriers

such as au and Vodafone have begun to release mobile phones with smart card functions using FeliCa, too. With regard to the services to be incorporated, it has been decided that the Suica, a transportation boarding pass, will also be incorporated into mobile phones by the end of fiscal 2005, following the Edy, electronic money. Thus, it is predicted that the integration of smart cards with mobile phones will steadily accelerate over the next several years.

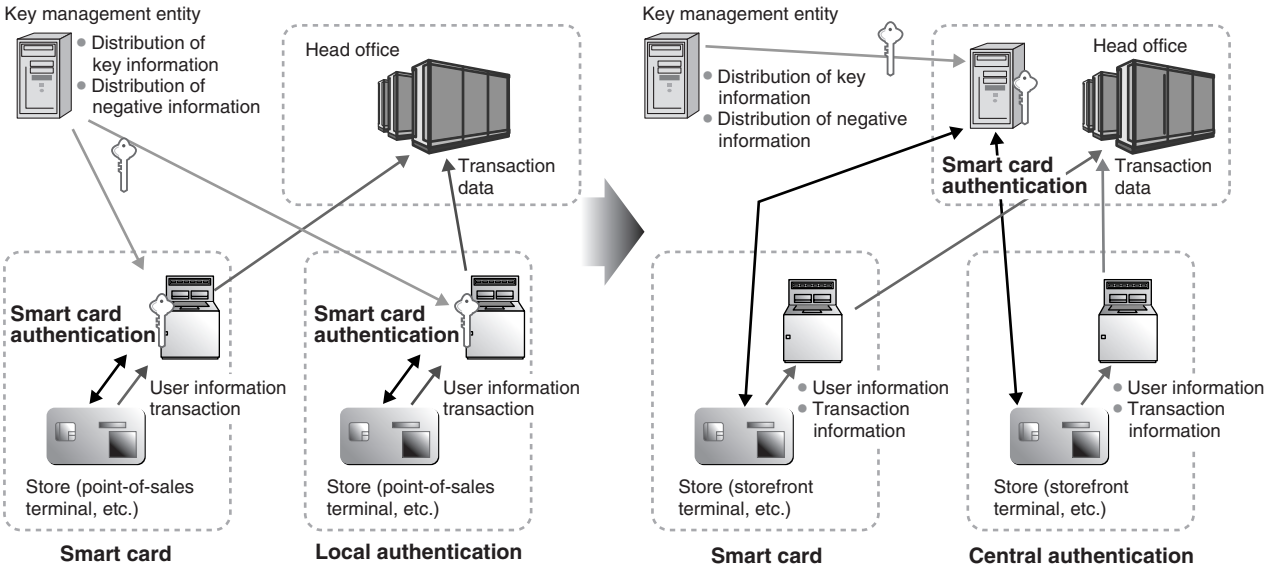
The integration of smart cards with mobile phones makes possible new services that use functions of mobile phones such as "showing information by means of a display" and "Internet connection by means of packet communications." Representative examples include browsing information stored on a smart card and downloading applications via mobile phone Internet. Besides these, the integration will make it possible to exchange smart card contents between terminals using infrared line communications functions or placing an order via the Internet after reading in a bar code recorded in a mail order catalog with a mobile phone camera and paying with electronic money on a smart card upon receiving a parcel.

b. Changes in Platform Technology

The requirements for platforms supporting these services are also becoming important. While a guarantee of interconnectivity between services of businesses to use various services is a matter of course, it will be necessary to establish an infrastructure for certification of a smart card as a previous step to use a service. In particular, a high security system is required when information relating to financial products such as credit and electronic money is recorded in a card and used. Specifically, it will be necessary to add security functions such as the recording of electronic certificates in smart cards to conduct mutual authentication with the smart card reader, or encrypted communications between cards and card readers. For example, EMV credit cards and EMV cash cards have already adopted a card authentication system (see Figure 5) by mounting electronic certificates encrypted using secret keys in cards and decoding the encrypted electronic certificate information with am open key recorded at a storefront terminal (e.g., CAT terminals, ATM terminals, etc.). This is also called local authentication.

However, a local authentication system that records key information in a storefront terminal cannot exactly be considered an ideal system in light of maintenance costs such as the periodic changing of keys and the addition and deletion of negative information (information on the suspension of card

Figure 5. Change in the Smart Card Authentication Infrastructure



Note: This figure represents a simplified version of infrastructure with reference to specifications (still in progress) of bank EMV cash cards.

use, etc.) as well as the risk of theft. Meanwhile, transmission costs have decreased and the shift to broadband service has been progressing in recent years. Against this backdrop, it will likely be possible to perform smart card authentication in an integrated manner at head offices or data centers in the near future. Therefore, such a perspective as how to establish an infrastructure for card authentication will become important when considering the incorporation of smart cards in customer services in the future.

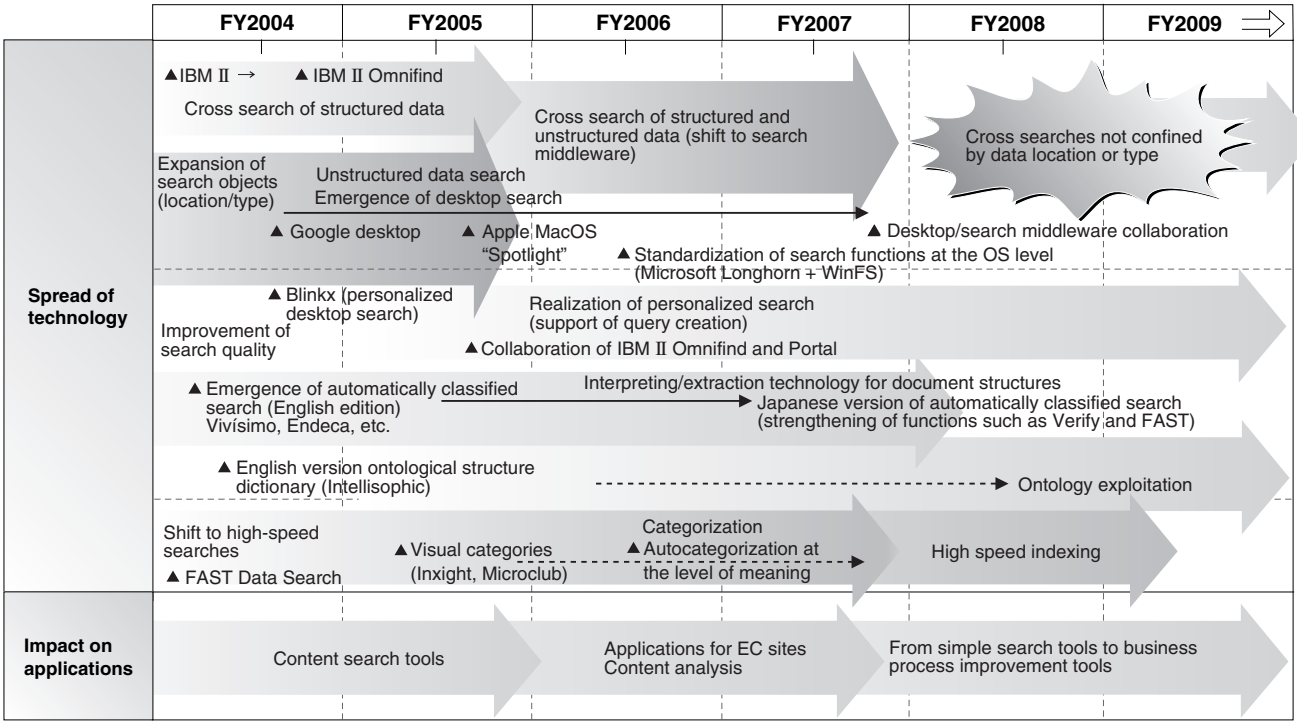
2 Road Map for Information Search Technology

Figure 6 is a road map for information search technology. Information search technology is an already existing technological field. The popularization of web searches by keyword through Google and Yahoo! may well illustrate that fact. A period of growth is beginning, however, as a result of new technological innovations against the backdrop of increasingly intensifying activity of major search software vendors since the latter half of 2004.

Advances in search technology are taking place in three broadly classified fields. The first field is advancement in the direction of cross searches that are not confined by the location of the data that is the object of information searches (information on the Internet; information on the internal servers of companies; or the contents of the local hard drive of a client's PC) and the types of objects to be searched (structured data and files consisting mainly of numerical values such as databases; data consisting mainly of text such as web pages; or multimedia images such as movies).

The second direction of advancement is the improvement of search quality. There are several techniques for improving search quality: traditional concept searches exploiting natural language processing technology and the narrowing of searches according to the meaning of the search results. A recently emerged technique that should be noted is the "personalization" of searches. This method, after identifying a user, presumes information sought based on the user identity and history of information access, enabling one to arrive closer to expected search results. For example, an engineer

Figure 6. Road Map for Information Search Technology



and a salesperson would expect different search results in performing a keyword search of company products. Personalization for searchers makes it possible to present useful search results through customized searches focusing on information on the technical specifications for and the fixing of the products for the engineer on the one hand, and on sales promotion tools and market information for the salesperson on the other.

The third direction of advancement is the shift to high-speed searches. This is a technical advancement that reduces the lead time between the time information is renewed and the time at which that information is reflected in the search results, making it possible to use information searches as business processes. Information searches have traditionally been confined to a structure separate from business applications. If a search engine can detect changes in information with a speed close to real time, however, it will become possible to use search engines to list necessary business information from business applications, and to use search systems as a means for accessing transactions handled by online systems.

Among the above three directions of advancement, topics relating to the expansion of search objects and the realization of cross searches, both of which will have significant impacts as new technological trends of information search technology, will be discussed below.

(1) The Emergence of Desktop Search Technology

In the search technology-related market of 2004, Google's application for a stock listing on the NASDAQ in April attracted a great deal of attention. New technologies and services emerged in the Internet search service market apparently driven by various steps taken by Google. The field of "desktop search," such as the Google Desktop Search function, which Google pioneered and announced in advance of other companies, is probably the most significant.

A desktop search installs a search engine itself in a client PC, enabling a search for information in the local drive of the client PC. It is a standalone application. In the past, searches of data kept in client PCs were limited to file names and the times and dates of file creation. As a result, searches for necessary information from groups of files stored on the hard drive of a personal PC were not performed very frequently.

Meanwhile, desktop search technology searches various files existing in the local hard drive of a client PC (office documents, PDFs, e-mails) and meta-data of sound and movie files such as creator names, the times and dates of file creation, and genre. Desktop search expands search objects to include the local hard drive, which were previously not included, and even further to include various types of unstructured data.

Following the beta edition release of Google's desktop search tools, many search services and software vendors such as Yahoo!, MSN, Autonomy UK and Justsystem of Japan also followed suit and one after another began to release desktop search products. In addition, a movement to integrate desktop search functions into operating systems can be observed. The desktop search technology "Spot light" was incorporated in the Mac OS X 10.4 in April 2005, and Microsoft plans to incorporate similar technology in its next-generation Windows OS, "Windows Vista," in the latter half of 2006. As such, the style of search technology employed by the end user is expected to change after 2007.

(2) "Shift to Middleware" for Searches

The expansion of search objects is advancing in the field of server products for enterprises, too. Regarding search server products used inside companies, this advancement is being directed toward the expansion of databases that are the search objects.

In the past, the in-house search objects of companies were classified broadly into two types of databases. The first type was a search for text data kept in web pages and file servers in an intranet. The second type was a search of structured data saved in databases and business applications. In conventional searches, only statically generated web pages and files could be used as search objects, and information on pages dynamically generated by DBMS

and business applications and on-screen information could not be searched simultaneously. As a result, users needed to log into individual business applications and separately search for the necessary data.

Among search server products, the question of how to identify necessary information from databases covering various systems in one keyboard instruction is becoming an issue. As a result, many products are beginning to include a function in which DBMS, ERP, CRM systems, etc., are turned over to the user and accessed, and multiple internal system searches are carried out concurrently with searches of the web and file servers.

User authentication and security becomes a problem when multiple different systems are included in search objects. Because authentication by ID and a password is required when accessing a business system, the search server must authenticate a user. With regard to the display of search results as well, search results for business applications cannot be shown in the same way to all employees. In such cases, it is also necessary to acquire information relating to user access privileges in addition to the search results from business applications.

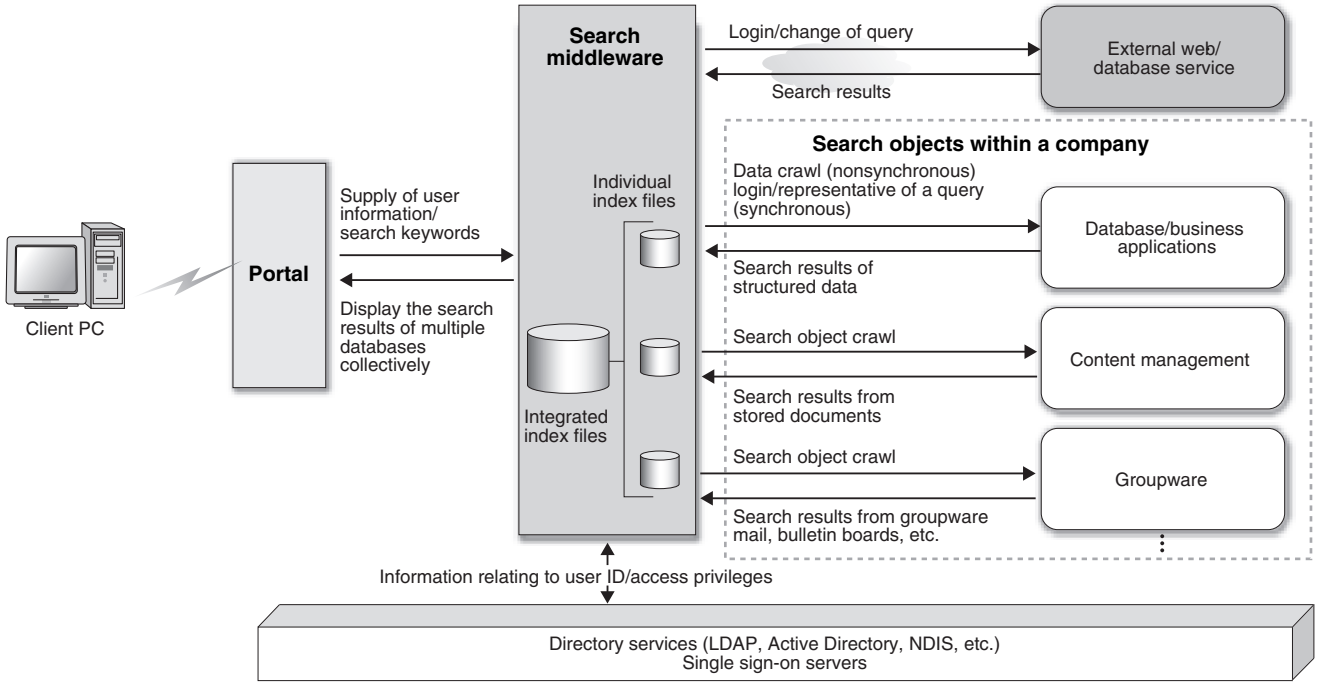
Recently beginning to emerge are search server products that perform searches safely in collaboration with business applications by exchanging authentication information through directory services such as LDAP and Active Directory, or single sign-on products. Products like these are not just one application of an information-related system; rather, they will assume the role of "search middleware" available for multiple purposes when a user accesses various databases. Conversely, it is also possible for business applications to acquire and use the search results of other business applications and text data from search middleware. Figure 7 shows the role that search middleware plays between other information-related systems and business applications.

A shift to search system middleware can already be seen at the product level. It is expected that search middleware will emerge in 2005 and attain a certain degree of maturity by 2006. Cross searches not confined to the locations of data or data source types are expected to be realized after 2006.

(3) What Search Object Expansion and Cross Search Bring to Companies

The achievement of the expansion of search objects and cross search is expected to exhibit an

Figure 7. Example of a System Structure Using Search Middleware



effect on the acceleration of information sharing within companies. It is inefficient for employees to scour the various systems within a company for pictures, movies and database information. Search services that search in-house systems horizontally and provide necessary information to the necessary people at the necessary time would lead to increased business efficiency and an improvement in productivity.

In addition, collaboration between search functions and business systems of search results by means of search middleware will change the role of search engines, which until now have been seen as information access tools for end users, to tools for collaboration between business applications. After 2007, it will likely be necessary to reexamine the use of information searches in company systems resulting from the search system shift to middleware.

3 Conclusion

This paper introduced the information technology map and the IT road map as part of NRI's IT navigation activities. NRI hopes to contribute to the formulation of IT strategies by our client companies as well as by NRI Group companies by carefully monitoring any future environmental changes involving information technology.