System Architecture for ITS in JAPAN

- Summary -

November, 1999

National Police Agency
Ministry of International Trade and Industry
Ministry of Transport
Ministry of Posts and Telecommunications
Ministry of Construction

Preface

Modern society is becoming increasingly information-oriented at the global level, and the road traffic is no exception. Also in Japan, the use of information technologies on roads, traffic and vehicles are being promoted in order to solve such problems as traffic accidents, congestion and the environmental deterioration , as well as to meet the market-expansion needs of the automobile industry, the information and communication industry and other industries.

To promote the use of information technologies on roads, traffic and vehicles, the five related government bodies (National Police Agency, Ministry of International Trade and Industry, Ministry of Transport, Ministry of Posts and Telecommunications, and Ministry of Construction) jointly finalized a "Comprehensive Plan for ITS in Japan" in July, 1996, which is based on the "Basic Guidelines for the Promotion of an Advanced Information and Telecommunications Society" (determined by the Advanced Information and Telecommunications Society Promotion Headquarters in February, 1996). They also demonstrated a long-term vision of basic ideas on ITS development, implementation and User Services in which ITS will be promoted systematically and efficiently from the users' view point, and promoted in Japan based on the Comprehensive Plan in cooperation with industrial and academic sectors.

Given this history, the practical use and R&D of each specific system of ITS have been further accelerated in recent years in Japan. At the same time, the five government bodies recognized the need to create a grand design which was more detailed than the long-term vision in order to efficiently realize an integrated, highly expandable ITS system to respond to changes in social needs and development in technology in the future. In August 1999, the five government bodies organized a draft copy entitled “System Architecture for ITS.” Subsequently, the draft was released so as to collect opinions from a broad range of the industrial and academic sectors and to actively address information overseas.

Recently “System Architecture for ITS” has been composed.

It is our hope to continue promoting ITS-related projects through extensive cooperation among the five government bodies with the industrial and academic sectors as well as other nations targeting an early and efficient realization of diverse ITS services based on the comprehensive plan and System Architecture.

November 5, 1999
National Police Agency
Ministry of International Trade and Industry
Ministry of Transport
Ministry of Posts and Telecommunications
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Chapter1　Background of Constructing the System Architecture

1.1　What is System Architecture?

In the late 20th century, man started to conduct large-scale projects with advanced and diverse purposes. At the same time, we saw dramatic improvements in the element technologies essential to realizing such projects. The most significant ones are information processing technologies including computers, and the information and telecommunication technologies which achieved digital communications. By combining information processing technologies and information and telecommunication technologies, man built large-scale systems with advanced and diverse purposes.

Such large-scale systems are made possible by associating diverse technologies that compose the systems in many ways. Therefore, when building a system, it is important to create a common awareness of the overall image among the parties involved, and promote the efficient realization of an integrated system. When building a large-scale system that consists of diverse technologies, we usually organize a structure for the entire system in advance, and then develop specific systems conforming to the structure.

System Architecture is a structure for the entire system that illustrates component elements (technologies and specific systems) and their relation to each other. It is essential for designing and developing a system that works as a whole.

1.2　History and Current Situation of ITS in Japan

(1) History of Constructing the "Comprehensive Plan for ITS in Japan"

Japan, one of first countries in the world to take on R&D for the Intelligent Transport Systems (abbreviated ITS), inaugurated ITS work when the Ministry of International Trade and Industry started to develop CACS (Comprehensive Automobile traffic Control System) in 1973.

Thus, Japan has been actively involved in the R&D of specific technologies that could become ITS core technologies. In the process, it became clear that since ITS would affect broad areas of road, traffic, vehicles and information and telecommunications, it would be necessary to work with people in various fields, promote ITS based on international exchanges, and provide User Services to meet their needs.

In February, 1995, the Advanced Information Telecommunications Society Promotion Headquarters headed by the Prime Minister determined the "Basic Guidelines for the Promotion of an Advanced Information and Telecommunications Society". And in August, 1995, the five related government bodies compiled the "Basic Government Guidelines for Advanced Information and Communications in the fields of Roads, Traffic and Vehicles," and started to apply those guidelines to development and practical issues such as selecting nine areas for ITS development as a basic ITS structure. In this climate, in July, 1996, the five government bodies compiled a "Comprehensive Plan for ITS in Japan" which is a long-term vision of ITS's goals regarding 20 User Services and development and implementation, so that the government bodies can maintain close ties with each other and promote ITS systematically and efficiently from the users' point of view.

(2) Towards the realization of ITS

While constructing the "Comprehensive Plan for ITS in Japan", Japan has seen active movement toward the practical use of specific systems such as VICS, ETC (Electronic Toll Collection System) and UTMS.

Thus, Japan has put some systems into practical use and accelerated other systems for practical use. However, there are difficulties in designing and developing specific systems effectively and efficiently such as a lack of the big picture of the large-scale system composed of diverse technologies, and unclear information and the necessary capacity to build a practical system based on the "Comprehensive Plan for ITS in Japan" which outlines 20 User Services.

1.3 International Trends Related to the System Architecture

(1) Trends in the USA

In America, the Department of Transportation (DOT) plays a major role. In September, 1993, DOT started a 33-month program to develop a System Architecture. In Phases I and II, several private sectors examined System Architecture designs before publishing the approximately 5000-page National System Architecture in the summer of 1996.

In the National System Architecture design, America not only promoted standardization activities, notification and PR activities based on the architecture, but also deployed actual systems and continues to maintain the National System Architecture.

As for the standardization activities, they presented 12 standardization requirements such as standardization of DSRC (Dedicated Short Range Communication) in the National System Architecture. Later in July, 1996, they published the ITS Five-Year Standardization Plan with a list of 44 priority standardization articles including communication rules between systems.

(2) Trends in Europe

In Europe, the European Commission (EC) is in charge. As a task force of DRIVE II (Dedicated Road Infrastructure for Vehicle Safety in Europe II), whose purpose was to increase safety and transportation efficiency and to decrease the effects on the environment by improving infrastructure, they formed SATIN (System Architecture and Traffic Control Integration) in 1994 to examine methods to build a System Architecture related to road traffic.

After completing DRIVE II, the EC started T-TAP (Transport-Telematics Application Programme). One of its activities is CONVERGE, methods to examine

System Architecture. They reformed the methods examined in SATIN, and added a method of System Architecture for railways, water transport, airways and other transportation besides road traffic after study and preparation.

Thus, the EC, which conducted R&D mainly on methods of building System Architecture, applied the research results of the methods to building a Pan-European System Architecture for KAREN (Keystone Architecture Required for European Networks).

1.4 Necessities for Constructing the System Architecture

After formulated "The Comprehensive Plan for ITS in Japan," specific ITS, which is comprised of diverse specific systems, has been actively put into practical use or under preparation. Therefore, in order to build concrete systems based on "The Comprehensive Plan for ITS in Japan" which conformed to 20 User Services, it is necessary to clarify the position of each specific system in the entire ITS and to develop designs considering the requirements for each specific system in relation to the entire ITS as well as common areas shared among other specific systems and the timing of putting those systems into practical use. To achieve this, it will be necessary to promote an understanding of the entire ITS by ITS-related people in industry and academic sectors and all users, and to show them the systematic development of ITS.

At the same time, other countries, such as America, are strategically promoting ITS considering the future development of overall ITS by formulating System Architecture and applying it to ITS standardization activities, notification/PR activities, deployment and so forth.

Japan should also make ITS an integrated system, build it efficiently, and develop it as a highly expandable system that corresponds to future changes in social needs and development in technology.

Also, Japan’s original system architecture (framework) has to be constructed in order to realize, in the global expansion of ITS environment, the original User Services which respond to Japan’s own natural and social environment. Japan’s original System Architecture needs to be based on the clear recognition and distinction between parts that should be standardized to foreign System Architecture and parts that is peculiar to Japan.

Therefore, in order to secure system efficiency in integration and building of the system during the process of promoting its actual building, it is necessary to consider the role of the specific systems in ITS when designing specific systems, share information and functions in the systems, and utilize such information and functions as a platform for developing systems. In order to secure system expandability, it is necessary to systematically organize information and functions in the systems, and make the interface and other elements in the systems interchangeable. Furthermore, it is also necessary to signify the system information and functions to be shared as Standardization Candidate Areas so as to effectively and efficiently participate in national and international standardization activities.

Now that Japan is striving to implement the service contents and basic concepts of the system presented in "The Comprehensive Plan for ITS in Japan" and acknowledges the necessity of System Architecture. This commitment has been published in order to efficiently build integrated systems, secure expandability of systems, and assure promotion of national and international standardization activities.

Chapter2　Concept for Constructing the System Architecture

2.1　Purpose of Constructing the System Architecture

The purpose of constructing the System Architecture for ITS is: 1) to build an integrated system efficiently, 2) to secure expandability of the system, and 3) to promote national and international standardization.

2.2　Concept for Constructing the System Architecture

(1) Procedure of constructing the System Architecture

The procedure of constructing the System Architecture is: 1) to define the details of User Services, 2) to construct the Logical Architecture, 3) to construct the Physical Architecture, and 4) to prepare Standardization Candidate Areas.

The first to be implemented, "1) to define the details of User Services" means to define detail contents of User Services to be analyzed in constructing Logical Architecture. To be more concrete, we defined "purpose" and "contents" of Specific User Sub-services. In this definition, User Services were subdivided into 172 detailed Specific User Sub-services. Also, Specific User Services were established as median organizing units between User Services and Specific User Sub-services and ITS services are systemized into four ITS service levels including development. The System Architecture for ITS should be constructed based on defined detail Specific User Sub-services. That way, the System Architecture constructing Logical and Physical Architecture, which are prepared after examining the entire sub-services will not be in the User Service category that is a structure of subsidizing services into sub-services.

The second to be implemented, "2) to construct the Logical Architecture", means to clarify information sent and received between users and systems and processed in the systems in order to offer each Specific User Sub-service; to take out "information" and "functions" while processing to systematize the "information," and to create a model of the relationship between the "functions" necessary to offer services and "information" processed in the function by using a common form.

"3) To construct the Physical Architecture" is to make a common combination of "functions" taken out in the Logical Architecture and "information" processed in the functions among Specific User Sub-services in order to integrate the entire system, and to distribute those combinations to cars, roadside and centers in order to create a model of the entire system to realize ITS.

"4) To prepare Standardization Candidate Areas" is to place all of the 24 subsystems, one of the achievements of the Physical Architecture, and four communication systems in the areas (Standardization Candidate Areas) to be standardized. This process is shown in the subsystems interconnect diagram. The subsystems evaluated based on the "degree of sharing Specific User Sub-services" and the communication points used in the subsystems is summarized. Its goal is to support the priority decision-making of standardization activities by standardization-related institutions.

(2) Structure to compile system architecture

It was decided that the five government bodies would compile the System Architecture for ITS in cooperation with VERTIS.

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Chapter1 Achievements of Constructing the System Architecture

1.1 Varieties of Achievements of Constructing the System Architecture

The achievements of constructing the System Architecture are composed of four sections: to define detailed User Services, to construct a Logical Architecture, to construct a Physical Architecture, and to organize Standardization Candidate Areas.

1.2 Characteristics of the System Architecture

In constructing a System Architecture, the following two points were emphasized: 1) Securing flexibility to meet changes in social needs and development in technology; 2)Ssecuring compatibility and interconnectivity with an Advanced Information and Telecommunication Society.

1.3 Ideas for Achieving Characteristics

(1) Ideas for securing flexibility to meet Changes in Social Needs and Technological Development

The System Architecture for ITS adopted the object-oriented analysis method which makes it easy to alternate/expand some parts of the System Architecture. It allows to secure flexibility to meet future changes in social needs and development in technology and to occasionally revise the architecture to meet changes in ITS promotion situations.

(2) Ideas for securing compatibility and interconnectivity with an advanced information and telecommunication society

In order to secure the second characteristic, which is the compatibility and the interconnectivity with the Advanced Information and Telecommunication Society, we established a 21st User Service which defines a society to be realized in the fields necessary to ITS. Then, after defining the detailed Specific User Sub-services, just as the 20 User Services were defined, we designed the System Architecture.

Chapter2 Detailed Definition of User Services

2.1 What is a Detailed Definition of User Services?

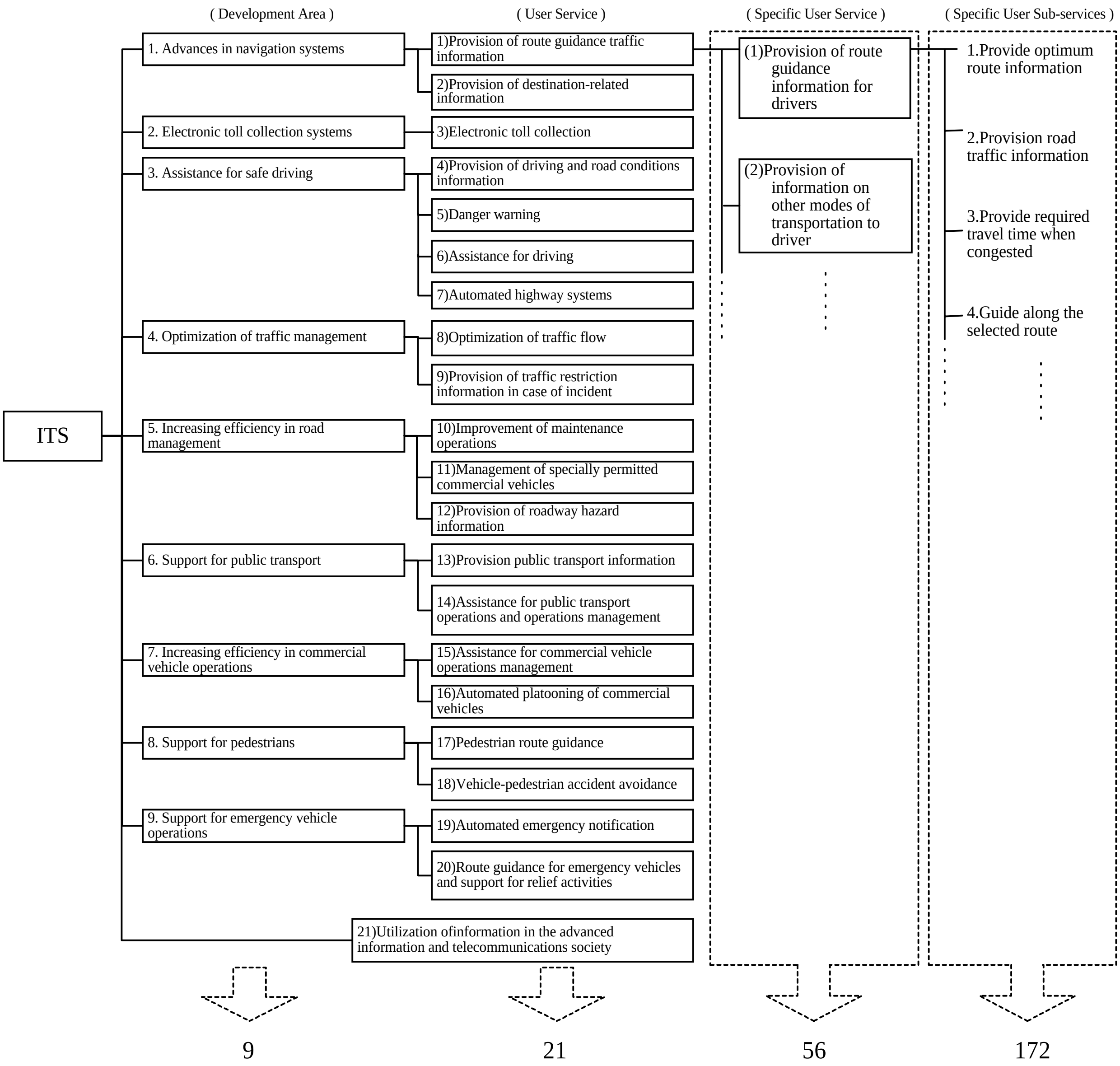
A detailed definition of User Services means subdividing the 20 User Services specified in “The Comprehensive Plan for ITS in Japan” and the newly added 21st User Service from users’ viewpoint, user situations, and the information contents used in the services in order to illustrate the flow for each situation of service provision from collecting to processing the information, which is required by users or the system. These subdivided User Services are called Specific User Sub-services. When constructing a logical System Architecture, a detailed definition of Specific User Sub-services means describing the “purpose” and functions of the sub-services and “contents” which summarize the information used for the sub-services in order to extract information received and transmitted between users and the system as well as processes in the system.

We established Specific User Services as a median unit which makes it possible to include sub-services between User Services and Specific User Sub-services.

2.2 Structure of ITS User Services

Based on a detailed definition of User Services, 56 Specific User Services and 172 Specific User Sub-services are systematically organized under the nine areas for development and 21 User Services.

Fig. 2.2-1 Overall structure of User Services that influenced constructing a System Architecture



Chapter3 Constructing the Logical Architecture

3.1 What is Logical Architecture?

In the Logical Architecture, upon clarification of the transmission and reception of information that occurs between the users and the system for the realization of sub-services and the processing performed within the system (called "procedures" below). The information and functions handled in those procedures are determined; the information is systematized; and the relationships between the functions which is needed for the realization of services and the information handled by those functions are shown in a model using a common format. Here, "information" refers to the elements collected on the basis of a phenomena outside the system, and the elements obtained by processing and condensing them. "Functions" are the portions which perform the collecting, the supplying, the processing of information as well as related control, and the other exchange of information within the system.

The functions, which are to be arranged under the Physical Architecture construction work, and also the information to be handled, have been clarified through these kinds of modeling. To make it easier to find the information and functions which can be shared among multiple sub-services in the construction of Physical Architecture, we have uniformly established the relevant terms and their content to prevent the use of different terms to describe the same phenomenon.

3.2 Achievements of Constructing the Logical Architecture

(1) Steps in Constructing Logical Architecture

The Logical Architecture has been constructed through the following steps, [1] to [5].

[1] After making assumption on the process for realization of services from the content of Specific User Sub-service definitions, and making distinction between the users and the system, which is a portion without user interposition, we listed the transmission and reception of information which will occur between users and the system, such as user requests and the supply of information from the system side, and processing which will be performed within the system (procedures). In listing these procedures, deliberate attention was paid in order to avoid any limitations on the specific realization technologies and devices.

[2] Next, we determined the information and functions which are to appear in each of the listed procedures.

[3] Concerning all of the information and functions which had been determined, we uniformly defined the terms and their content in order to prevent the use of different terms when describing the same phenomenon.

[4] With regard to the information which had been determined, we first established the basic elements related to ITS, such as the operational body, drivers, and public

transport vehicles, then arranged them into groups according to the correlations among elements, and took these groups as sets of information expressed by the names of basic correlated elements. Based on the subset relationships among these information sets, we indicated the structure of the grouped information by strata. This system, having a stratified structure, is called an "information model."
[5] Concerning the functions which had been determined, we used a common format to model the functions needed for realization of each Specific User Sub-service, along with the information to be handled by those functions. This model is called a "control model."

(2) Achievements of Logical Architecture

[1] Information Model

An information model is a model of the relationships between the “functions” and the “information” to be handled by those “functions”. It clarifies the correlations among all of the “information” handled in ITS, and it relates all of the “information” as a system having a stratified structure in order to facilitate expansion and changes to the System Architecture in case any additions or changes have to be made in the “information” handled by ITS due to future changes in social needs or technological process. The “information” placed under this system is uniformly defined by this systematization, thus avoiding the existence of redundant information expressing the same content in the system.

The “information” handled by ITS has been arranged into a stratified structure with seven basic information sets (spot, routes, roadway, moving body, schedule, operational body, and external institute) all at the highest level. (No other information sets can be placed at a higher level than these sets.)

We also organized the vertical relationships among information sets to ensure that the nature of higher level information sets is carried down to all lower levels. Focusing on only the stratified structure of this model, we refer to this structural portion as the "detailed model" with regards to the “information” model.

We have organized all of the information handled by ITS into such strata by applying the relevant “information” to the various information sets. These information sets were arranged in this way.

In systematizing the information with regards to the relationships among information sets, we have indicated not only the stratified relationships of inclusiveness, but also the interrelationships among them. In this manner, we have been able to prepare a single overall system, which clarifies all of the correlations among information as stratified relationships of inclusiveness or as other relationships.

As a result of the systematization of information, we have been able to produce a diagram showing an overview of the entire information system (by indicating only the relationships among the highest level information sets existing in common in the nine ITS development areas). This is called the "core model" of the information model.

[2] Control Model

Using a common format, the control model is the result of modeling the relationships among the "procedures" and "functions" needed for the realization of sub-services and the "information" they handle. The first objective of determining the control model is to clarify the functions, which are to be arranged in the subsystems such as centers, roads, and vehicles, in construction of the Physical Architecture.

The second objective is to facilitate the finding of information and functions which should be shared in construction of the Physical Architecture, through the use of uniformly defined functions and the information they handle, as well as modeling by a common format.

In the control model, “functions” and “information” they handle are treated together. Therefore, it becomes possible to make overall change in the system without any affect to other “functions” which is treated together with “information” absorb the content of additions or changes in the “information.”

Here, the control model for a representative sub-service is given as an example. Moreover, it becomes easy to detect “functions” related to “information” in which additions or changes are made.

Chapter4　Constructing the Physical Architecture

4.1　What is Physical Architecture?

The Physical Architecture is a model of the overall image of the system to realize ITS and arrange the vehicles, roads, centers, etc. with sharing among the sub-services to promote integration of the entire system with regard to the combination of the functions determined by the Logical Architecture and the information handled by those functions.

Construction of the Physical Architecture clarifies the positions of all of the subsystems constituting ITS and the information exchanged among the subsystems, and indicates the overall system structure (framework). The subsystems are a combination or aggregation of the functions determined by the Logical Architecture and the information handled by those functions.

4.2　Achievements of Constructing the Physical Architecture

[1] Physical Model for Each Specific User Sub-service

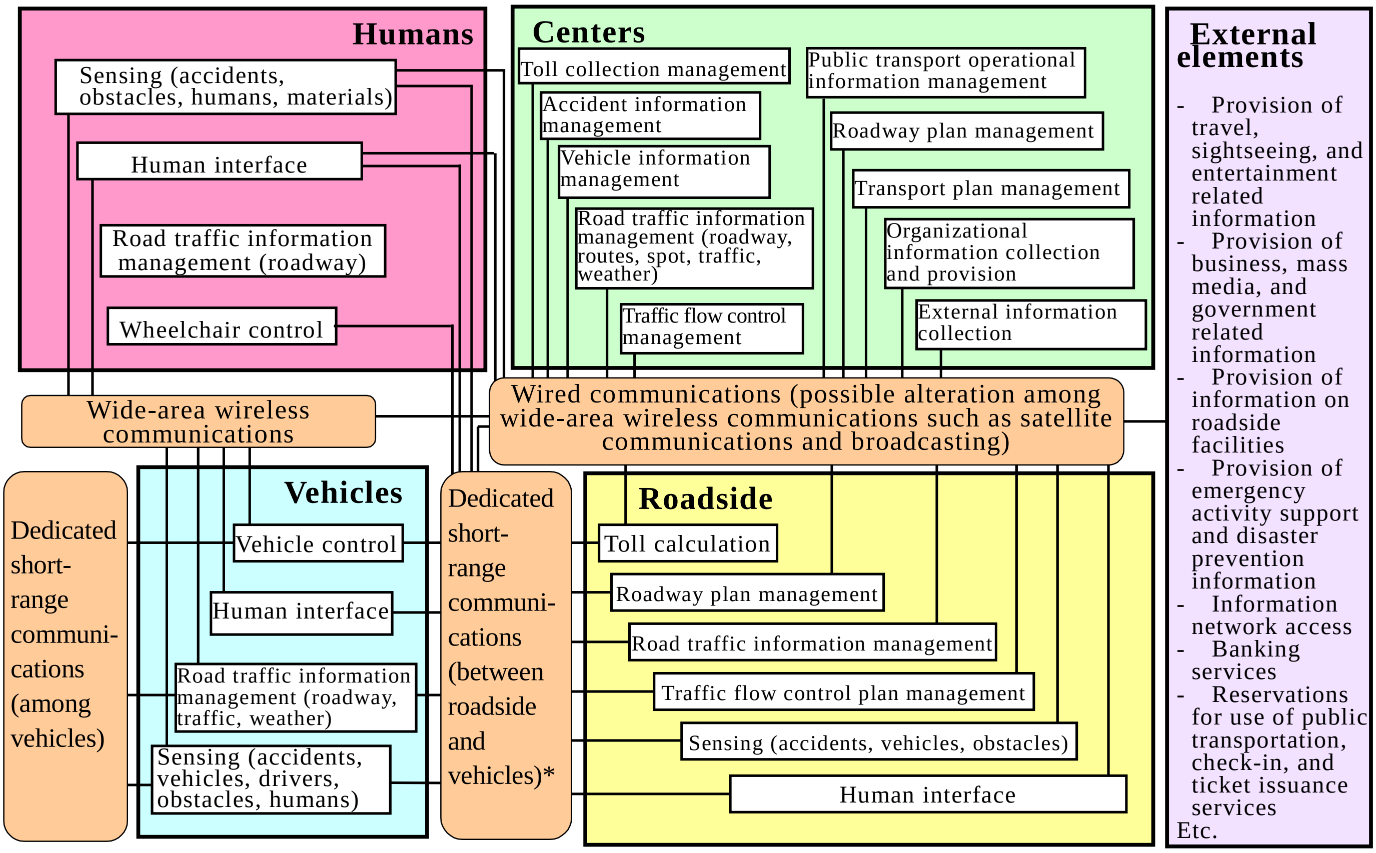
"Physical models for each Specific User Sub-service" are formed by organizing the information exchanged among the Lowest Level Subsystems and the communications formats, and by arranging the Lowest Level Subsystems within the Highest Level Subsystems. Construction of the "physical models for each Specific User Sub-service" has clarified the structure of the system for realization of the subsystems.

[2] Physical Model for the Entire System

The "Physical Model for the Entire System" clarifies the overall system structure (framework) for realization of ITS, by arranging the Lowest Level Subsystems making up the overall system within the Highest Level Subsystems, and by modeling the information exchanged among subsystems and the used communications formats. In the "Physical Model for the Entire System", the Lowest Level Subsystems have been expressed collectively in order to facilitate determination of the overall system structure (framework).

We have drawn up a subsystems interconnect diagram in order to provide an overview of the structure (framework) of the overall system. The subsystems interconnect diagram shows the composition of the Highest Level Subsystems by means of the collectively expressed Lowest Level Subsystems, and also indicates the information collection and provision among subsystems shown on the chart which is shared among Highest Level Subsystems, along with the communications formats thereof. In preparing the subsystems interconnect diagram, external subsystems have been identified in order to express more clearly that mutual operability and mutual connectivity with an advanced information oriented society have been ensured.

Fig. 4.2-1 Subsystems Interconnect Diagram



* Dedicated short-range communications (between roadside and vehicles) means narrow-area communications which are conducted among roadsides, vehicles, and humans.

Chapter5　Standardization Candidate Areas

5.1　What are the Standardization Candidate Areas?

Because many of the subsystems and communications points included in ITS are shared by various sub-services, the ITS System Architecture considers all of the four communications formats and 24 subsystems indicated in the subsystems interconnect diagram as areas requiring future standardization (Standardization Candidate Areas).

For the promotion of standardization, by constructing the System Architecture, it becomes possible to refer to the achievements of evaluations on the areas included in ITS from various viewpoint. Here, as an example of the evaluation, we made evaluation on all of the communications formats and subsystems indicated in the subsystems interconnect diagram from the standpoint of ensuring general applicability, according to factors such as the degree of sub-service sharing and the frequency of subsystem usage.

By making such evaluation, it becomes possible to smoothly promote our contribution to the study of standardization strategies at related organizations, along with its importance in terms of policy and the progress situation of standardization work in foreign countries.

5.2 Evaluation of the Areas from the Viewpoint of Securing Compatibility

(1)　Procedures for Evaluation of Areas

As an examples of evaluation based to System Architecture after separate scoring of evaluation points based on the factors listed as i) to v) below, we evaluated all of the subsystems indicated in the subsystems interconnect diagram according to the total score of evaluation points from each factor.

i)　Frequency of subsystem sharing

ii)　Degree of sub-service sharing

iii)　Connectivity with advanced information oriented society

iv)　Range of actual subsystem availability

v)　Progress of study on subsystem standardization

As an example of evaluation based on the System Architecture, the four communications formats indicated on the systems interconnect diagram are evaluated, from the viewpoint of securing compatibility, in the following procedure.

i) Of all of the combinations of Lowest Level Subsystems conducting communications across multiple Highest Level Subsystems, we listed those combinations in which one or both of the Lowest Level Subsystems received high scores for the five factors given in part (1) above.

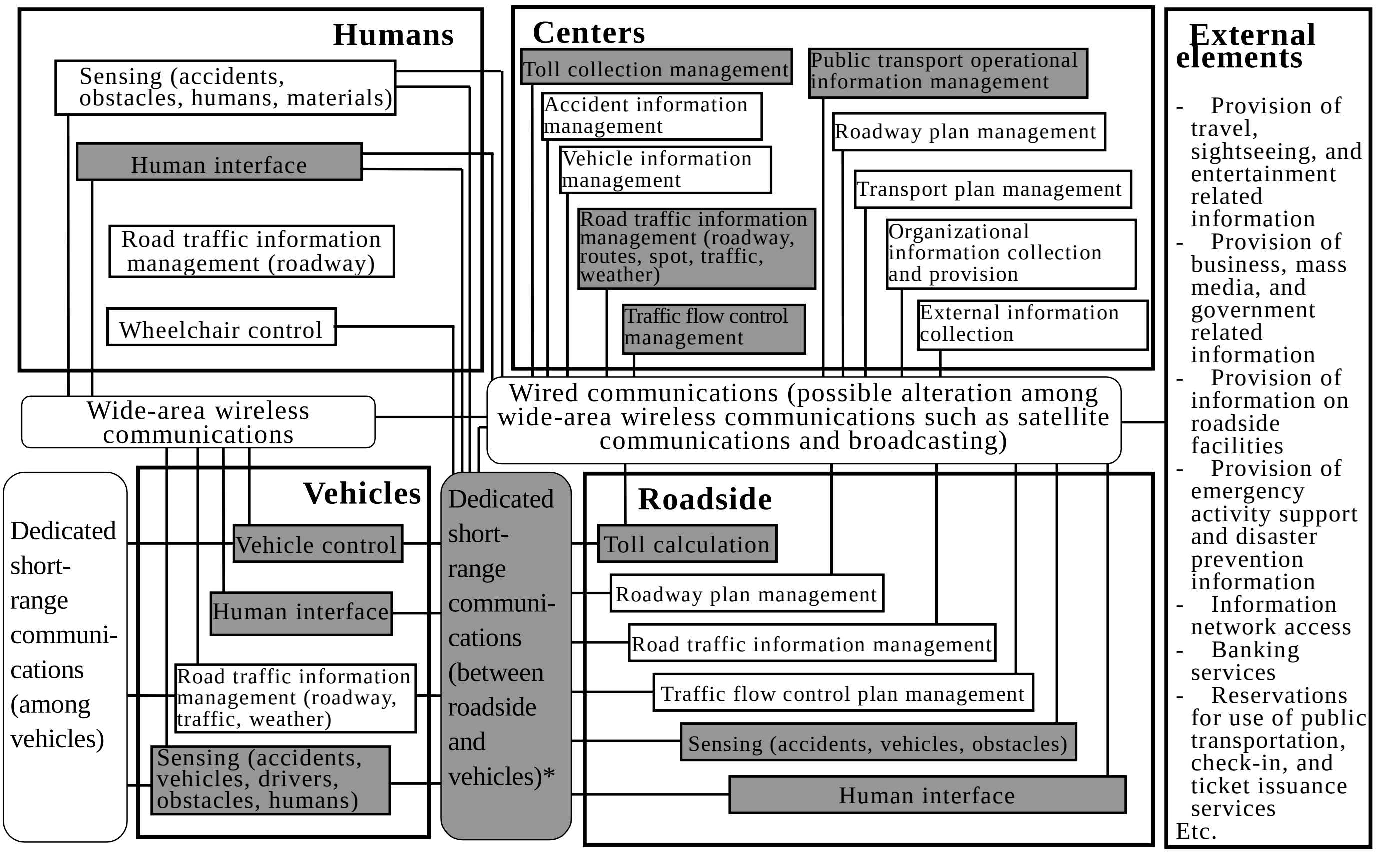
ii) We gathered the Lowest Level Subsystems, listed in part i) above, under the four communications formats, and took the numbers of Lowest Level Subsystem combinations using each format as evaluation points.

(2) Examples of the Achievements of Evaluation of Areas

As an example of evaluation based on the System Architecture, the following 11 subsystems received high scores, from the viewpoint of securing compatibility, in the evaluation of area related to subsystem. These subsystems include some which form a common basis for the system, such as vehicle and road based detection, road traffic information management in centers, and traffic flow control plan management; and some with a high frequency of usage, such as toll collection management in centers and toll calculation at roads.

As an example of evaluation based on the System Architecture, the short – range communications (between roadside and vehicles) received a high score, from the viewpoint of securing compatibility, in the evaluation of areas related to communications.

Fig.5.2-1 Examples of the evaluations made in of the Areas from the View-point of Securing Compatibility



* Dedicated short-range communications (between roadside and vehicles) means narrow-area communications which are conducted among roadsides, vehicles, and humans.

[grey box] :Areas receiving high scores in the evaluation from the viewpoint of securing compatibility

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Chapter1　Concept for Applying the System Architecture

1.1　Stages of Applying the System Architecture

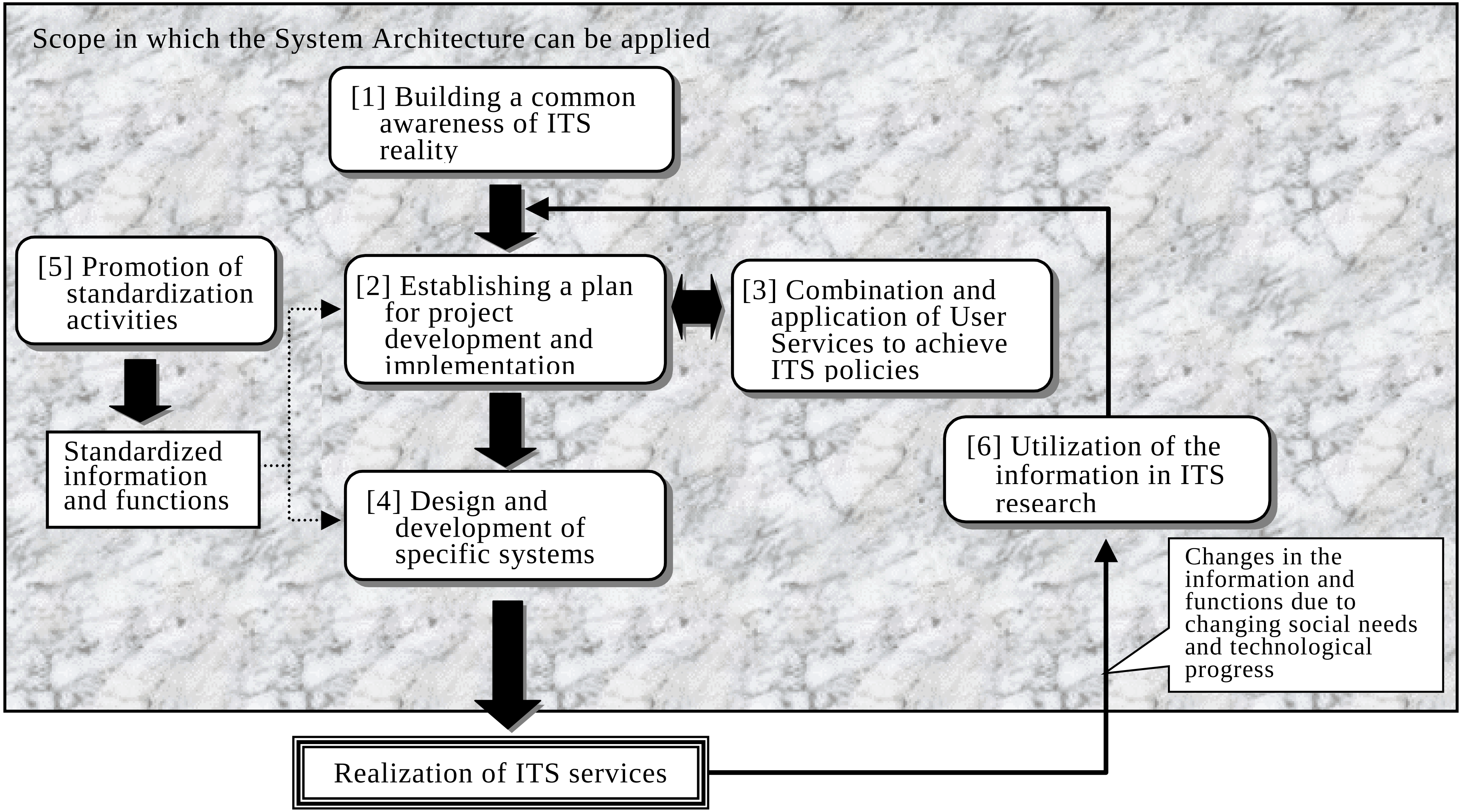
The application of System Architecture is a description of the achievements for reference in each application situation and the application methods, based on the establishment of application situations to achieve the three objectives of System Architecture construction.

The process of realization of ITS services includes the following stages: "[1] building a common awareness of ITS reality", "[2] establishing a plan for project development and implementation", "[3] combination and application of User Services to achieve ITS policies", and "[4] design and development of specific systems".

In order to allow an efficient promotion through the standardization of information and functions which are to be shared with regard to the stages of specific system planning and development, which are "[2] establishing a plan for project development and implementation" and "[4] design and development of specific systems", an important stage for the realization of ITS services is "[5] promotion of standardization activities", which will allow efficient promotion through the standardization of information and functions which are to be shared.

In the stage of realization of ITS services, "[6] utilization of the information in ITS research" is another important stage, because this will implement full-scale ITS research and transportation phenomena analysis. This will also provide a feedback to stages [2] and [4] on suggestions for changes in the information and functions due to change in social needs and development in technology.

Fig. 1.1-1 Process of Realization of ITS Services, and Application Situations



1.2 How to Apply the System Architecture and Who it Applies to

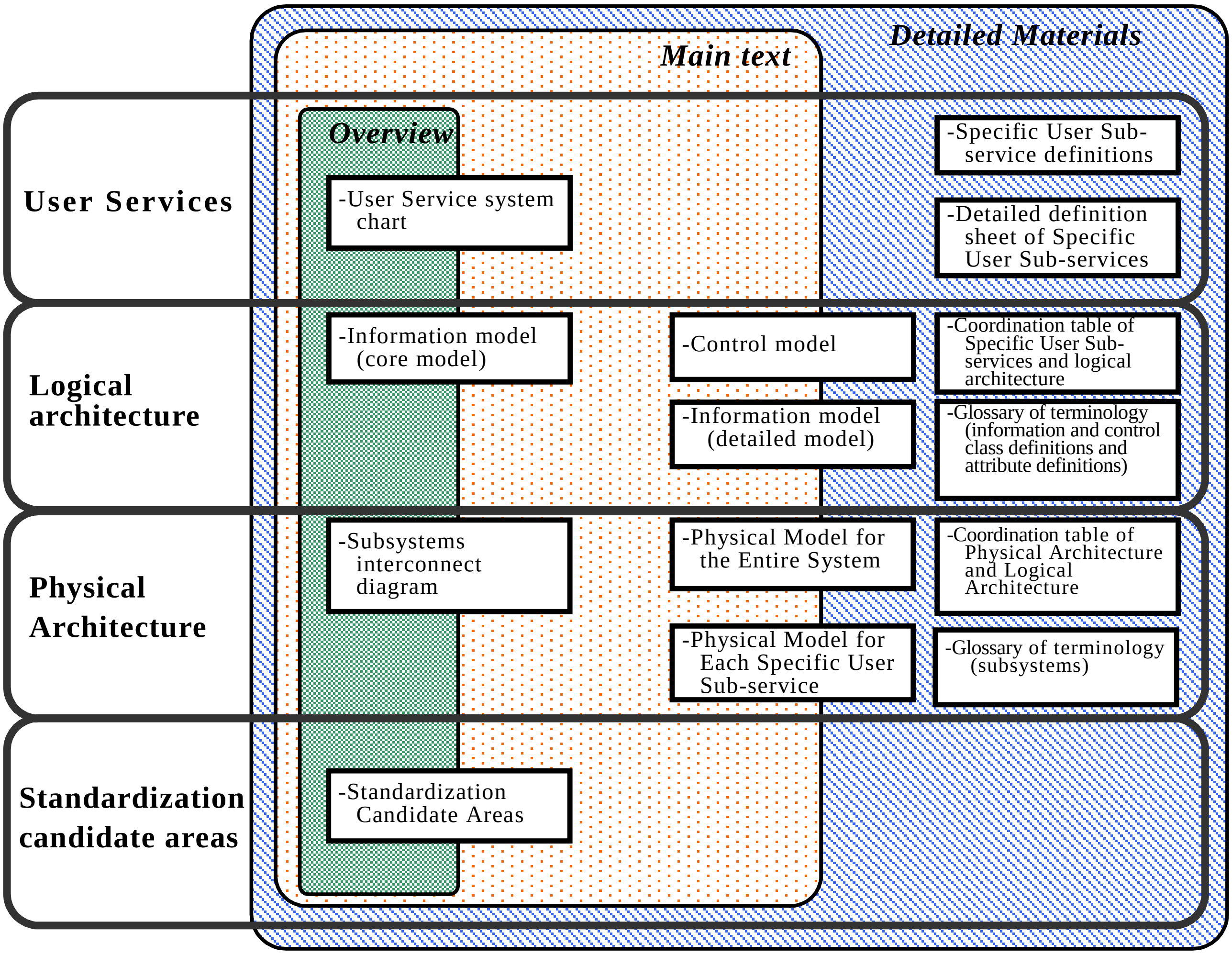
The System Architecture, which has now been constructed, consists of a summary section, the main text in two volumes, and Detailed Materials prepared by practical organizations.

The summary section presents the main points in the content of the ITS System Architecture, and should be referred to by ITS-related interested parties in government, the private sector, and academia, for building a common awareness of ITS reality.

The main text is a presentation and a summary of the concepts and so forth concerning the construction objectives, achievements, and application objectives of ITS System Architecture. It gives an overview of some of the achievements of User Services, Logical and Physical Architecture, Standardization Candidate Areas, and explains the ways of applying the Logical Architecture and Physical Architecture indicated in the Detailed Materials. Therefore, the main text should be referred to by ITS-related interested parties in government and industry for deciding application methods and combining User Services for the establishment of plans for project development and implementation and the realization of ITS measures.

The volume of “Detailed Materials” consists of the descriptions of detailed documentation of the User Services provided under ITS, the Logical and the Physical Architecture. Those who are in ITS-related interested parties in government, the private sectors, and academia should refer to “Detailed Materials” in order to promote the standardization activities, to use of information for ITS research, to design and to develop the specific system.

Fig. 1.2-1 Document Composition of the Summary Section, Main Text, and Detailed Reference Materials



Chapter2　Actual Application of the System Architecture

2.1　Building a Common Awareness of ITS Reality

Since the System Architecture, which has now been constructed, presents the main points concerning: [1] the concept of ITS, [2] the services to be realized through ITS, and [3] ITS as a system. The application thereof will make it possible to build a common awareness of ITS reality among the various interested parties in industry, academia, and the government.

2.2　Establishing a Plan for Project Development and Implementation

“Physical Model for the Entire System” is a clarified view of the overall of ITS which is made by arranging “information” and “functions” properly in order to make ITS function as a system.

In the future, when a new business, such as a plan for goods and services related to ITS is being discussed and when new policy and/or infrastructure are being evaluated, the service contents which infrastructure provides and the included areas of subsystems need to be clarified on the Physical Architecture,. This process makes it possible to coordinate the area which is being harmonized with the whole system of ITS, and also to easily grasp the relation between “functions” and “information”. In this manner, it becomes possible to evaluate efficiently the technical method, standards, various systems needed for the realization of new business, policy and/or infrastructure. It also enables to move on easily from the work of evaluating the content of the services and the areas of the functions which systems carry, to the work of extracting items such as specifications which systems should provide.

2.3　Combination and Application of User Services to Achieve ITS Policies

The System Architecture presented here provides a systematic overview of ITS-related services, organized into 56 Specific User Services and 172 Specific User Sub-services, under 9 development areas and 21 User Services. By combining these User Services, they can be applied to the achievement of an integrated TDM (Transportation Demand Management) system.

Moreover, when constructing specific systems, it will be possible to use groups of sub-services efficiently through the recognition of information and functions that can be used in common.

This will make it possible to improve the efficacy of comprehensive policies on wide-ranging areas, to contribute to the resolution of problems such as traffic congestion and environmental damage. In order to ensure the continuous and effective use of the System Architecture, which has now been constructed, it will be essential to keep changing and revising it to reflect future international trends and technological development trends in industry.

2.4 Design and Development of the Systems Concerning ITS

The design and development of specific systems can be classified mainly into two categories: Basic design which assembles the outlines of specific systems, and detailed design which includes detailed study of the structures of programs included in the system. In basic design, it becomes possible to use the information and functions, which are already organized according to their mutual relationships in the System Architecture, as a framework for system design and development when the information and functions required for realization of the specific systems are drawn out using the System Architecture which has now been constructed. This eliminates much of the work needed for basic design, such as collecting the necessary peripheral information.

In some cases, the functions realized in other systems are also contained in the system to be designed or developed. In detailed design, the System Architecture, which has now been constructed, is used to allow discovery of identical functions existing in separate specific systems. Therefore, the detailed design concerning overlapping functions can be unified, and the functions contained in the system to be designed or developed can be made generally applicable so they can be used by other specific systems as well.

2.5 Promotion of Standardization Activities

In the System Architecture which has now been constructed, after organizing the Standardization Candidate Areas in view of ITS overall, the subsystems and communications formats which are important in system construction are drawn out, as components that have an especially high need for standardization in future standardization activities.

Keeping in mind an evaluation of the various areas from the viewpoint of ensuring general applicability, this was constituted in order to contribute to the decision of degrees of priority of standardization activities at the organizations involved in it. Thus, the use of the System Architecture supports the promotion of effective standardization activities by the private sector with reference to this.

By drawing out the information and functions related to Standardization Candidate Areas for reference, using the “Physical Model for the Entire System” and “Physical Model for Each Specific User Sub-service”, it is possible to contribute to the concrete study work for standardization.

2.6 Utilization of the Information in ITS Research

When the specific systems for realization of ITS services begin to be developed in accordance with the “Physical Model for the Entire System”, subsystems interconnect diagram, and other elements which have now been constructed, it will become possible to determine the locations of specific systems which handle the detailed data which is needed for ITS-related research and the analysis of traffic phenomena.

Universities and research institutes will be able to easily and appropriately obtain the data they need through information networks, by referring to these and determining their locations. This will allow the use of information in full-scale ITS research and the analysis of traffic phenomena. The effects produced by ITS will be further enhanced. This will make it possible to provide a feedback on social demands to the stages of establishing plans related to development and implementation of projects and the design and development of specific systems.