# Virtual Standards Development Environments for Concurrent Standardization Process

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## ABSTRACT

Recently, the increased handling of on-line standards information has emerged as an important feature of information and communications technology (ICT) standardization. In order to meet market needs for on-time standards deployment, most standards organizations are actively seeking more efficient ways of standardization using electronic means in order to accelerate the standards making process. This paper suggests a virtual standard development environment designed for standards developers to carry out their standards-related activities online. In this paper, we outline a conceptual model of a concurrent standardization process and describe the design and implementation of an Extranet-based network system called standards information cooperative network (SICN). The system was created with a view to fostering faster standards development with functionalities such as a virtual management of networked standards developers, collaboration support tools, a workflow-based electronic signature system, and dynamic links for ready retrieval of standards information stored in a database. We conclude this paper with an introduction to the concept of a virtual standards development organization (VSDO) that supports all the features needed by the relevant standards making bodies to carry out their activities in a dynamic on-line environment.

# I. INTRODUCTION

The importance of standardization in the ICT field is rapidly increasing in a time when resources for standardization are limited and market demands for on-time standards deployment are on the rise [1]. In light of the rapid evolution of technology and the growing need for interoperability among ICT products in the market, a consensus is emerging among standards development organizations that their standards development procedures should be streamlined in order to facilitate more efficient ways of standardization via electronic means. In this context, since 1994 a number of standards organizations including ITU–T have started to develop an electronic collaborative environment called an electronic document handling (EDH) system which supports the electronic exchange of standards related information and allows standards users to readily access standards documents, contributions, meeting schedules, and other information.

The terminology of EDH arose from ITU–T/TSAG (Telecommunication Standards Advisory Group) activities in 1993. Due to a shift from technology-driven to market-driven standards emphasizing de-facto standards of Fora/Consortia over de-jure standards, international/regional/ national standards organizations have been trying to adapt their standards making processes to satisfy increasingly challenging ICT market demands. In keeping with this trend, ITU–T/TSAG established the working party (WP) 3 in 1993 to develop an EDH system for standardization that could facilitate effective on-line standards handling. Under the WP3 activities, ITU–T started the ITU–TIES (Telecommunication Information Exchange Services) [3] and the ITU Publication Online services. ITU–TIES is a set of networked information resources and services supporting the ITU-related information exchange requirements of the global telecommunications community. ITU Publication Online services provide all the ITU Recommendations electronically to paying subscribers.

With the WP3 in ITU–T/TSAG, other standards development organizations (SDOs) have also begun to introduce EDH methods in order to accelerate their respective standards development processes [3]-[8]. Particularly noteworthy is the work of the Global Standards Collaboration (GSC) [9], a community of international/regional/national standards organizations, which has reflected the collaborative EDH methods being used by the participant SDOs (ATSC, ETSI, T1 Committee, TSACC, TTA, and TTC) with ITU–T. This has led to the provision of the GSC Server (www.gsc.etsi.fr), which links the EDH systems of each SDO electronically. In the future, EDH-based collaboration processes among SDOs might be accelerated for a more efficient development and implementation of standards.

Considering the EDH methods currently used by SDOs, it is noteworthy that most SDOs are using quite similar systems based on the Internet and WWW technologies.

They have developed their own Web home pages providing access to standards information databases, including published standards documents, meeting calendars, brief overviews of participating organizations, etc. Even though these on-line systems are useful for standards users who do not actively participate in standardization activities, their most important feature is the potential to provide standards developers with collaborative working tools enabling them to engage in effective on-line standards making. These tools may include on-line management of standards developers, Web-based electronic balloting, group editing of Draft standards, on-line comment gathering, and virtual meeting facilities such as audio-visual conferencing. With regard to audio-visual conferencing, general features of conference control may be needed such as the option to convene, join or leave meetings, etc. In order to further enhance their standards making, standards developers also require tools which will help them access dynamic information such as working standards documents, contributions, meeting reports, and so on.

So far, EDH systems in most standards organizations have been dedicated to the electronic exchange of standards information itself. In order to process pure on-line standards making, such systems need to provide an integrated environment that serves the needs of both user classes on EDH: a one-stop search and retrieval environment for standards users and a concurrent standards making environment for standards developers linked over a network.

This paper suggests such an integrated environment that might be able to meet the future needs of ICT standardization. After analyzing the current EDH systems of major standards organizations and examining the inefficiencies of conventional standards making procedures, this paper presents the new concept of a virtual standards development environment together with suggestions for implementation of an SICN system.

Section II suggests a conceptual model for concurrent standardization and points out the drawbacks of the conventional standards making process in order to emphasize the necessity of EDH. Section III defines the major characteristics needed to build a virtual standards development environment and shows the design architecture and modular components of an SICN system that might be useful for on-line standards making activities. Section IV describes the implementation of the system, and Section V concludes this paper with a suggestion of the concept of a VSDO.

## II. NECESSITY OF ON-LINE PROCESSING FOR STANDARDS MAKING

### 1. A Conceptual Model for Concurrent Standardization

In considering the state of ICT standardization today, several distinctive features become immediately apparent: quan-
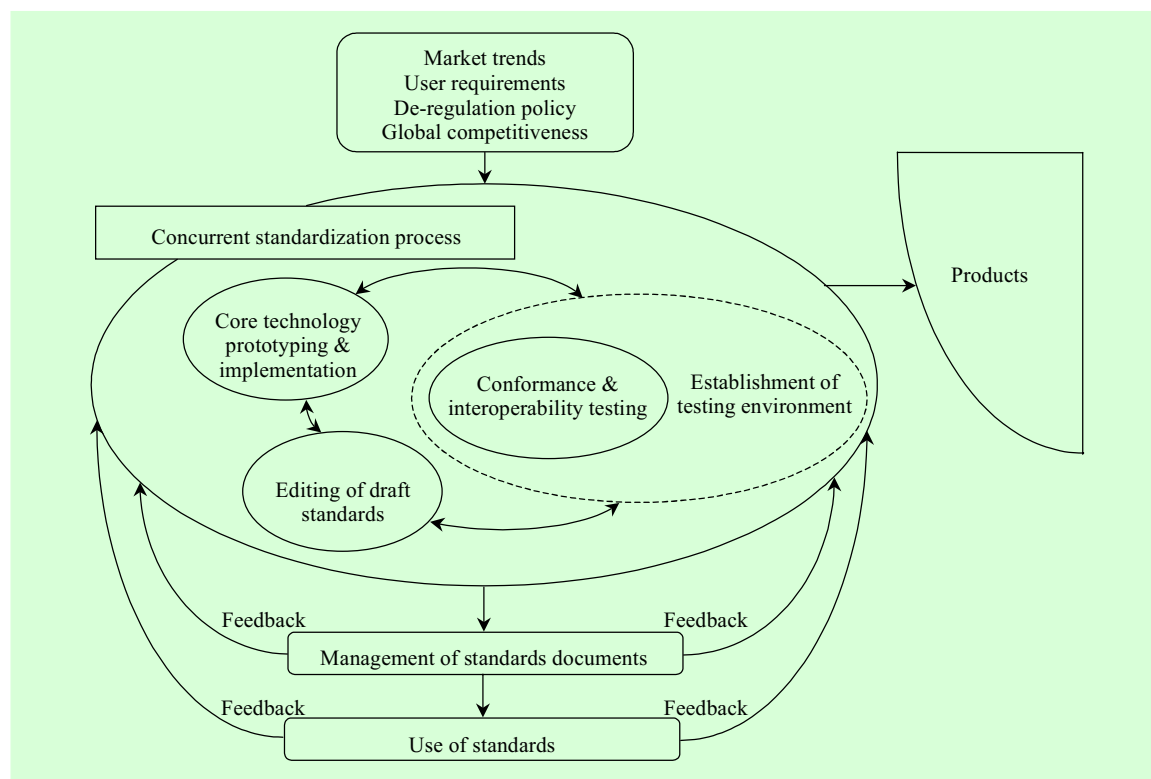
**Fig. 1.** Conceptual model of a concurrent standardization process.

titative increase and qualitative complexity of standards work items, limited resources for standards making and increasing market needs for on-time standards deployment. In order to comply with the above features of ICT standardization, it is becoming widely recognized that the systematic improvement of the standardization process and methodology has to be advanced in line with a dynamic priority setting and allocation of various new items to be standardized [10]. Moreover, as conventional face-to-face communication in meeting places is no longer adequate for satisfying the growing market demands, an en-

vironment for the electronic handling and exchange of standards information is becoming a pre-requisite to satisfy the market needs for on-time standards.

Introduction of the concept of on-line standards handling via electronic means is expected to increase not only the speed of standards development processes, but also the need to change standardization procedures in favor of concurrent standardization providing simultaneous handling of consequent standards development processes. Figure 1 describes a conceptual model of the concurrent standardization process. The three smaller circles inside the larger

circle represent mutual collaboration aimed at meeting market demands through faster standards development. In line with the prototyping of core technology and implementation, the editing of draft standards would take place at the same time as the conformance and interoperability testing. Standards making carried out in this manner are much faster and dynamic than the sequential approach of conventional standards development processes.

## 2.   Comparison among SDOs on EDH

In general, standards organizations including ITU and ISO have quite similar standards making processes. In the case of ITU–T, the normal standards development process is as follows [11]:

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①

Table 1. Electronic tools used for collaboration by SDOs.

| Major SDOs including Fora/ Consortia | URL | Document distribution | Electronic voting | Group document editing | Group comment gathering | Virtual meeting |
|---|---|---|---|---|---|---|
| ANSI/IISP | www.ansi.org | √ | | | | |
| ATIS/T1 | www.t1.org | √ | √ | | | √ |
| ATM FORUM | www.atmforum.com | √ | Paper-based | | | |
| ATSC | www.austel.gov.au | √ | | | | |
| DAVIC | www.davic.org | √ CD-ROM | √ | | | |
| ETSI | www.etsi.fr | √ | √ | | | |
| GSC | www.gsc.etsi.fr | | | | | |
| ICTSB | www.ict.etsi.fr | √ | | | | |
| IEC/TC 100 | www.iec.ch/tc100 | √ CD-ROM | √ | | | |
| IETF | www.ietf.org | √ | | | | √ |
| ISO/TC 68 | www.iso.ch | √ | Paper-based | | | |
| ISO/TC 184 | www.iso.ch | √ | √ | | | √ |
| ISO/CS | www.iso.ch | √ | √ | √ | √ | √ |
| JTC1/SC 24 | www.bsi.org.uk/sc24/ | √ | √ | √ | √ | |
| JTC1/SC 29 | www.chips.ibm.com/.sc29/ | √ | √ | √ | √ | |
| MMCF | www.mmcf.org | √ | | | | |
| TTA | www.tta.or.kr | √ | | | | |
| TTC | www.info.Web.jp | √ | √ | | | |
| ITU–T | www.itu.int | √ | | √* | √* | |

* The use of "informal FTP areas," Mailing lists and FTP "dropboxes" offer limited functionalities in these areas.

of a cast ballot which requires the ballot collector to respond to the ballot tabulation of results is also manual. Several organizations, including JTC1, are moving toward an Internet-based balloting system, which allows votes to be cast directly into the database system. Under such system, automatic confirmation and instantaneous result tabulation are possible without manual handling. Several SDOs have conducted limited trials involving the use

of audio-conferencing technologies in their standards meetings. Several organizations

Taking into account the above requirements of SDOs, this paper shows the design and implementation of an integrated environment that supports all features needed for on-line processing of standards making activities.

## III. DESIGN ARCHITECTURE OF A VIRTUAL STANDARDS DEVELOPMENT ENVIRONMENT

### 1. Design Characteristics

This subsection describes the major design characteristics that should be considered in the construction of an integrated standards development environment. First, the environment has to be developed based on Extranet [14], [15] because the goal of a virtual standards development environment is to be accessible to many and unspecified persons on the network. The SICN system, a target system for a virtual standards development environment, is an Extranet-based Web application permitting registered users of a given virtual private network (VPN) to access standards related information on the server and to make standards on-line.

Second, the virtual environment has to be provided with a workflow-based electronic signature mechanism. In order to process standards approval procedures or other contributions on-line, the features to handle those in line with a pre-defined workflow are required. The SICN system provides an electronic signature mechanism based on TCP/IP e-mail. Unlike typical GroupWare applications, which require installation of specific client software, this system only requires a general purpose Web browser on the client side. Its advantage is that many and unspecified persons on the Extranet can exercise the right of approval using their electronic signature images. Using Internet e-mail, an approval request can easily be sent over the Internet to a relevant person and the user's Web browser can automatically reach the target document on the Extranet Web server via the URL contained in the body text of the e-mail. All electronic signature images of registered users are stored in the user management database on the server.

Third, the integrated environment should support a security mechanism which protects the original information against exposures [16], [17]. The SICN system provides a security mechanism using Pretty Good Privacy (PGP)/Multipurpose Internet Mail Extensions (MIME) and Message Authentication Code (MAC). PGP/MIME is an e-mail security tool based on the public key and MAC guaranties integrity of the document itself. Because the Web platform communication mechanism between Web servers and Web browsers is based on the event, the next event of the Web browser is determined by the URL. This means that valuable

information such as the document location, user Id and password can be exposed. However, with this system, e-mail messages can be protected before being sent over the Internet through encryption of the original text. The system also generates a random key code linked to a given e-mail message in order to guarantee protection of the message contents.

Fourth, the virtual environment has to provide collaboration support tools that would help participants carry out their on-line standards making activities. Those tools may include dynamic group management and resource management. Dynamic group management can handle the requests related to the creation and deletion of a virtual group on-line. Resource management has features needed by group participants in the on-line making of standards such as group document editing, comment gathering, e-mail broadcasting, electronic balloting and a workflow-based electronic signature mechanism.

Finally, the virtual environment should provide a very large database on standards-related information including standards experts, standards documents, on-going contributions, meeting results, and standards organizations, etc. The SICN system provides those databases with a dynamic link relationship in between the various databases. Noting the above design characteristics, the remainder of this paper focuses on the following implementation issues of the SICN system.

- Design of a dynamic and reliable content structure that supports user's various prospects. For this, six different content databases have been identified from the user requirements: standards documents, meeting reports, applications services and the protocol stacks, standards organizations, standards experts, and miscellaneous information.

- Design of general-purpose collaborative tools, which are necessary for on-line standards making. Those are on-line management of virtual standards groups, Web-based electronic voting and electronic gathering of comments, meeting notice broadcasting and shared workspaces for group editing of documents.

- Design of a general-purpose workflow system with an electronic signature mechanism that can process on-line standards making from new work item (NWI) proposal to final approval. The system should support a feature that regulates the workflow for the standards making process according to various approval procedures of each standards organization.

- Design of a dynamic search engine for one-stop retrieval and a graphical viewing function that provides optimal search conditions in Extranet-based environment.

## 2. System Architecture and Module Components

Figure 2 shows the overall architecture of the system composed of a three-tier model, which includes a Web server, mail servers and clients. This model features several implementation restrictions. First, each user registered on the system has a unique Internet e-mail address. By using TCP/IP e-mail address, the addressee can promptly confirm the occurrence of the event (for example, an electronic signature request). Second, all users must have installed in their system a POP server. For Extranet based applications, the addressee's reaction to the received mail should be processed immediately. The POP server is quite useful in conducting periodic searches of incoming mails. Finally, the user client program should support a Web browser and Web mail clients. This environment provides users with direct access to the Extranet application by clicking the URL address contained in the body text of the e-mail. E-mail browsing with a TCP/IP telnet application does not support direct access to the target application. In conclusion, those who want to access the target system do not need to install any particular software except a general Web browser and Web mail client that can improve the extendibility of the client side.

The target system consists of four main modules: the client interface module, the standard roadmap and database module,
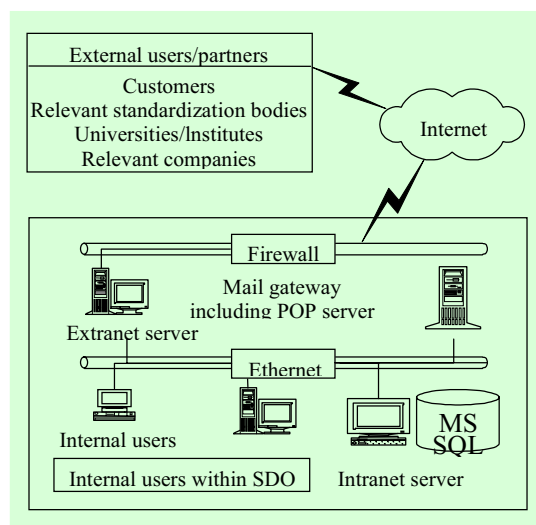


**Fig. 2.** Overall architecture of the system.

the collaboration tools support module, and the electronic signature module.

### A. Client Interface Module

The client interface module manages the flow scenarios between the server system and the Web client. There are three different types of users who can access the SICN server. One is the normal user who has an account to connect to the server and who can simply navigate pre-approved information on the server. The second type is the standards expert. For those who want to participate in the virtual standards groups with the right to create and modify contents on the server, the SICN system provides a special registration procedure. It notes that the dynamic schemes to build up the database from those are necessary to maintain up-to-date information

on the database. Finally, the third type of user is the administrator who manages the accounts of all users and controls the databases.

This Web client has an efficient user interface with a graphical menu hierarchy that is shown on the client screen. Wherever a user navigates on the client screen, all search conditions can be displayed on screen with graphic icons. The client interface module displays all search results using a form-based style presentation.

## B. Standard Roadmap and Database Module

The standard roadmap and database module provides very large databases of standards-related information and access interfaces with a dynamic search engine. It consists of six different types of basic contents connected to dynamic links. In order to satisfy different user interests, these six basic contents are displayed on screen as main menus for the starting search points. These are standards documents, meeting reports, applications services and the related protocol stacks, standards organizations, standards experts and miscellaneous information. The content structure of standards documents consists of the document name, document number, publishing organization, document abstract, standards area, standards domain, priority, standards experts, date of creation, name of persons authorized to make modifications, and so on. Standards documents to be covered in this system are those published by ITU–T, ITU–R, JTC1 and major international

Fora or Consortia such as the ATM Forum, DAVIC, IETF, etc. For easy retrieval of standards document information, this module provides a standard clarification mechanism that is composed of a two-dimensional matrix (34 standards areas and 36 standards domains now used by ITU–T). Figure 3 shows dynamic relationship among basic content databases.

## C. Collaboration Tools Support Module

This module is useful for standards developers. The system supports the functions required to create a virtual group among members for discussion of a specific standardization area of mutual interest. As soon as a user requests the system administrator to create such a group, the system allocates room to the group with all the necessary collaboration tools such as member management, meeting management, Web-based electronic voting, group comment gathering of the group, and a dedicated bulletin board for the members. Then the collaboration tools support module is ready to serve and the person who requested creation of the group may assume the chairmanship of the group.

Member management tools manage membership of the group with functions of subscription request and expel request. Meeting management is useful to call a meeting of group members. As the chairman calls for the group members a meeting, a meeting management tool automatically broadcasts a meeting notice to the members
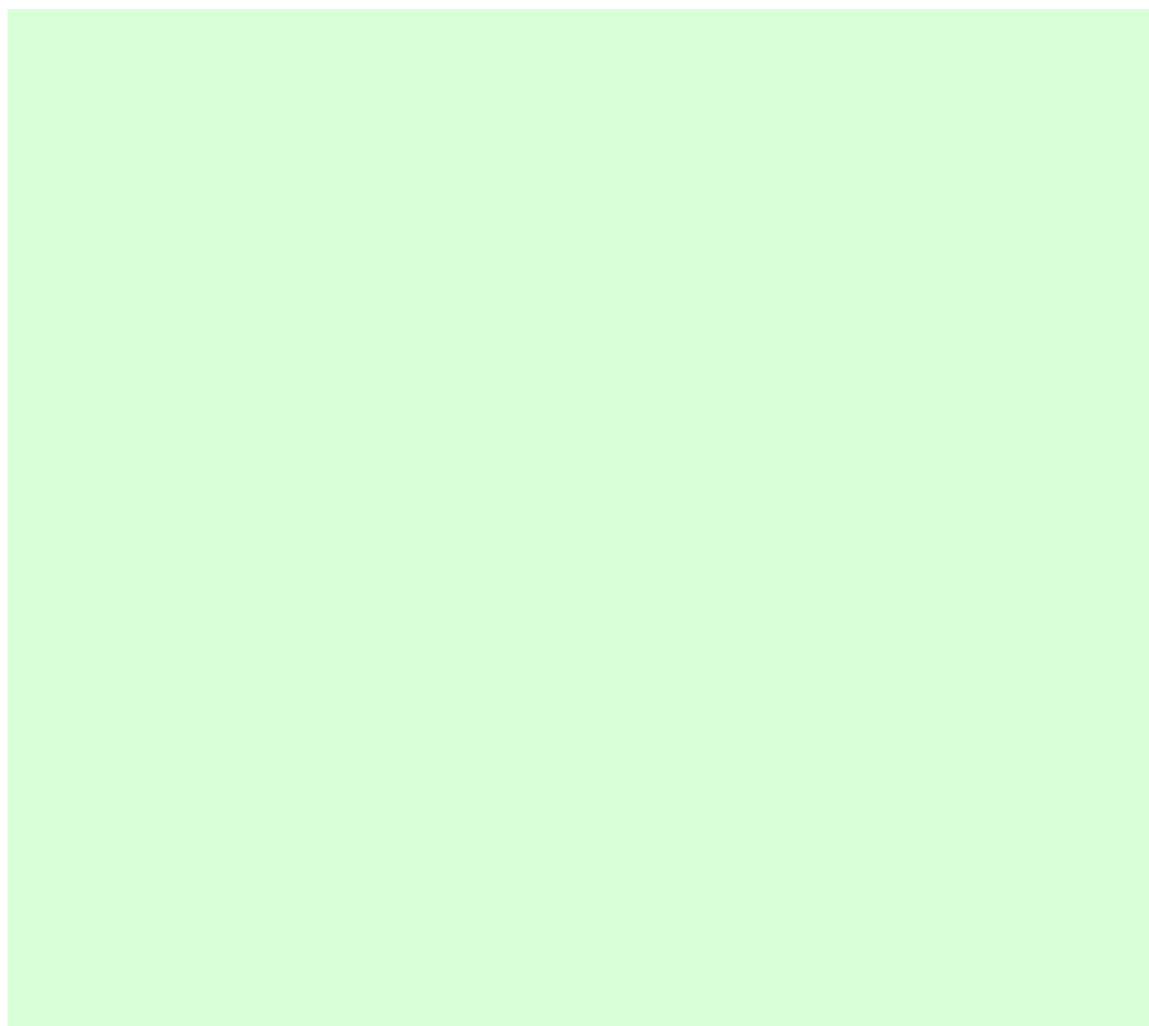
**Fig. 3.** Dynamic relationship among databases.

automatically and calculates the percentage of positive answers among participants according to their reactions. The electronic balloting process consists of three components: request-ballot, answer-to-ballot, and ballot-results. The chairman of a group can initiate a request-ballot of all or selected members of the group using on-line balloting forms. The balloting request is sent to the members via e-mail with the random
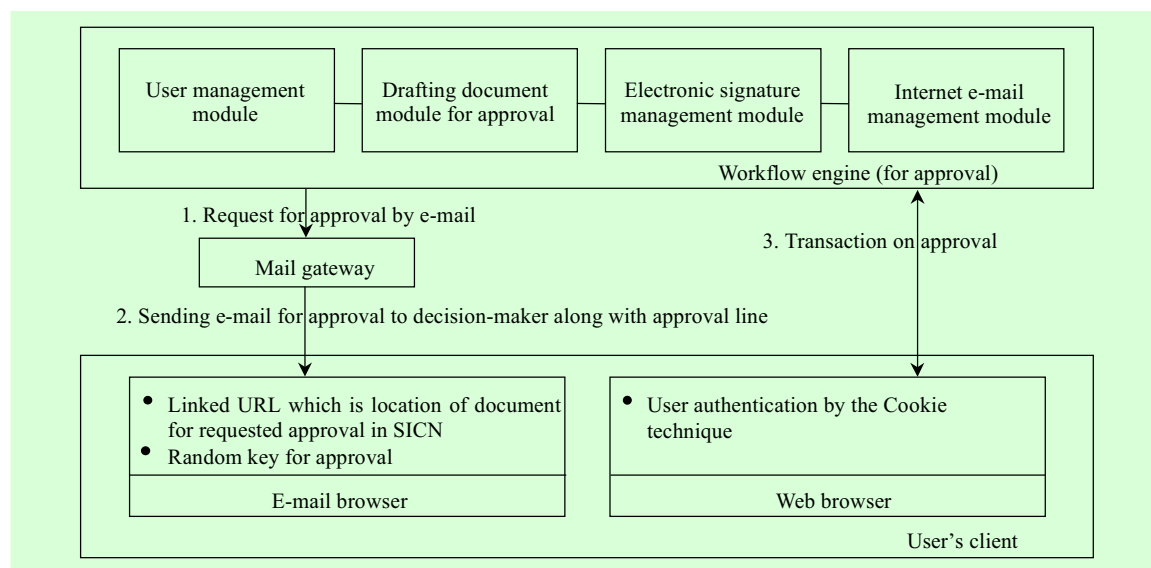
Fig. 4. Basic workflow for approval of document.

Group comment gathering provides a means of gathering all the comments against a standard or contribution to be dealt with. According to the reaction of all the users participating in the group, the tool automatically combines the comments and sends it to the originator. The bulletin board can be used for discussion and exchange of members' thoughts and opinions.

### D. Electronic Signature Module

In order to simulate the on-line standards development process from proposal to approval, it is necessary to have a workflow system based on the standards making procedure. With the workflow based SICN system, the electronic signature module provides the environment of on-line processing according to already existing standards development procedures. Subsection 3 describes in detail the design of the electronic signature mechanism.

### 3. Design of the Electronic Signature Mechanism

The electronic signature is a core function in the standards development system. Electronic signatures should not be confused with digital signatures. Electronic signature function only as an approval mechanism for requested work or documents, whereas digital signature are generally used in non-repudiation for security.

Figures 4 and 5 respectively show the electronic signature module and a workflow scenario requesting electronic signatures to the designated high-level decision-makers from the original submitter's side.
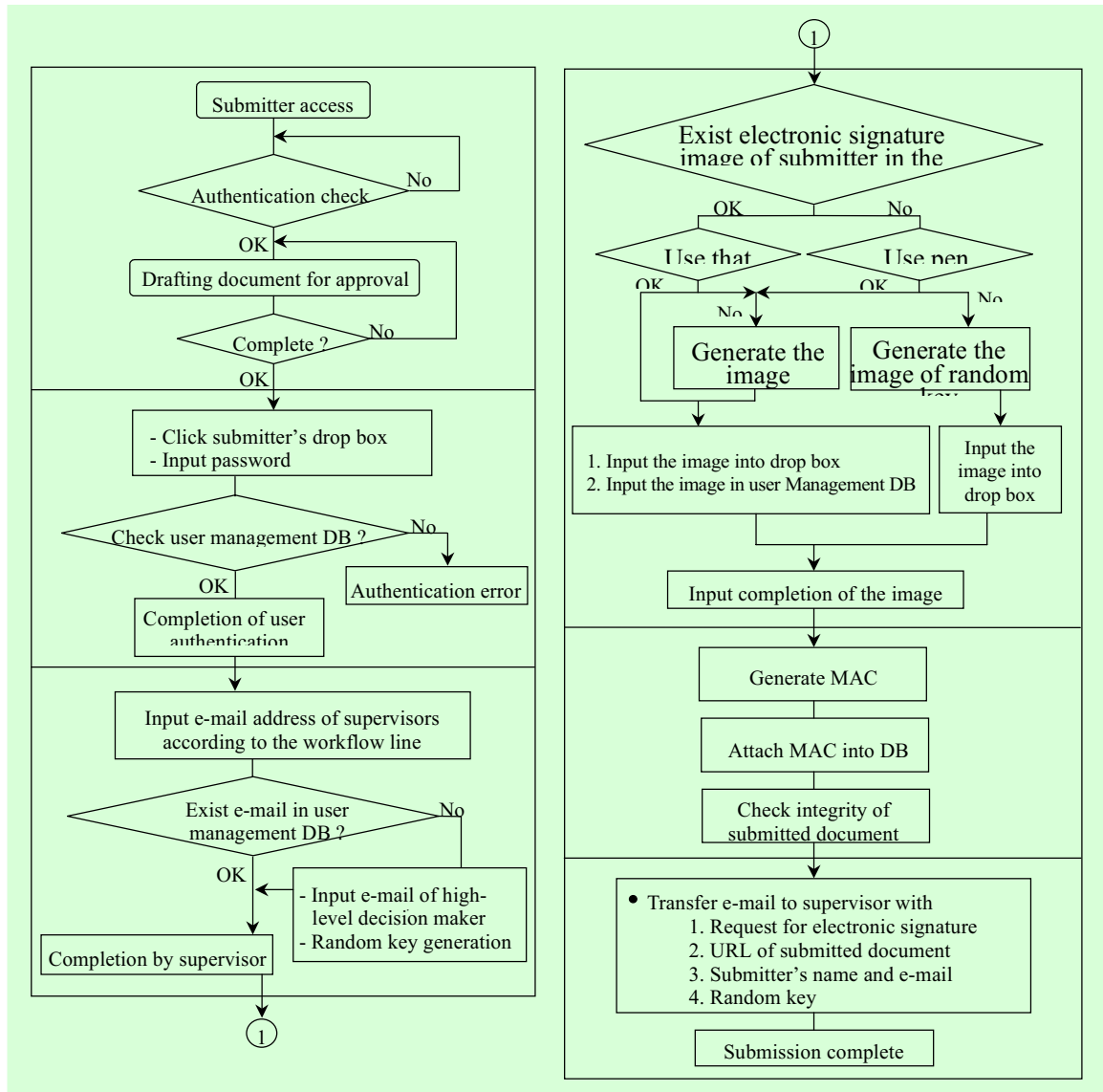
**Fig. 5.** Workflow chart (a submitter's side).

The electronic signature module consists of four sub-modules: user management sub-module, drafting document sub-module for approval, electronic signature management sub-module for the drafted document (proposals, draft standards, and final standards), and the Internet e-mail management sub-module.

The functions of each sub-module are as follows:

(1) User management sub-module: All users are authenticated by a unique e-mail

address on the user management database.

(2) Drafting document sub-module for approval: Only authenticated users can access this module to draft documents and upload relevant attached files to the system for approval in a given form-based interface. They can also modify and/or delete the relevant documents when logging into the system.

(3) Electronic signature management sub-module for the drafted document (proposals, draft standards, final standards): The basic idea is that a higher-level decision-maker, such as a committee chair, can decide on a requested approval document using his/her electronic signature. The approval is done by a random key in an e-mail, and the decision-maker can directly access the requested document by a linked URL that is the location of the document in the system.

This consists of four components:

① User authentication component: All relevant users should have a unique e-mail address and password, the same as in module (1).

② Approval line management component: The original drafter, who is usually the submitter of a proposal for a standards project, should designate an approval sequence of person of higher position. This is done by using each person's e-mail. All relevant information is identified and retrieved from the resource database. The approval sequence is determined by the particular SDO's workflow rules. Designation of the approval sequence is input using a form-base interface.

③ Approval management component: This module generates a random key for document approval. A random key is inserted into an e-mail and only the decision-maker can approve the document with this key. Alternatively, one may design an approval method using unique approval image management.

④ Integrity management component for requested approval: The related approved document should not be changed. The system ensures this by MAC for each access.

(4) Internet e-mail management sub-module: According to the approval sequence, the system sends e-mails to the relevant decision-makers.

## IV.  IMPLEMENTATION

The target system has been implemented based on Windows NT 4.0 and IIS 4.0 for the Web server. The active server pages (ASP), a powerful server-side scripting engine included in IIS, was used for the server/browser communication interface. When user selects one of the main menus, additional selectable icons are automatically shown on the left side of the screen that provides relative search conditions on that screen. All the database tables are designed and implemented under the relational database, MS SQL 6.5. Each

table has a well-defined connection and hierarchical structure with related links. As mentioned in the previous section, only authenticated users can access this system. Registered users who want to propose standardization works should fill out each field in the form according to a given SDO's standardization rules and procedures. In this case, all relevant information is described with documents. This may include the submitter's information, an approval sequence, IPR information, related SG/Working Group, etc, in the form. Examples of such documents include proposals, draft standards, standards, external liaison statement, and suggestions, etc. Once the original drafter submits documents, the remainder of the process automatically proceeds by the workflow engine.

The other implemented items are white board, electronic voting board, on-line manual, form-based mailing services, and FAQ, etc.

## V. CONCLUSION

Today, standards making are being considered in terms of effectiveness, seamlessness, and globalization [18]-[20]. Due to the growing competition and convergence between information technologies and telecommunications, most SDOs are trying to change their standardization systems using electronic means [21]. The goal of the EDH is to facilitate and enhance the

standards development process, and the usefulness of EDH is being emphasized to develop standards and recommendations to the market. Nevertheless, the concept of EDH systems of most standards development organizations has been dedicated to the electronic exchange of standards information itself. For pure on-line standards making by participants, they have to provide an integrated environment that serves the needs of both user classes on an EDH that provides a one-stop search and retrieval environment for standards users and concurrent standards making environment for standards developers on network basis.

The basic concept of this paper is to suggest an integrated environment that might be useful for standards making to the ICT market. This paper also suggests the implementation of a SICN system based on the Extranet environment. The system is expected to be useful for both user classes and their on-line standardization activities. In the future, the system will be enhanced to incorporate pure multimedia system features such as Internet phones, collaborative document editing, and audio-visual conferencing, etc. For those who want to adapt this system to their own particular standardization environment, the API concept of generic functions is also available with this SICN system. When a full processing of on-line standardization is realized, the concept of the VSDO will be commonplace. The

VSDO is essentially a virtual standard development organization linked over a network; through which all users can access standards-related information and participate in all phases of standards development activities.

With regard to the related future work on VSDO, careful consideration should be given to IPR and copyright matters of standards resources in order to assure the widest possible application of on-line standards making environments [22].

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