

Information Technology Engineers Skill Standards

Network Systems Engineer

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The original document in Japanese prepared on December 25, 2000 (update on September 28, 2001)

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1. Overview

1.1 Background of developing the "Information Technology Engineers Skill Standards"

At present, great hopes are placed on information technology as the sources of industry regeneration and new economic growth. This is because the roles of IT have been expanded from the tools for manufacturing cost reduction and service speedup to those for effective collaboration among enterprises and the creation of new industries. From now on, the rise or fall of an enterprise will be determined by quality of computerization investment. It is therefore an urgent matter to bring up engineers who construct advanced information systems and those who utilize them.

In view of this, the Central Academy of Information Technology has repeated a study on how to bring up, evaluate, and select good engineers who can show their practical ability on actual jobs. As a conclusion, the academy decided to establish the "information technology engineers skill standards" centering on the criteria to determine whether the required jobs can be performed adequately or not.

1.2 Significance and objective of developing the "Information Technology Engineers Skill Standards"

The results of surveys that the Central Academy of Information Technology has conducted on information technology engineers have suggested an important issue to be solved in the industrial world and by educational institutions such as schools. The issue is the establishment of the guidelines that clearly define what the industrial and educational worlds are expecting to get. While these guidelines need to define the level of knowledge, skills and capability to be equipped with by IT personnel (engineers) who do the actual jobs in the industrial world, they need to define the models of IT engineers who can be accepted internationally, and the ways how schools and other educational institutions should conduct education training on the basis of these models. One example of the guidelines is the "Skill Standard for IT Engineers" developed by the Northwest Center for Emerging Technologies (NWCET) as part of the establishment of "Skill Standards" by the US Department of Labor.

The "Information Technology Engineers Skill Standards" have been developed as a tool that solves the issue mentioned above, and apply to all the sections of the information technology engineers examinations as criteria to evaluate the skills of engineers who have been brought up. The application of this skill standard is significant for the industrial world in "recruiting human resources with the guaranteed ability to do actual jobs." For educational institutions such as schools, this is significant for "understanding and confirming the knowledge, ability, and the achievement levels of the engineers required by enterprises." For government agencies, this is significant for "grasping the technical level of the entire industrial world."

1.3 Configuration of the "Information Technology Engineers Skill Standards"

The "Information Technology Engineers Skill Standards" is a tool that provides information about knowledge and skill needed to do jobs such as building, operational control, usage and evaluation of IT system in organizations such as corporations. It also provides indicators to determine the outcome of jobs. "Information Technology Engineers Examinations: Overview of the New System" and "Information Technology Engineers Examinations: Scope of Examinations" describe knowledge, technology (technical knowledge), and ability that information technology engineers need to have, and performance indicators (listed in 1), 2), and 3) below). The established skill standards describe these points more specifically by consulting actual jobs.

- 1) Roles and jobs
- 2) Expected technical levels
- 3) Scopes of examinations: examination in the morning and that in the afternoon
(The above information can be downloaded to access
<http://www.jitec.jipdec.or.jp/>.)

The "Information Technology Engineers Skill Standards" consists of three kinds of technical information described below. In this standard, individual skill standards are established for each examinees classified according to examination categories.

(1) Key activities

This chapter describes jobs that are keys unique to each examination categories. It describes the "roles and jobs" in 1) above more specifically.

(2) Skill criteria

This chapter describes what knowledge and skill should be used to do the key activities in (1) above, and also describe performance indicators to determine what outcome should be obtained. It describes "expected technical levels" in 2) above more specifically.

(3) Body of knowledge

This chapter systematically describes common knowledge independent of examination categories and knowledge needed to do the key activities in (1) above. This chapter also covers the "scopes of examinations" in 3) above.

1.4 Image of "Network Systems Engineer" and skill standards

These skill standards have been prepared by applying the framework of the information technology engineers skill standards, which have been introduced until now, to "network systems engineer."

(1) Image of applicable persons

For information systems, network systems engineer engage in activities with respect to planning, design, construction and operation of network systems. Those engineers are required, in addition to responsibility as an administrator to manage network resources as foundation for information systems, to have ability to analyze requirements for WAN/LAN in information systems and to carry out design, construction and operation taking the efficiency, reliability and security into consideration.

Furthermore, the role of giving technical supports with respect to networking in development of individual systems is expected.

(2) Skill standards

The skill standards below apply to network systems engineer.

- 1) IT common body of knowledge
- 2) Network systems engineer
 - Key activities, skill standards, practical body of knowledge, and core body of knowledge

2. Key Activities

The key activities mean contents that are shown as procedures with relation to the basic activity area for network systems engineer such as works in the phases of construction and operation of network systems. In these skill standards, this activity area is called "network system development process."

Activities in "network system development process" are divided into 7 basic "activities" shown in Fig. 2-1.

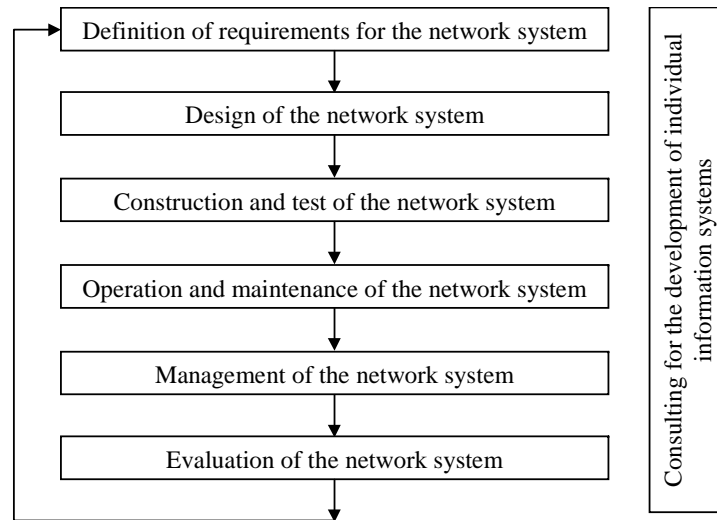


Fig. 2-1 Network systems development process

Each activity is further divided into more detailed jobs called "tasks." In these skill standards, processes of development of network systems are shown in the following form:

Activity	Task	Job outline
1. Act 1	1-1 Task 1	x x x x x x x x x x x x
	1-2 Task 2	x x x x x x x x x x x
	1-3 Task 3	x x x x x x x x x
2. Act 2	2-1 Task 1	x x x x x x x x x x
	2-2 Task 2	x x x x x x x x x x x
	2-3 Task 3	x x x x x x x x x x x x
	2-4 Task 4	x x x x x x x x x x x

As shown in Fig. 2-1, main roles of network systems engineer are such activities as "Definition of requirements for the network system," "Design of the network system," "Construction and test of the network system," "Operation and maintenance of the network system," "Management of the network system," "Evaluation of the network system" and "Consulting for the development of individual information systems." In these processes, their abilities are exhibited through such tasks as "recovery from trouble," "security management," etc.

[Network system development process]

Activity	Task	Job outline
1. Definition of requirements for the network system	1-1 Analysis of requirements for application	In order to analyze the requirements for the network application, to receive from network users and application system developers information on performances required by the application, as well as transmitting and receiving points, data volume and frequency, kinds of data and the direction of the flow of data that should be covered by the application.
	1-2 Analysis of the existing network system	In the case where an application is to be added to the existing network, to make a survey on the traffic flowing in the existing network and to identify the problems in the current situations and to investigate the influence of the addition of the new application on other applications. In the case of reconstruction of the foundation for the network, to identify problems in current situations by checking the traffic flowing in the existing application.
	1-3 Decision on the scope of works	To decide on applications to be dealt with, and to decide on the scope of the work; and, to set the objective, scale of the work, target to be achieved, the period of the work concerning the project of design and construction of the network system.
	1-4 Definition of requirements for network system	To define requirements (economical efficiency and performance) in design and requirements for operation management of the network system (requirements for expandability, reliability and security); and, to carry out the review of requirements specifications together with network users and application system developers.

Network Systems Engineer Skill Standards (Error! Style not defined.)

Activity	Task	Job outline
2. Design of the network system	2-1 Survey and evaluation of technologies and products to be applied	To investigate and evaluate technologies, products, communication services, information on vendors, cases of users who introduced the system and trends of standardization regarding the network.
	2-2 Design of the network system	To design the network system considering the following items as important matters: (1) To decide on the network architecture including placement of systems such as servers and clients, protocol, and topology; and to evaluate expected performances. (2) As security measures, to recognize the security policy and to decide on network technologies and equipments necessary for realization of required security measures. (3) As reliability measures, in order to ensure necessary communication in the case of network equipment and line troubles or failures by disasters or accidents; to decide on backups and measures for restoration for network equipments and lines; and, to decide on network management measures for efficient management. (4) To prepare multiple design scenarios for network architecture, security measure and reliability measure; and, to evaluate cost performance and possibility of realization of each scenario.
	2-3 Activity operating plan for the new network system	To prepare the network system operational procedures on the new network; and, to prepare a transition plan for transferring business activities on the existing network system to the new network system.
	2-4 Preparation of work plan	To prepare a work plan with respect to construction of the new network system; The work plan must be such that effect on users' activities can be minimized; to make the work plan widely known to network users and application system developers and hardware/software vendors; and, if there is any problem, to consult and make necessary coordination.
	2-5 Design review	To conduct reviews of design of the network system, the operation plan and the work plan among network users, application system developers, and hardware/software vendors.

Network Systems Engineer Skill Standards (Error! Style not defined.)

Activity	Task	Job outline
3. Construction and test of the network system	3-1 Advance preparations	To make arrangements for equipments and lines in accordance with work plan; to make the plan widely known to users, vendors and installation workers; and, if any problem occurs in relation with the schedule, to make necessary adjustment each time and to carry out documentation of the results.
	3-2 Installation works	To install network equipments and lines, and network software, and to carry out connection and setting of each equipment and line.
	3-3 Preparation of the test specifications	To make clear requirements for test and the scope of application and to prepare a test specifications; to prepare test procedures; and, to make an appropriate test plan.
	3-4 Execution of test	To carry out test based on the test specifications for the network system; and, to repeat tests until the function of the applications is verified or the scope of application of test is changed.
	3-5 Analysis and evaluation of test results	To carry out documentation of pass or failure of the test results; if there is any failure, to fix the failed part and to carry out test again; and, if there is any problem, to make a proposal for improvement of the network system.

Network Systems Engineer Skill Standards (Error! Style not defined.)

Activity	Task	Job outline
4. Operation and maintenance of the network system	4-1 Measures for users	To set accounts of network users and to make the network system available; to prepare a plan for education for users and to carry out the education for users; to carry out documentation of procedures in order to ensure security and to make it widely known to users; and, to respond to requests for consultation from users.
	4-2 Formulation of policy for maintenance and updating (upgrading)	To formulate the policy for maintenance; and, furthermore, to make a plan for reconfiguration, enhancement and additional installation of appropriate equipments taking economical efficiency into consideration after carrying out analysis of capability of the existing network system.
	4-3 Preparation of the maintenance plan	To make a maintenance plan in accordance with the policy for maintenance so that effect on users can be made minimal; furthermore, to carry out documentation of requirements for and procedures of maintenance and to make them widely known to network users, application system operators and to communicate details of change if there is any change.
	4-4 Execution of maintenance and updating (upgrading)	To carry out maintenance or updating (upgrading) in accordance with the plan for maintenance; and, to record details of activities for the maintenance.
	4-5 Backup and data recovery	To prepare a procedural manual for data backup with respect to equipments of the network system; to carry out data backup following the procedures in accordance with the plan for maintenance; and, if any problem occurs, to fix data efficiently without delay.
	4-6 Management of the configuration of the network system	To give names such as IDs to equipments forming the network system and network software and to record the contents of their setting; and, to renew the record in accordance with change in or updating (upgrading) of configuration.

Network Systems Engineer Skill Standards (Error! Style not defined.)

Activity	Task	Job outline
5. Management of the network system	5-1 Surveillance over the network	To make a plan for objects and frequency of surveillance over performance and security, and to carry out surveillance as planned; and, to report promptly to network users and application system operators if any irregularity in the network or security breach is detected.
	5-2 Analysis of and restoration from failures	To identify the failed part and to analyze the cause of failures and carry out restoration in a short period of time in order to minimize the damage from network failures.
	5-3 Analysis of the performance of the system	To carry out analysis in the light of performance criteria laid down based on network system requirements from the performance surveillance. Performance criteria must be renewed in response to changes such as updating (upgrading) of the network system.
	5-4 Analysis of and coping with security breach	To carry out security analysis in the light of security criteria laid down based on network system requirements from the security surveillance and, if there is any problem, to take necessary measures for security. Security criteria must be renewed in response to changes such as updating (upgrading) of the network system.
6. Evaluation of the network system	6-1 Evaluation of the system	To analyze and evaluate problems in the current situations and potential problems after the analysis of performances and capability of the existing network system, and to make a report on the results.
	6-2 Proposal for improvement of the system	To carry out a survey on the trends of network technology and products, to analyze problems in the current situations (lifecycle of the system), and to make a proposal for appropriate improvement taking into consideration the economical efficiency and expandability of the network system.
7. Consulting for the development of individual information systems	7-1 Advice on a plan for and analysis of the network system	To provide technical advice from the standpoint as a project member or a person to provide consultation with respect to LAN/WAN plan and analysis in individual information system development.
	7-2 Advice on design and construction of the network system	To provide technical advice from the standpoint as a project member or a person to provide consulting with respect to LAN/WAN design and construction in individual information system development.
	7-3 Advice on operation and maintenance of the network system	To provide technical advice from the standpoint as a project member or a person to provide consultation with respect to LAN/WAN operation and maintenance in individual information system development.

3. Skill Criteria

The skill criteria correspond to tools (tables) that provide indicators to check the status of achievement whether or not a network systems engineer has successfully promoted a series of works in accordance with appropriate procedures utilizing appropriate methodology, appropriate knowledge and appropriate skills with respect to the process of network system development process shown in the key activities.

The skill criteria provide indicators ("performance indicators") to indicate what outcome need to be achieved as the result of job execution of activities for each "task" of each of 7 different kinds of activities and, further, knowledge required ("required knowledge") and required skills ("required skill") for execution of the activities are added.

[Network Systems Engineer Skill Criteria]

1. Definition of requirements for the network system				
No.	Task	Performance indicators	Required knowledge	Required skill
1-1	Analysis of requirements for application	<ul style="list-style-type: none"> • Contents of requirements are reliable and such that the actual situations are grasped. • Source of information and the methodology of identifying requirements are appropriate. • Information is accurate, complete and appropriate. • Methodology is in accordance with methodology of interview for collection of information executed by the company appropriately. • Information is collected cost efficiently and continually. • Analysis of the application's requirements for the network system is appropriate. • Constraints and possible inconsistency have been identified appropriately. • Regarding constraints, clear discussions have been carried out at a proper period. • Regarding analysis of risks and tradeoff as well as a contingency plan, clear discussions have been carried out. 	<ul style="list-style-type: none"> • Knowledge about methodology, procedures and execution of collection of information • Knowledge to set targets and the scope of the survey • Knowledge about network architecture, topology, hardware and software • Knowledge about network connection technology and operational environment • Basic knowledge for network design • Basic knowledge about system configuration • Knowledge about application software configuration (middleware configuration) • Knowledge about technological constraints, hardware and software standards, and processing • Knowledge about risk analysis technique 	<ul style="list-style-type: none"> • Ability to identify main sources of information on users' needs • Ability regarding setting of amount of information to be collected • Ability to analyze answers from individuals and groups • Ability to select/obtain data regarding tasks and identify needs for data • Ability to organize and summarize information on requirements • Ability to analyze information and construct theory on interdependence • Ability to prepare detailed reference materials regarding constraints • Ability to carry out free discussions and to confirm questions • Ability to work together with other persons

Network Systems Engineer Skill Standards (Error! Style not defined.)

1-2	Analysis of the existing network system	<ul style="list-style-type: none"> • Information from survey are accurate and complete. • Source of information and grasping of requirements are in accordance with appropriate methodology. • Information has been collected with survey methodology in accordance with standardized survey methodology adopted by the company. • Information has been collected efficiently and continually. • Survey on the actual status of the existing network system has been carried out appropriately. • Survey on actual status of the existing application has been carried out appropriately. • Identification of the forms of the activities and the grasp of problems are appropriate. • Complaints of users have been identified appropriately. 	<ul style="list-style-type: none"> • Knowledge about the information collecting method • Knowledge about measurement of traffic • Knowledge about traffic analyzing tools • Knowledge about system configuration • Knowledge about network configuration • Knowledge about application software configuration (middleware configuration) 	<ul style="list-style-type: none"> • Ability regarding measurement and evaluation of traffic • Ability to assume bottlenecks of the network system from system configuration • Ability to analyze systems
1-3	Decision on the scope of works	<ul style="list-style-type: none"> • Objectives and the scope of the network system development project have been identified and consensus has been obtained. • Criteria for targets to be achieved in the network system development project have been set. • The scope of works that correspond to budget, quality and delivery time required by the user has been recognized. • Resources that correspond to the required contents are able to be secured and an estimate has been made. • Risks have been analyzed and the appropriate countermeasures against emergency have been planned. • The scope of works has been documented accurately, completely and concisely. 	<ul style="list-style-type: none"> • Knowledge about network architecture, topology, hardware and software • Knowledge about network connection technology and operational environment • Knowledge about availability of resources and delivery time of the project • Knowledge about effort for the work • Knowledge about technological constraints 	<ul style="list-style-type: none"> • Ability to prepare detailed reference materials regarding the scope of works • Ability to organize as requirements that meet the objectives • Ability to foresee the results of development with experience and knowledge in possession • Ability to make a plan regarding requirements for resources and constraints • Ability to visually represent the sequence and parallelism regarding tasks to be executed • Ability to negotiate about criteria to be achieved • Ability to consider many things globally

Network Systems Engineer Skill Standards (Error! Style not defined.)

1-4	Definition of requirements for network system	<ul style="list-style-type: none"> • Items of requirements for network system development are complete and have no discrepancies. • Items of requirements are consistent with requirements of whole project. • Items of requirements have been documented accurately. • Performance and the evaluation criteria have been shown clearly. • Security policy has been shown clearly. • Economical efficiency by the network system development has been shown clearly. • Efficiency of the network system development has been shown clearly. • Expandability of the network system has been shown clearly. • Reliability of the network system has been shown clearly. • The security policy has been documented and distributed. • Requirements for activity transfer to the new network system have been shown clearly. • Priority for organizations and individuals have been shown clearly. • A series of organized requirements have been communicated to users and approved. 	<ul style="list-style-type: none"> • Knowledge and complete understanding about the system and system capability integration • Knowledge about network connection technology and operational environment • Knowledge about network architecture, topology, hardware and software • Knowledge for recognizing items of requirements for performance • Knowledge about security of the network • Knowledge about the lifecycle of the system • Knowledge about the reliability of the network • Knowledge about operational requirements of the network • Knowledge about how to carry out review 	<ul style="list-style-type: none"> • Ability to reflect the organization's information processing requirements as system requirements • Ability to identify users' expectations • Ability to recognize contradicting requirements and to present solutions • Ability to analyze the accuracy and consistency of information • Ability to solve technological problems • Ability to evaluate system configuration • Ability to prepare detailed reference materials that support requirements • Ability to observe objects multilaterally
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Network Systems Engineer Skill Standards (Error! Style not defined.)

2. Design of the network system				
No.	Task	Performance indicators	Required knowledge	Required skill
2-1	Survey and evaluation of technologies and products to be applied	<ul style="list-style-type: none"> • Surveyed information is accurate and sufficient. • Sufficient survey has been carried out about innovative technologies for networks. • Complete survey has been carried out about specifications/limits of vendors' products, architectures and equipment. • Sufficient survey has been carried out about communication services and charges. • Sufficient survey has been carried out about cases of users who has installed the system. • Sufficient survey has been carried out about the trend of standardization. • Evaluation indicators are appropriate. 	<ul style="list-style-type: none"> • Knowledge about collecting method of information • Knowledge about network architecture, topology, hardware and software • Knowledge about technological constraints, hardware and software standards and processing 	<ul style="list-style-type: none"> • Ability to analyze information and theoretically organize interdependence • Ability to explain technological information utilizing appropriate tools • Ability to prepare detailed reference materials regarding constraint items.
2-2	Design of the network system	<p>(1) Regarding decision on network architecture</p> <ul style="list-style-type: none"> • Functional requirements for the application are shown clearly. • Requirements for performance of the application are met. • Operational requirements of the network system are met. • Products, vendor's architecture and specifications/restrictions are investigated without omission. 	<ul style="list-style-type: none"> • Knowledge about system configuration of the application • Knowledge about high-layer service in OSI model • Knowledge about standards for and processing of network connection technology • Knowledge about architecture design tools and methodology • Knowledge about network architecture, topology, hardware and software • Knowledge about communication scheme • Knowledge about type and load of traffic • Knowledge about throughput • Statistical knowledge on traffic load and throughput estimate 	<ul style="list-style-type: none"> • Ability to make distinction between practical requirements and technological desires • Ability to foresee the results based on the past experiences and prior knowledge • Ability to analyze the trend of methodology for prediction • Ability to analyze technological information and explain clearly and briefly

Network Systems Engineer Skill Standards (Error! Style not defined.)

		<p>(2) Regarding security measures</p> <ul style="list-style-type: none"> • Security policy has been shown clearly. • Security policy has been understood. • Security requirements have been met. • Security criteria of vendors have been investigated without omission. <p>(3) Regarding reliability measures</p> <ul style="list-style-type: none"> • Operational requirements for the network system is met. • Consensus has been obtained for reliability measures and yardsticks for evaluation. <p>(4) Regarding multiple design scenarios</p> <ul style="list-style-type: none"> • Alternative plans have been studied and analysis of tradeoff and risks of technological alternatives has been carried out. • Criteria for selection have been well established. • Selected plan has been practical and have superior cost efficiency and meet the specifications of the system. • Selected plan has been clearly documented and justified. • Selected plan has been effectively communicated to all persons concerned. 	<ul style="list-style-type: none"> • Knowledge about system security and potential security holes • Knowledge about safe network • Knowledge about how to ensure protection for secrecy of information <ul style="list-style-type: none"> • Knowledge about reliability • Knowledge about economical efficiency (tradeoff between installation cost and costs of operation and maintenance) • Knowledge about communication services <ul style="list-style-type: none"> • Knowledge about networking standards and processing • Knowledge about system configuration of application • Knowledge about network architecture, topology, hardware and software • Knowledge about networking technology and implementation of functions of equipments 	<ul style="list-style-type: none"> • Ability to recognize security policy and materialize it • Ability to evaluate security criteria and modify them • Ability to recognize ethical problems <ul style="list-style-type: none"> • Ability to recognize the level of requirements for reliability measures for application • Ability to balance reliability measures and required costs <ul style="list-style-type: none"> • Ability to carry out optimum reuse of the existing hardware • Ability to prepare flow charts and to utilize diagramming tools • Ability to foresee achievements/results based on prior knowledge • Ability to present complicated ideas/information • Ability to evaluate alternative plans and decide on selected plan in a rational way • Ability to apply standards and procedures for technical documents
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Network Systems Engineer Skill Standards (Error! Style not defined.)

2-3	Activity operating plan for the new network system	<ul style="list-style-type: none"> Operational requirements for the network system have been met. In the transition plan, business suspension period for users is minimized. Change in procedures is tracked and updated at proper timing The milestones of business transition to the new network have been set and a plan of business transition has been prepared. All of relevant departments follow the procedures of the company and no exception is accepted. 	<ul style="list-style-type: none"> Knowledge about the business operation Knowledge about parties concerned and work groups Knowledge about procedures for change Knowledge about organizational problems regarding security 	<ul style="list-style-type: none"> Ability to present problems and requirements and ask questions readily and organize questions Ability to identify needs for information Ability to promote collaboration Ability to analyze and summarize information Ability to utilize project management software Ability to maintain the processes of the organization based on the rules of the company Ability to understand an application of users and relate their needs to its configuration Ability to visually analyze relation between parts and the whole as well as processes and procedures
2-4	Preparation of work plan	<ul style="list-style-type: none"> The design has been made taking all technological resources and human resources into consideration. Design and the business operation plan have been completed and those plans have been well understood and approved by parties and organizations concerned. Work plan has been laid down and it has been understood and approved by parties concerned and the organizations. Design and construction work are such that easiness and quality of system implementation have been evaluated. Design and integration plan have been documented completely, clearly and correctly. 	<ul style="list-style-type: none"> Knowledge about integration methodology and traffic analyzing tools Knowledge about the way to realize the plan and effect on users Knowledge about networking and operational environment 	<ul style="list-style-type: none"> Ability to collect and analyze information Ability to clearly explain about technological information Ability to interpret and summarize results Ability to analyze information/situations and make a plan within the business and financial limits Ability to plan and coordinate activities Ability to make an action plan and carry it out Ability to utilize project management tools and scheduling software

Network Systems Engineer Skill Standards (Error! Style not defined.)

2-5	Design review	<ul style="list-style-type: none"> • The way to carry out design reviews is shown completely. • Necessary parties concerned are involved in review of design specifications of the network system. • Review points are shown to participants in the review. • Project team and all of users have understood and approved the design. • The result of the design review has been documented correctly. • The results of the design review have been communicated to all relevant parties to enable them to take necessary actions. 	<ul style="list-style-type: none"> • Knowledge about procedures of the design review and how to promote it • Knowledge about network architecture, topology, hardware and software • Knowledge about networking and operational environment 	<ul style="list-style-type: none"> • Ability to communicate technological information to various users • Ability to clearly explain about technological information • Ability to listen to constructive criticism • Ability to explain technological information clearly and briefly utilizing appropriate tools.
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Network Systems Engineer Skill Standards (Error! Style not defined.)

3. Construction and test of the network system				
No.	Task	Performance indicators	Required knowledge	Required skill
3-1	Setups in advance	<ul style="list-style-type: none"> Problems have been identified and the solutions have been obtained timely and by appropriate methods. Discussions on construction schedule and expected items have been held among the users, vendors and construction team. Discussions on countermeasures against contingencies have been held among the users, vendors and construction team. Suspension of business and changes in schedule are kept to a minimal level. New configuration is documented completely and accurately. 	<ul style="list-style-type: none"> Knowledge about system configuration Knowledge about software installation and configuration procedures Knowledge about parties concerned and working group 	<ul style="list-style-type: none"> Ability to analyze situations and information Ability to consider about risks Ability to prepare alternative plans Ability to formulate action plans Ability to conform to appropriate procedures Ability to document business process flow in details Ability to negotiate and coordinate until the relevant parties agree to the setups
3-2	Installation works	<ul style="list-style-type: none"> Software is installed and placed with minimal effect on business flow. Data is converted and the compatibility problem is solved timely. Software is placed appropriately for the system and activities of users. Software and hardware configurations have been standardized. Users satisfaction to new installation and configuration is confirmed. Strategy for placement is laid down and documented. Vendors' security criteria and standard methodology for installation of equipment are followed. 	<ul style="list-style-type: none"> Knowledge about software installation and configuration procedures Knowledge about data conversion problem and procedures for its solution Knowledge about compatibility problem and procedures for its solution Knowledge about hardware configuration Knowledge about network architecture, topology, hardware and software 	<ul style="list-style-type: none"> Ability to construct new application Ability to present various information on installation works to users Ability to carefully listen to verbal and documentary communication and respond appropriately Ability to utilize continual improvement strategy and its tools Ability to solve contradictions timely Ability to organize multiple schedules and manage milestones and make necessary adjustments Ability to illustrate effect on productivity and make necessary adjustments

Network Systems Engineer Skill Standards (Error! Style not defined.)

3-3	Preparation of test specifications	<ul style="list-style-type: none"> • Test procedures and test plan in accordance with standards of the company have been documented • Test plan covers the scope to ensure quality. • Acceptance criteria are shown clearly. • Purposiveness of the test have been approved by key-persons. • Applicability of the test has been proven clearly and documented. • Test plan has been prepared taking funds, manpower and schedule into consideration. • Resources such as funds, new technologies, products of vendors and participants are accurately estimated and the schedule is appropriate. • Test plan includes tests related to security. • Test plan includes tests by end-users. 	<ul style="list-style-type: none"> • Knowledge about test tools and procedures • Knowledge about business requirements • Knowledge about applications • Knowledge about network environment • Knowledge about effect of errors on system performance • Knowledge about required funds and organizational structure • Knowledge about network architecture, topology, hardware and software 	<ul style="list-style-type: none"> • Ability to complete system analysis • Ability to communicate and understand information • Ability to analyze and construct system structure • Ability to identify testing equipments • Ability to relate errors with system functions • Ability to analyze causes/reasons of problems and propose action plan • Ability to analyze data • Ability to judge on appropriateness of business situations and system structure • Ability to negotiate for providing required resources • Ability to recognize strong points of the system and its limitations
3-4	Execution of test	<ul style="list-style-type: none"> • Test environment has been made clear and sufficient preparation has been made. • Parties concerned have agreed to performance of the network system. • The test has been carried out as scheduled within the budget. • The test is repeated until the sufficiency of the functions of the network system is verified. • Test is carried out in accordance with the test plan. 	<ul style="list-style-type: none"> • Knowledge about methodology for execution of test and procedures • Knowledge about network architecture, topology, hardware and software 	<ul style="list-style-type: none"> • Ability to utilize scheduling tools • Ability to tackle at processes and procedures on his own responsibility • Ability to analyze details critically • Ability to record test results • Ability to consider proper way of promoting processes • Ability to control milestones • Ability to encourage and support members of the team and to set responsibilities to achieve the target of the team

Network Systems Engineer Skill Standards (Error! Style not defined.)

3-5	Analysis and evaluation of test results	<ul style="list-style-type: none"> • Errors are reported timely. • Steps to re-create errors/problems have been documented. • Errors have been corrected. • Accurate evaluation of problem/test has been documented. • Report on test is accurate and complete and acceptance has been completed. • The report includes recommendation and proposal for system improvement. • Continual improvement plan has been implemented sufficiently. 	<ul style="list-style-type: none"> • Knowledge about products and interrelationship in test environment • Knowledge about continuous improvement process for execution of test • Knowledge about reporting procedures in the company 	<ul style="list-style-type: none"> • Ability to apply rules/principles to process/data and utilize logic to draw out conclusion • Ability to explain about complicated ideas/information • Ability to consider creative solving method and construct new plan/approach • Ability to translate and understand test results as actual problems
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Network Systems Engineer Skill Standards (Error! Style not defined.)

4. Operation and maintenance of the network system				
No.	Task	Performance indicators	Required knowledge	Required skill
4-1	Measures for users	<ul style="list-style-type: none"> Registration of users is carried out in accordance with standard operational procedures Users are able to access a necessary system and resources when necessary. Users are able to receive necessary consultation with respect to network connection. Security of user accounts is maintained throughout the system. Appropriate education and training for users have been planned and documented. Initial and continual education and training as well as support for users are being carried out. 	<ul style="list-style-type: none"> Knowledge about the policy and procedures of the company Knowledge for expansion of procedures Knowledge about documentation and its storage Knowledge about security tools Knowledge about OS and network systems Knowledge about users' network settings 	<ul style="list-style-type: none"> Ability to apply rules/procedures to documentation and accounts Ability to describe the outline of maintenance procedures Ability to follow rules, policies and procedures Ability to identify and solve problems Ability to accept free questions and identify the contents of questions
4-2	Formulation of policy for maintenance and updating (upgrading)	<ul style="list-style-type: none"> Policy is documented with clear sentences effectively. Policy is such that appropriate resources for the present and future works are specified. Policy is materialized successfully with minimal suspension of business. Policy meet users' needs. 	<ul style="list-style-type: none"> Knowledge about business systems Knowledge about the lifecycle of the network system Knowledge about network architecture, topology, hardware and software Knowledge about interdependence between OS and the system Knowledge about backup procedures 	<ul style="list-style-type: none"> Ability to identify users' needs and expectation Ability to foresee achievement/results based on knowledge in possession Ability to propose and execute action plan Ability to explain about complicated ideas and information Ability to evaluate system configuration/stability Ability to acquire information on new products always
4-3	Preparation of maintenance plan	<ul style="list-style-type: none"> Maintenance works are scheduled taking scope, schedule and requirements of system usage into consideration. Requirements for maintenance are documented clearly and timely communications is made with appropriate parties concerned. Necessary changes are made appropriately. Effect on daily activities is minimal. Works are carried out in accordance with schedule guidelines. Maintenance procedures have been sufficiently tested. 	<ul style="list-style-type: none"> Knowledge about maintenance tools and procedures Knowledge about operational procedures for intra-company network system 	<ul style="list-style-type: none"> Ability to evaluate effects of defects Ability to clearly document information as detailed supporting documents Ability to negotiate toward agreement Ability to foresee technological results Ability to understand data and communicate information to various parties concerned convincingly and to meet the objectives

Network Systems Engineer Skill Standards (Error! Style not defined.)

4-4	Carrying out maintenance and updating (upgrading)	<ul style="list-style-type: none"> • Updating (upgrading) is carried out with minimal effect on business. • Updating (upgrading) meets users' needs. • Applicability of maintenance procedures has been reevaluated. • Updating (upgrading) is carried out in accordance with appropriate procedures. • Appropriate parties concerned are called together and development and review of policy and procedures are carried out. • Maintenance procedures have been documented and authenticated by appropriate parties concerned. • Maintenance documents are timely distributed among appropriate parties concerned. • Requirements for amendment are identified and measures are taken before influence appears. 	<ul style="list-style-type: none"> • Knowledge about procedures for executing updating • Knowledge about components containing reasons for updating • Knowledge about data conversion problems and procedures as well as compatibility problems and solving procedures • Knowledge about network architecture, topology, hardware and software • Knowledge about maintenance procedures • Knowledge about procedures and standards for documentation of maintenance documents 	<ul style="list-style-type: none"> • Ability to carry out improvement/modification in line with development of technologies • Ability to evaluate system configuration/stability • Ability to plan execution processes • Ability to follow appropriate procedures • Ability to understand system operation/response • Ability to understand and evaluate received data • Ability to represent information clearly and concisely
4-5	Backup and data recovery	<ul style="list-style-type: none"> • Backup criteria and criteria for disposing backup data have been documented. • Backup is carried out as scheduled in accordance with procedures • Documentation about backup is made accurate and complete. • Importance of problems is evaluated and reported to appropriate persons timely. • Revision of backup is reflected to change control processes. • Data is restored appropriately and effectively. 	<ul style="list-style-type: none"> • Knowledge about backup and restoring procedures • Knowledge about network architecture, topology, hardware and software • Knowledge about backup media 	<ul style="list-style-type: none"> • Ability to identify problems in the system and evaluate their importance • Ability to follow the procedures • Ability to document information and actions as detailed supporting documents • Ability to evaluate effects of actions

Network Systems Engineer Skill Standards (Error! Style not defined.)

4-6	Management of configuration of the network system	<ul style="list-style-type: none"> • Network diagrams (for whole company, for each office and floor) have been prepared. • Equipment registry has been prepared and accurate identifying information, identification tags and locations are included. • Network configuration is accurately documented and maintained with consistency. • Changes are reported to appropriate parties concerned timely. 	<ul style="list-style-type: none"> • Knowledge for making the registry into data base and accessing the database • Knowledge about company's procedures for procurement and investment control 	<ul style="list-style-type: none"> • Ability to utilize component controlling tools • Ability to utilize registry database • Ability to prepare detailed supporting documents • Ability to carry out surveillance over safe and efficient usage of materials • Ability to coordinate with users regarding allocation of memory • Ability to carry out surveillance over the structure and effective usage of invested resources
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Network Systems Engineer Skill Standards (Error! Style not defined.)

5. Control of the network system				
No.	Task	Performance indicators	Required knowledge	Required skill
5-1	Surveillance over the network	<ul style="list-style-type: none"> • Surveillance data is collected without delay. • Status of irregularities is appropriately grasped and documented. • Status of irregularities is reported to the operation control manager and appropriate countermeasures against the irregularity is taken. • Sign of troubles can be grasped. 	<ul style="list-style-type: none"> • Knowledge about collection method of surveillance data • Knowledge about usage of surveillance tools • Knowledge about OS • Knowledge about applications • Knowledge about network architecture, topology, hardware and software • Knowledge about LAN/WAN • Knowledge about security policy and procedures of the company • Knowledge about documentation, storage and security tools 	<ul style="list-style-type: none"> • Ability to analyze surveillance data • Ability to document analyzed contents in details without error • Ability to grasp the trend in performance and diagnose eccentricity in performance • Ability to utilize project management software • Ability to analyze system operation and effect/efficiency of the system
5-2	Trouble analysis and recovery	<ul style="list-style-type: none"> • Occurrence of troubles is minimized as much as possible. • Troubleshooting can be carried out promptly. • Even when irregularities occur in the system, their effect on business is minimal. • Cause of the trouble is identified and countermeasures is taken before influence appears. 	<ul style="list-style-type: none"> • Knowledge about analysis method of surveillance data • Knowledge about OS • Knowledge about applications • Knowledge about network architecture, topology, hardware and software • Knowledge about LAN/WAN • Knowledge about components and equipment control of the network • Knowledge about procedures for troubleshooting 	<ul style="list-style-type: none"> • Ability to take appropriate measures when irregularity is found • Ability to interpret and evaluate data • Ability to carry out troubleshooting against malfunctioning and stop of the system • Ability to grasp the trend in performance and diagnose eccentricity in performance
5-3	Analysis of system performance	<ul style="list-style-type: none"> • The standards have been updated in accordance with the change in network configuration • Performance data has been systematically collected and documented. • Collected data is impartial. • All surveillance data has been analyzed. • The adequacy of performance is checked from the aspect of equipment configuration. 	<ul style="list-style-type: none"> • Knowledge about network architecture, topology, hardware and software • Knowledge about traffic status • Knowledge about response • Knowledge about system lifecycle 	<ul style="list-style-type: none"> • Ability to utilize network surveillance and measuring tools • Ability to complete system analysis • Ability to utilize test tools • Ability to analyze data and to evaluate accuracy of it as information • Ability to diagnose the limitation of performance

Network Systems Engineer Skill Standards (Error! Style not defined.)

5-4	Analysis of security breach and counter measures	<ul style="list-style-type: none"> • The criteria have been updated in accordance with the change in network configuration • Policy, countermeasures and system to cope with security breach have been established. • Information on security hole is collected always. • Security holes have been all checked and removed. • When security breach is found, it is appropriately reported to parties concerned. • Security procedures have been established and the penalty for violation of procedures has been properly established. 	<ul style="list-style-type: none"> • Knowledge about network architecture, topology, hardware and software • Knowledge about surveillance procedures • Knowledge about unauthorized intrusion detecting tools • Knowledge about countermeasures against security breach • Knowledge about security hole and countermeasure patch • Knowledge about computer virus 	<ul style="list-style-type: none"> • Ability to take appropriate countermeasures at the time of breach • Ability to utilize network surveillance tools and unauthorized intrusion detecting tools • Ability to utilize vaccine tools • Ability to collect information continually
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Network Systems Engineer Skill Standards (Error! Style not defined.)

6. Network system evaluation				
No.	Task	Performance indicators	Required knowledge	Required skill
6-1	Evaluation of the system	<ul style="list-style-type: none"> • Performance of the network system has been accurately evaluated in accordance with the company's procedures • Existing and potential problems and the measures for improvement have been reported. • Strong and weak points of the network system have been reported. • Points of network system to which enhancement is required can be pointed out. • Reports have been distributed to appropriate parties concerned/relevant departments. 	<ul style="list-style-type: none"> • Knowledge about evaluation procedures, surveillance procedures, reporting procedures and policy of the network system in the company • Knowledge about resources of the company and their restriction • Knowledge about process of and procedures for surveillance over system • Knowledge about standards for documentation and about procedures for distribution in the company 	<ul style="list-style-type: none"> • Ability to analyze and integrate information • Ability to utilize modeling and simulation tools • Ability to evaluate/adjust the action plan • Ability to identify points that need improvement • Ability to provide easily understandable reports to various persons concerned
6-2	Proposal for improvement of the system	<ul style="list-style-type: none"> • The lifecycle of the existing network system is identified and advice on the timing of the next system transfer can be given. • Survey on the technological trends is carried out and the timing of the spread of new technologies is recognized and appropriate advice is given. 	<ul style="list-style-type: none"> • Knowledge about the lifecycle of the network system • Knowledge about traffic forecasting • Knowledge about information collection method • Knowledge about technological constraints and hardware and software standards and processing 	<ul style="list-style-type: none"> • Ability to propose modifications and improvements of the system and analyze targets/constraints • Ability to acquire information on new products always • Ability to grasp the trend of network system configurations of other companies

Network Systems Engineer Skill Standards (Error! Style not defined.)

7. Consulting for development of individual information system				
No.	Task	Performance indicators	Required knowledge	Required skill
7-1	Advice on planning and analysis of the network system	<ul style="list-style-type: none"> • An optimal network plan can be recommended based on the requirements of the application • The lifecycle of the network can be identified and advice on the analysis of the network system can be given 	<ul style="list-style-type: none"> • Knowledge about the lifecycle of the network • Knowledge about evaluation of the network system 	<ul style="list-style-type: none"> • Ability to grasp the trend of network system configurations in other companies • Ability to confirm the main points in free discussions and questions • Ability to work with other persons in concert • Ability to make presentations
7-2	Advice on design and construction of the network system	<ul style="list-style-type: none"> • Advice on the system configuration of the application is given in order to bring out an optimal network system performance • Advice on the optimal network configuration can be given based on the system configuration of the application 	<ul style="list-style-type: none"> • Knowledge about design and construction of the network system 	<ul style="list-style-type: none"> • Ability to grasp the trend of network system configurations in other companies • Ability to confirm the main points in free discussions and questions • Ability to work with other persons in concert • Ability to make presentations
7-3	Advice on operation and maintenance of the network system	<ul style="list-style-type: none"> • Advice on the security of the application can be given from the standpoint of the network system management • Advice on the application operation can be given from the standpoint of the network system operation 	<ul style="list-style-type: none"> • Knowledge about operation and management of the network system 	<ul style="list-style-type: none"> • Ability to grasp the trend of network system configurations in other companies • Ability to confirm the main points in free discussions and questions • Ability to work with other persons in concert • Ability to make presentations

4. Body of Knowledge

The body of knowledge for network systems engineers has been prepared by classifying into technological or problem-solving themes and organizing in a hierarchical structure such knowledge that is required to accomplish activities stated in "2. Key activities" successfully and to consider solutions for various problems such as diversification and increase in complexity in needs, increase in operation management cost, and measures to cope with emerging technologies.

The body of knowledge necessary for network systems engineers consists of the following two kinds:

- 1) IT common body of knowledge
- 2) Network systems engineers' practical body of knowledge and core body of knowledge network systems

As the "IT body of common knowledge" in 1) above is necessary not only for network systems engineers, but also for applicants to all the examination categories, it is prepared as a separate booklet. For its details, please refer to "IT Common Body of knowledge - Information Technology Engineers Skill Standards."

Network systems engineers are tested for knowledge in five fields of IT common knowledge at the following technological levels in accordance with the "Scope of examinations for Information Technology Engineers":

- "II. Computer system (Level II)"
- "III. System development and operation (Level II)"
- "V. Network technology (Level III)"

"VI. Security (Level III)"

"VI. Standardization (Level III)"

In 2) "Practical body of knowledge and core body of knowledge for network systems engineers," the part corresponding to "the practical body of knowledge" is prepared by organizing knowledge about "A. Design and Construction of Network System" and "B. Operation, Maintenance and Management of Network System" for which network systems engineers should display their abilities, "C. Implementation Technology for Network System" which requires ability to solve problems and "D. Trends in Technologies for Network System" that will be utilized technologically in future. In the part corresponding to the "Core body of knowledge," the body of knowledge organized in the "IT common body of knowledge" is pursued deeper.

Note: "i mode" is the trademark of NTT DoCoMo.
Ezweb is the trademark of KDDI.

Network Systems Engineer Skill Standards (Error! Style not defined.)

[Network systems engineers' practical body of knowledge, and core body of knowledge]

Knowledge field	Major classification	Intermediate classification	Minor classification
A. Design and construction of network system			
	1	Definition of requirements for the network	
		1.1	Analysis of requirements of application
			1.1.1 Study of application (The locations and number of servers, the locations and number of clients, the number of simultaneous accesses, the number of uses/day, the time length per use, the volume of data per transmission and congested time zone)
			1.1.2 Analysis of application
			1.1.3 Analysis of issues
		1.2	Analysis of the existing network system
			1.2.1 Study of network architecture (The location and number of servers, the locations and number of clients, the number of simultaneous accesses, the number of uses/day, the time length per use, the volume of data per transmission, congested time zone, protocol used and traffic pattern)
			1.2.2 Analysis of the network architecture
			1.2.3 Analysis of issues
		1.3 Decision on the scope of work	
		1.4	Definition of requirements for the network system
			1.4.1 Functional requirements (functions to be realized)
			1.4.2 Requirements for traffic (expected traffic patterns)
			1.4.3 Requirements for performance (expected performance)
			1.4.4 Requirements for reliability (expected reliability)
			1.4.5 Security requirements (security criteria)
			1.4.6 Requirements for maintenance and operation (cost of operation and maintenance)
			1.4.7 Management requirements (policy for management)

Network Systems Engineer Skill Standards (Error! Style not defined.)

	2 Design of the network system		
	2.1 Study and evaluation of the applicable technologies and products		
		2.1.1	Collection of information
		2.1.2	Comparative study of applicable technologies and products
		2.1.3	Points for comparison of applicable technologies and equipment
	2.2 Design of the network system		
		2.2.1	Decision on protocol
		2.2.2	Decision on topology
		2.2.3	Decision on link (communication performance of the link)
		2.2.4	Decision on nodes (processing capability of the nodes)
		2.2.5	Decision on performance of the network (performance simulation)
		2.2.6	Decision on reliability measures
		2.2.7	Decision on security measures (Study on security measures and evaluation of network technologies and equipment toward realization of measures)
		2.2.8	Selection of network equipment (Preparation of criteria for selection (cost, performance, capacity, processing volume, delay), consistency of the estimate ranges, study on necessity of advance test, confirmation on interconnectivity)
	2.3 Plan for business operation on the new network		
		2.3.1	Confirmation of business processes
		2.3.2	Installation plan
		2.3.3	Transition plan
	2.4 Preparation of work plan		
		2.4.1	Role sharing
2.5 Design review			
3 Construction and test of the network system			
3.1 Installation work			
	3.1.1	Advance preparation	
	3.1.2	Witnessing	
	3.1.3	Management of construction	
3.2 Test and evaluation			
	3.2.1	Connection test	
	3.2.2	Security test	
	3.2.3	Performance test	
	3.2.4	Overall test	
3.3 Transition work			

Network Systems Engineer Skill Standards (Error! Style not defined.)

Knowledge field	Major classification	Intermediate classification	Minor classification
B.	Operation, maintenance and management of the network system		
	1	Operation and maintenance of the network system	
	1.1	Measures for users	1.1.1 User management
			1.1.2 User education
			1.1.3 User consultation
	1.2	Preparation of policy and plan for maintenance and updating (upgrading)	1.2.1 Confirmation of the policy
			1.2.2 Equipment to be addressed
			1.2.3 Time of inspection
			1.2.4 Time of upgrading
	1.3	Execution of maintenance and updating (upgrading)	1.3.1 Points in the case of contracting to outsiders
			1.3.2 Points in the case of carrying out in-house
	1.4	Backup and data recovery	1.4.1 Data storage and disposal
			1.4.2 Backup
			1.4.3 Data recovery
	1.5	Management of network system configuration	1.5.1 Management of component equipment (IP address, workstation ID, Mac address)
			1.5.2 Management of software
			1.5.3 Network configuration diagram
	2	Management of the network system	
	2.1	Surveillance of the network system	2.1.1 Network management equipments (SNMP, M1B2, RMON (Remote network MONItoring))
			2.1.2 Surveillance of performance utilizing tools (LAN monitor)
			2.1.3 Surveillance of trouble utilizing tools
			2.1.4 Surveillance of security utilizing tools (Intrusion detecting system)
			2.1.5 Checkpoints for surveillance of performance
			2.1.6 Points of surveillance of the line troubles
			2.1.7 Checkpoints for surveillance of security
	2.2	Analysis of troubles and restoration	2.2.1 Points of analysis of troubles (LAN analyzer)
			2.2.2 Points of troubleshooting
			2.2.3 Points of preparation of reports on troubles (Necessary items to be described)

Network Systems Engineer Skill Standards (Error! Style not defined.)

		2.3 Analysis of performances of the system	
			2.3.1 Point of analysis of performance of the system
		2.4 Analysis of and countermeasures against security breach	
			2.4.1 Analysis of security breach (Investigation on status of damages, collection of information about security, identification of the cause)
			2.4.2 Points to cope with unauthorized access (Points of countermeasures from detection to resumption of service)
			2.4.3 Points to cope with computer virus (Points of countermeasures from detection to elimination of the virus)
	3	Evaluation of the network system	
		3.1 Evaluation of the system	
			3.1.1 Limit of capability
			3.1.2 Analysis of potential problems
			3.1.3 Points of evaluation of the system
		3.2 Proposal for improvement of the system	
			3.2.1 Lifecycle of the system
			3.2.2 Economical efficiency of the system
			3.2.3 Expandability of the system
			3.2.4 Points of proposal for improvement

Network Systems Engineer Skill Standards (Error! Style not defined.)

Knowledge field	Major classification	Intermediate classification	Minor classification
C. Implementation technology of the network system			
	1	Network protocols	
		1.1	Industry protocols
			1.1.1 Commercial protocols (SNA, IPX, Apple Talk)
			1.1.2 Business protocols (JCA procedures, Zen-gin (all Japan banking) procedures)
	2	Reliability design	
		2.1	Basic theories
			2.1.1 MTBF (Mean Time Between Failures)
			2.1.2 MTTR (Mean Time To Repair)
			2.1.3 RAS (Reliability, Availability and Serviceability)
			2.1.4 RASIS (RAS, Integrity and Security)
			2.1.5 FMEA (Failure Mode and Effects Analysis)
			2.1.6 FTA (Fault Tree Analysis)
		2.2	High-reliability technologies
			2.2.1 High-reliability technology for hardware
			2.2.2 High-reliability technology for software
			2.2.3 High-reliability technology for system maintenance
			2.2.4 Fault tolerance technology
		2.3	Quality of communication
			2.3.1 Voice quality
			2.3.2 High-quality audio quality
			2.3.3 Image quality
			2.3.4 Data transmission quality
			2.3.5 Service quality
	3	Telecommunication service	
		3.1	Mechanism of telecommunication service
			3.1.1 Intranet service
			3.1.2 Service for interconnection of both ends of leased circuits with public switched networks

Network Systems Engineer Skill Standards (Error! Style not defined.)

	4 Network equipment and devices		
	4.1	xDSL modem	
	4.2	ISDN router	
		4.2.1	Interface
		4.2.2	Functions (No-communication controlling function, NAT function)
	4.3	FRAD (FRame Assembly/Disassembly), CLAD (CeLI Assembly/Disassembly)	
		4.3.1	Interface
		4.3.2	Functions
	4.4	Remote access server	
		4.4.1	Functions
		4.4.2	Mechanisms
	4.5	Office PHS	
		4.5.1	Functions
	4.6	Repeater hubs	
		4.6.1	Dual-speed hub (Functions and mechanism)
	4.7	LAN switch	
	4.8	Layer 3 switch	
		4.8.1	Functions
		4.8.2	Mechanism

Network Systems Engineer Skill Standards (Error! Style not defined.)

	5	Network service	
		5.1	IP address
			5.1.1 Mechanism
			5.1.2 DHCP
			5.1.3 I Pv6 (mechanism and transition technology)
		5.2	DNS (Domain Name System)
			5.2.1 Functions
			5.2.2 Mechanism (FQDN, domain names)
		5.3	Electronic mail
			5.3.1 Functions
			5.3.2 Mechanism (SMPT, POP, MIME, IMAP4, LDAP)
			5.3.3 Mailing list (Functions and mechanism)
			5.3.4 Web mail (Functions and mechanism)
		5.4	Electronic news
			5.4.1 Functions
			5.4.2 Mechanism (NNTP)
		5.5	WWW
			5.5.1 Functions
			5.5.2 Mechanism (HTTP)
		5.6	Load distribution
			5.6.1 Web switch

Network Systems Engineer Skill Standards (Error! Style not defined.)

		5.7 Electronic authentication	5.7.1 Functions
			5.7.2 Mechanism
			5.7.3 Certificate authority
			5.7.4 Electronic certificate
		5.8 Mechanisms of services	5.8.1 Providers
			5.8.2 Provider roaming services
			5.8.3 Dial-up IP connection
			5.8.4 CATV connection
			5.8.5 Internet telephone (Vol P)
			5.8.6 Internet broadcasting (Multicast)
			5.8.7 EC service
			5.8.8 Electronic settlement
			5.8.9 Contents delivery
			5.8.10 Mobile communications (i mode, EZweb)
			5.8.11 Hosting, housing
			5.8.12 EDI (EDI rules, F procedures, Web EDI)
			5.8.13 B to B
			5.8.14 B to C
			5.8.15 ASP
			5.8.16 Data center

Network Systems Engineer Skill Standards (Error! Style not defined.)

	6	Intranet/extranet	
			6.1 Typical applications
			6.1.1 WWW
			6.1.2 Groupware
			6.2 Backbone LAN
			6.2.1 100M ethernet
			6.2.2 FDDI
			6.2.3 ATM
			6.2.4 Optical fiber
			6.3 Full duplex LAN
			6.3.1 Functions and mechanism
			6.3.2 Method for realization
			6.4 Connection between LANs
			6.4.1 Connection modes and characteristics (ISDN, leased line, frame relay)
			6.4.2 Effective utilization of WAN (QoS, data compression, MP, BOD)
			6.5 Remote access
			6.5.1 User authentication (PPP)
			6.5.2 Access from mobile communication (PIAFS, Packet switching services)
			6.6 Reliability measures
			6.6.1 Duplexing of communication equipment
			6.6.2 Duplexing of WAN
			6.7 Address translation
			6.7.1 NAT functions
			6.7.2 IP masquerade
			6.8 Internet VPN
			6.8.1 Functions
			6.8.2 Mechanism
			6.9 Virtual LAN
			6.9.1 Functions
			6.9.2 Mechanism
			6.10 Coexistence with other protocols
			6.10.1 Multi-protocol router
			6.10.2 IP tunneling

Network Systems Engineer Skill Standards (Error! Style not defined.)

Knowledge field	Major classification	Intermediate classification	Minor classification
D. Trends of network system technology			
	1 Large scale networking	1.1	Broadband ISDN
		1.2	Optical net (FTTH, ATM-PDS, STM-PDS)
		1.3	Telephone cable (xDSL, HDSL, VDSL, ADSL, CATV)
		1.4	Wireless network
		1.4.1	Mobile telephone system (WLL, CDMA, IMT-2000)
		1.4.2	High-speed fixed wireless (FWA)
		1.4.3	Satellite network
	1.5 Backbone network	1.5.1	SONET (Synchronous Optical NETwork)
		1.5.2	SDH (Synchronous Digital Hierarchy)
		1.5.3	WDM (Wavelength Division Multiplexing)
		1.5.4	IP over SONET/SDH
		1.5.5	IP over WDM
	2 High-speed LAN	2.1	DQDB (Dual Queue Dual Bus)
		2.2	Gigabit ethernet
		2.2.1	1000 Base F
		2.2.2	1000 Base T
	3 Communication service	3.1	Full-time IP connection service
		3.2	Local IP network

Information Technology Engineers Skill Standards
Network Systems Engineer

Original version in Japanese published on December 25, 2000

Publisher	Central Academy of Information Technology Japan Information Processing Development Corporation 19th Floor, Time 24 Building, 2-45 Aomi, Koto-ku, Tokyo 135-8073, Japan
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URL	http://www.cait.jipdec.or.jp

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