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Information technology — User interfaces for mobile tools for management of database communications in a client-server model

Technologies de l'information — Interfaces utilisateur pour outils mobiles de gestion de communications des bases de données dans un modèle client-serveur

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 18021 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 35, *User interfaces.*

Annexes A to D of this International Standard are for information only.

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Introduction

In recent years, MoBile Tools (MBT), typically personal digital assistants (PDA), smart phones (mobile phones with web-browsing, e-mail, or some other network function) and other small size devices have become increasingly popular. MBT are constrained by requirements of low power consumption, small physical size, light weight, limited memory, low CPU processing power and restricted display screen size. To enable a variety of services and applications to be used comfortably and efficiently on hardware-restricted MBT, they are typically operated in conjunction with other devices via communication links. When the MBT works in conjunction with server machines or other computers, it becomes more powerful and more useful. Due to these restrictions, it is more difficult to achieve compatibility and interoperability than it would be in a large device. In order to achieve compatibility and interoperability, a different approach than that used for larger equipment is necessary.

When the MBT exchanges data (e.g. address data, schedule data, or sales data, etc.) with other devices via a potentially unreliable or narrow communication line, as in wireless communications, user interfaces for management of database communications of mobile tools are required to meet user's needs such as fast response, high usability, reliability and easy-to-use features. Standardizing these new user-interfaces will be very beneficial and convenient for MBT users.

A MoBile Tool client (MBT client) is defined as the software of an MBT that performs client operations with other devices via communication links. A MoBile Tool server (MBT server) is defined as the software of a device that acts as a server with the MBT client via a communication link. An MBT server can be run on a multi-accessible server or on another MBT. When an MBT client communicates with another MBT that has these MBT server capabilities, the former acts as the MBT client and the latter as the MBT server, thereby allowing them to operate together.

The MBT client typically has a small display screen, which provides the user interface that displays information and receive user instructions/input. The MBT client and the MBT server each have their own database. The user instructs/controls the database operation via the small display screen on the MBT client.

The following problems can occur with the utilization/operation of databases via communication links:

— There is the possibility that another device can operate the MBT client’s database or the MBT server’s database via communication links. The user needs to know in advance which operations will be executed or whether data in the MBT client’s database will be transmitted. However, there is no standard means to enable the user to prevent the update of the MBT client's database or the transmission of data from the MBT client's database without his approval. This creates a security problem.

— The connection, especially wireless, is sometimes broken. In this case, the user needs to know whether the MBT client’s database and/or the MBT server's database have been updated or not. There is no standard means for the user to receive feedback as to whether the MBT client's database has been successfully updated. For this is the reason feedback is required.

The purpose of this International Standard is to satisfy these user requirements. If user interfaces providing these functions are standardized, then the user can operate differing types of MBTs in a consistent manner.

This International Standard applies to smart phones, electronic organizers, PDAs, and palm sized personal computers. The adoption of this International Standard will improve compatibility, interoperability and user efficiency for database management.

Note: The principles described in ISO 9241-10 “Ergonomic requirements for office work with visual display terminals (VDTs) – Part 10: Dialogue principles” are of key importance for this International Standard.

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Information technology — User interfaces for mobile tools for management of database communications in a client-server model

1 Scope

This International Standard defines user interface functions for management of database communication of an MBT client capable of interchanging data with an MBT server.

This International Standard is applicable to MBT clients.

This International Standard specifically defines the following two user interfaces.

— The user interface function for obtaining user approval in advance when MBT client's database is updated via a communication link, or when data in the MBT client's database is transmitted to another database.

— The user interface function for providing feedback to the user, after the MBT client's or the MBT server's database has been updated via a communication link, or data in MBT client's database has been transmitted to another database.

2 Conformance

A system conforms to this International Standard if it provides the screen contents described in sub clause 5.2 before the MBT database operation is executed and the contents described in sub clause 5.3 or sub clause 5.4 after the MBT database operation has been executed.

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
feedback to the user (failure)
function of the user interface that displays information about an *MBT database operation* if and when the *MBT database operation* fails to execute

3.2
feedback to the user (success)
function of the user interface that displays information about an *MBT database operation* after the *MBT database operation* is successful

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3.3
consistent area
non-scrollable information area that is provided in a section of the *MBT*'s screen

3.4
MoBile Tool, MBT
mobile communications device with a small display screen and a database intended to interchange data with other devices / a server

Note: The screen size is typically between those of personal computers and mobile telephone devices.

3.5
MoBile Tool client, MBT client
software for *MBT*, which operates under user instruction as a client in a communication link with other devices

3.6
MoBile Tool database operation, MBT database operation
database operation executed by the *MBT server application*,

Note: Database operation includes the processes of adding, modifying, removing and reading data. Updating of database includes the processes of adding, modifying and removing data, but it doesn't include the process of reading data.

3.7
MoBile Tool database operation parameter, MBT database operation parameter
parameter used by the *MBT server application* to execute the *MBT database operation*

Example: When the user operates the schedule book, he specifies year, month, day and time as parameters; when he operates the address book, he specifies name, address, telephone number and E-mail address, and when he operates the inventory database, he specifies product code, customer name and number of stock.

3.8
MoBile Tool server, MBT server
software for a device that operates as a server with the *MBT client* via a communication link

3.9
MoBile Tool server application, MBT server application
application software on the *MBT server* that, at the request of the *MBT client*, executes an operation and feeds back the result of the operation to the *MBT client* via data interchange of any kind

3.10
screen content
information presented on physical display of an MBT

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3.11
user approval
function of the user interface by which the user grants permission to the *MBT server application* to update the *MBT client's database* or transmit data from the *MBT client's database* to the *MBT server* before the operation is executed

4 Illustration of processes for an MBT database operation

4.1 Functions of user interfaces

When an MBT database operation is executed, the MBT client provides a user interface, which displays information and receives user instructions/input.

The two functions available as part of the user interface for the MBT database operation are:

— User approval or disapproval.

— Feedback to the user.

4.1.1 User approval or disapproval

User approval or disapproval is necessary before the MBT database operation is executed. One screen content is provided for the user to give his approval or his disapproval for operations yet to be performed.

4.1.2 Feedback

Feedback to the user is provided after the MBT database operation has been executed. It provides two screen contents, one which displays information after the MBT database operation has been completed successfully, and the other which displays information if and when the MBT database operation fails to execute.

4.2 Sequence of functions

The screen content for input of user approval or disapproval is displayed before the MBT database operation is executed. If the user grants approval via this screen content, the MBT database operation is executed and the feedback screen content that corresponds to the result of the operation is displayed. If the user disapproves, the MBT database operation is not executed. However, the screen content for input of user approval or disapproval for the MBT database operation need not be displayed, if this MBT database operation only consists of updating the MBT server's database, and if neither the MBT client's database is updated nor data in the MBT client's database is transmitted.

The processes for MBT database operation are illustrated in Figure 1.

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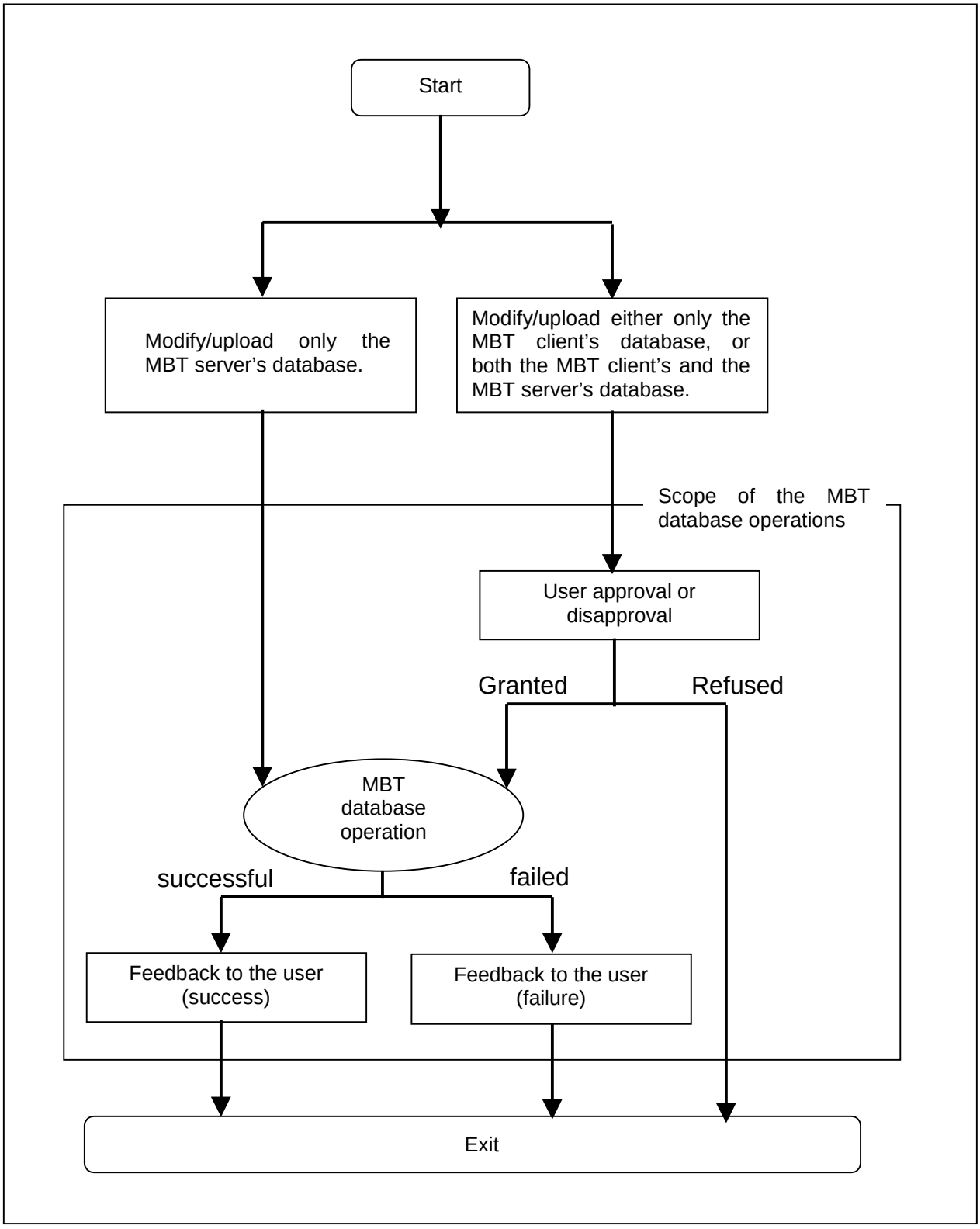

Figure 1 - Illustration of processes for MBT database operations

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5 Description of contents in MBT database operation screens

5.1 General

When the MBT database operation is executed, the MBT client shall provide the screen contents described in sub clauses 5.2, 5.3, and 5.4.

Regarding the support of cultural and linguistic adaptability requirements, message numbers specified in this standard shall be used to preserve data interoperability among applications in different natural languages. The messages may be modified or adapted in any natural language. However, the resulting changes shall respect the function defined in this clause to which the messages applies.

Communication between components (the MBT client and the MBT server) shall always use one of the message numbers.

Note: General messages of sample application corresponding to all example message numbers refer to Annex B. It is understood that in the future graphics, voice messages, sounds could be used as the representation for the user. Should it be the case, message numbers shall always be used for data interoperability between components (the MBT client and the MBT server).

The system should have the capability to disable the notification upon the request of the user.

5.2 User approval or disapproval

5.2.1 Prior notice

The MBT client shall inform the user in advance that

— the MBT database operation will be executed. (Note: Example message number 0100)

When appropriate, the MBT client shall inform the user in advance that

— the MBT client's database will be updated by the MBT server application. (Note: Example message number 0111)

— the MBT server's database will be updated by the MBT server application. (Note: Example message number 0121)

— data in the MBT client's database will be transmitted to the MBT server. (Note: Example message number 0131)

5.2.2 Granting or refusing approval

The MBT client shall provide an on-screen button, a fixed button outside of the display screen, or similar control as the means for:

— granting approval for the MBT server application to execute the MBT database operation,

— refusing approval for the MBT server application to execute the MBT database operation.

When the user grants approval, the MBT database operation shall be executed.

When the user refuses approval, the MBT database operation shall not be executed and another screen content shall be displayed.

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The MBT client shall ensure an exclusive choice between granting and refusing approval for an MBT database operation, by providing radio buttons, select buttons, or the like.

The buttons for granting and refusing approval for the MBT database operation should always be displayed on the screen in a consistent area without being removed by scrolling or any other navigation by the user. Those buttons should be laid out side by side.

5.2.3 Parameter setting

The MBT client may provide a text input area, check buttons, a selectable menu, or similar control, as the means for setting the MBT database operation parameters, if necessary for executing an MBT database operation. If the user sets those MBT database operation parameters, the parameters shall be used by the MBT server application to execute the corresponding MBT database operation. The means for setting the MBT database operation parameters should be displayed on the screen.

5.3 Feedback to the user (success)

5.3.1 Notice of successful completion

The MBT client shall inform the user that:

— the MBT database operation has been completed successfully. (Note: Example message number 0200).

When appropriate, the MBT client shall inform the user that:

— the MBT client's database has already been updated by the MBT server application. (Note: Example message number 0211).

— the MBT server's database has already been updated by the MBT server application. (Note: Example message number 0221).

— data in the MBT client's database has already been transmitted to the MBT server. (Note: Example message number 0231).

5.3.2 User acknowledgement of successful completion

The MBT client shall provide an on-screen button, a fixed button outside of the display screen, or similar control, as the means for acknowledging the successful completion of an MBT database operation.

After the user has acknowledged the successful completion of the operation, another screen content shall be displayed.

The button for acknowledging the successful completion of the MBT database operation should always be displayed on the screen in a consistent area without being removed by scrolling or any other navigation by the user.

5.4 Feedback to the user (failure)

5.4.1 General notice of failure

The MBT client shall inform the user:

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— that the MBT database operation has failed to execute. (Note: Example message number 0300).

When appropriate, the MBT client shall inform the user that:

— the MBT client's database has already been updated by the MBT server application. (Note: Example message number 0311),

— the MBT client's database has not been updated by the MBT server application. (Note: Example message number 0312),

— the MBT server's database has already been updated by the MBT server application. (Note: Example message number 0321),

— the MBT server's database has not been updated by the MBT server application. (Note: Example message number 0322),

— data in the MBT client's database has already been transmitted to the MBT server. (Note: Example message number 0331),

— data in the MBT client's database has not been transmitted to the MBT server. (Note: Example message number 0332).

5.4.2 Detailed reasons for failure

The MBT client should display the reason why the MBT database operation failed to execute. (Note: Example message numbers 1001, 1002, 1003)

5.4.3 Acknowledgement of failure

The MBT client shall provide an on-screen button, a fixed button outside of the display screen, or similar control as the means for acknowledging the failure of an MBT database operation.

When the user has acknowledged the failure of the operation, another screen content shall be displayed.

The button for acknowledging the failure of the MBT database operation should always be displayed on the screen in a consistent area without being removed by scrolling or any other navigation by the user.

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Annex A

(informative)

Utilization/operation of database of mobile tool

A.1 Utilization/operation of database

A.1.1 General

A user can utilize a database from an MBT client in the following three ways.

A.1.2 Utilization/operation of database (1)

This sub clause describes the stand-alone utilization/operation of the MBT client.

The user of the MBT client updates the MBT client's database without communicating with other devices. In this instance/situation, the MBT client accesses the local database only, as shown in Figure A.1.

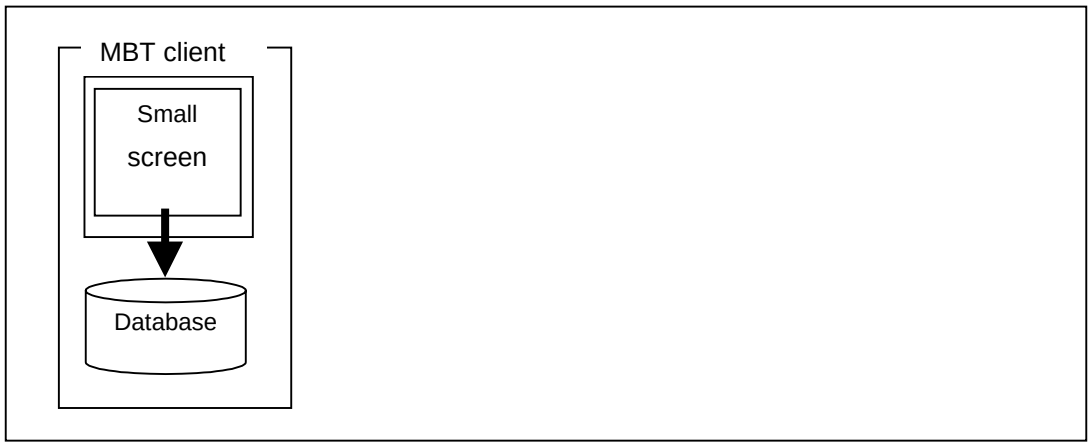

Figure A.1 - Database access by MBT client (1)

NOTE A database access that involves no communication links is outside of the scope defined in clause 1.

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A.1.3 Utilization/operation of database (2)

This sub clause describes the utilization/operation of the MBT server's database by the MBT client.

The user of the MBT client updates the MBT server's database via a communication link.

In this operation, the MBT client accesses the MBT server's database through the MBT server's application as shown in Figure A.2.

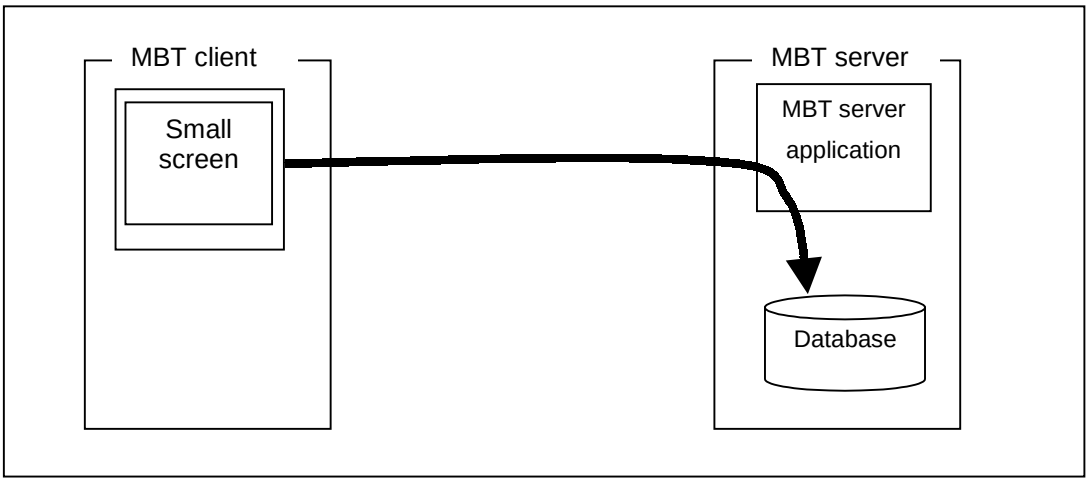

Figure A.2 - Database access by MBT client (2)

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A.1.4 Utilization/operation of database (3)

This sub clause describes the utilization/operation of the MBT client's database via the MBT server.

The user of the MBT client updates the MBT client's database by cooperating with the MBT server. In this operation, the MBT client accesses the MBT client's database through the MBT server's application, as shown in Figure A.3.

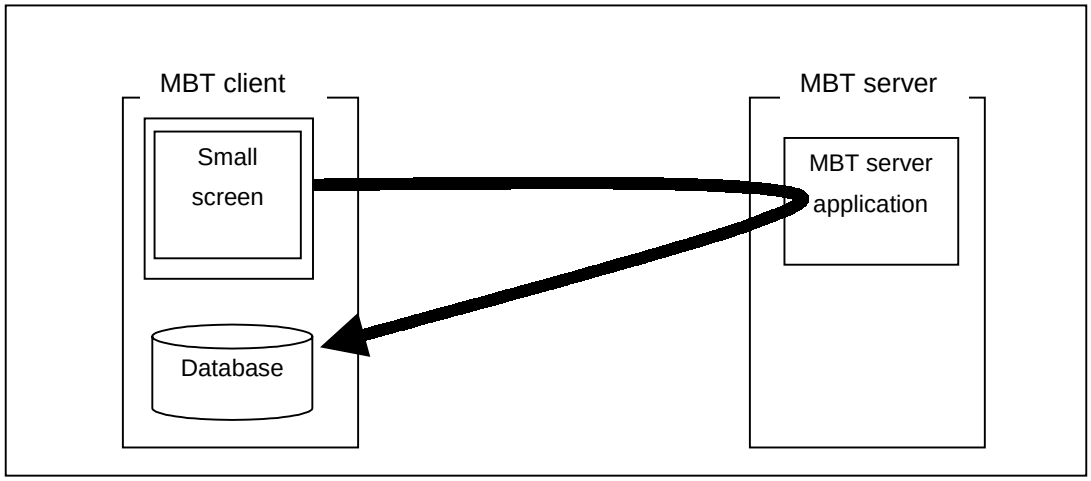

Figure A.3 - Database access by MBT client (3)

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A.2 Sample application utilizing database via communication links

The screen contents described in sub clauses 5.2, 5.3, and 5.4 provide users with a common user interface used, for example, to synchronize the database of a PDA with the database of an office server. The office database retains data for many users, typically address data, schedule data, or similar information. The user downloads data from the office server to his PDA's database before he leaves the office. When he returns to his office, he can update his PDA's database and the database in his office. The capability of synchronization allows the user to maintain the latest level of information both on the database of his PDA and the database in his office.

To synchronize the PDA's schedule book with the one on the office server, the software for the data synchronization of the MBT server application operates on both the MBT client's database and the one on the MBT server. Since the MBT client has limited memory and low CPU power, the execution of the software for the data synchronization on the MBT server is more efficient than the execution of it on the MBT client. The software for the data synchronization operates the MBT server's database as described in sub clause A.1.3, and it operates the MBT client's database as described in sub clause A.1.4. Figure A.4 is an example of the software for the data synchronization. In this case, the user on the MBT client gives only the "run" instruction to the software for the data synchronization on the MBT server, and cannot know which operations will be performed in advance and which operations have been performed following execution.

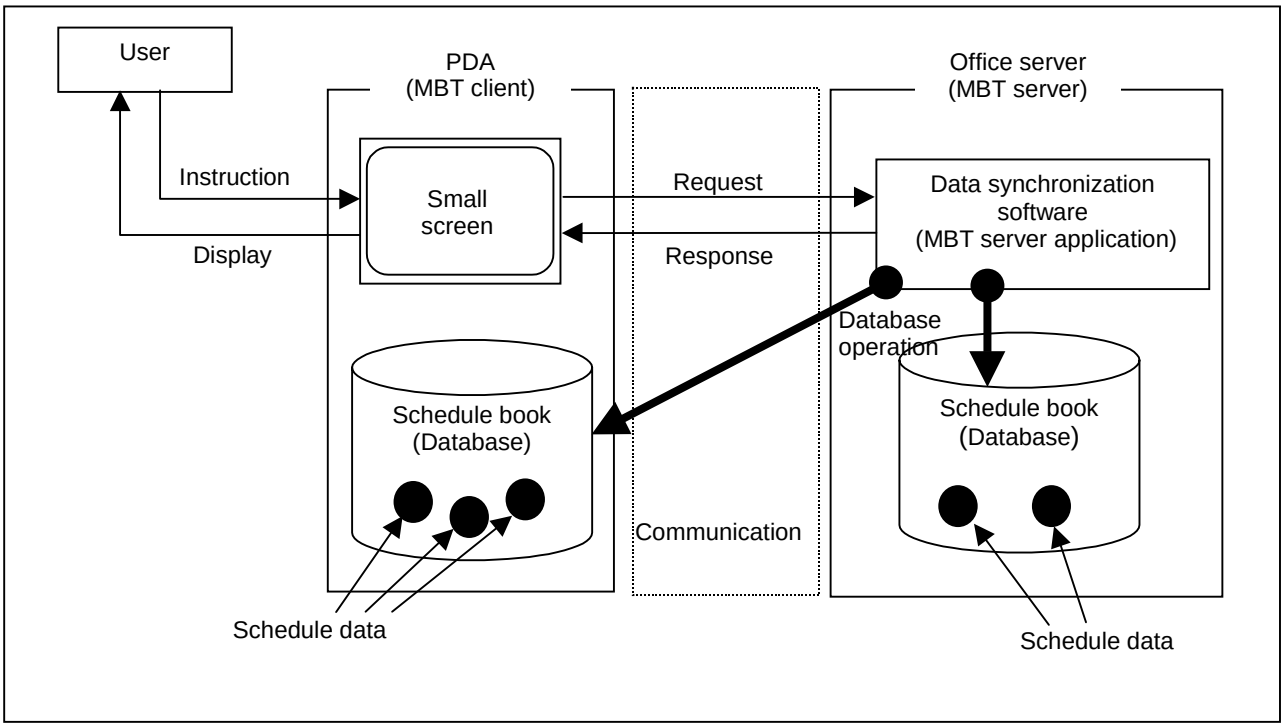

Figure A.4 - Example operational flow of MBT server application (Data synchronization software)

The screen contents described in sub clauses 5.2, 5.3, and 5.4 will enable the user to know the information on the MBT database operations and control its execution.

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Annex B
(informative)
Basic Screen Contents Presentation

B.1 User approval or disapproval

B.1.1 General

This sub clause provides an example of dialogue screen contents that is used to implement the functions defined in sub clause 5.2, as shown in Figure B.1.

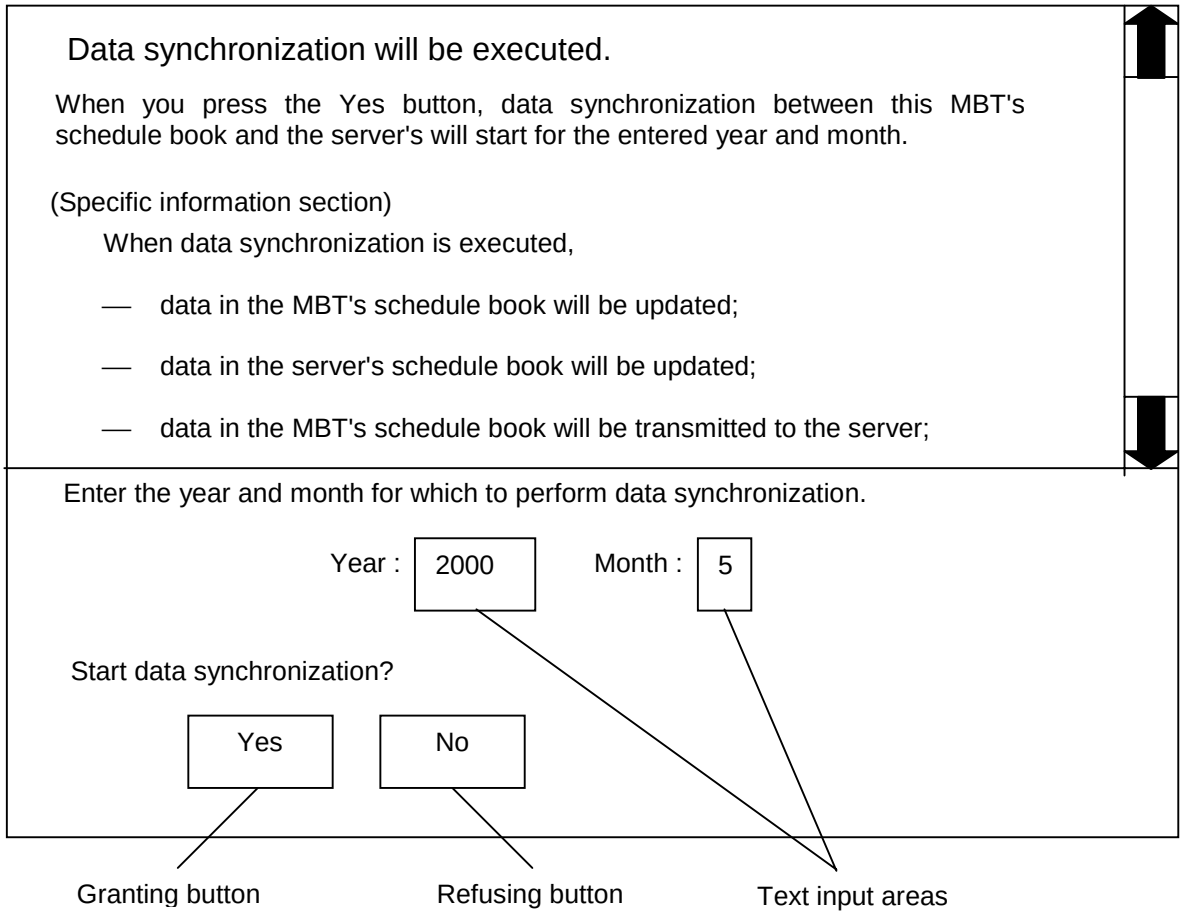

Figure B.1 - Example screen contents for user approval or disapproval

B.1.1 Prior notice

According to sub clause 5.2.1, some text messages are displayed in the above example.

The following text messages shown in Table B.1 are examples of prior notice for data synchronization. Each message corresponds to the example message number shown in sub clause 5.2.1, and message descriptions may be changed appropriately, adapted to applications and languages.

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Table B.1 - General messages of prior notice for data synchronization

Example message number	General message
0100	Data synchronization will be executed. / When you press the Yes button, data synchronization between this MBT's schedule book and the server's will start for the entered year and month.
0111	When data synchronization is executed, data in the MBT's schedule book will be updated.
0121	When data synchronization is executed, data in the server's schedule book will be updated.
0131	When data synchronization is executed, data in the MBT's schedule book will be transmitted to the server.

B.1.3 Granting and refusing approval

According to sub clause 5.2.2, in the above example,

— if the Yes button is pressed, the data synchronization performed by the MBT server application should *be executed.*

— if the No button is pressed, the data synchronization performed by the MBT server application is not to be executed, and another screen content should be displayed.

The Yes and No buttons should be laid out in a consistent area, and the user is prevented from pressing both the Yes and No buttons at the same time, in the above example.

B.1.4 Parameter setting

According to sub clause 5.2.3, the text input areas in which the year and month for data synchronization are provided in a consistent area that is not removed by scrolling in the above example.

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B.2 Feedback to the user (success)

B.2.1 General

This sub clause provides an example of dialogue screen contents that is used to implement the functions defined in sub clause 5.3, as shown in Figure B.2.

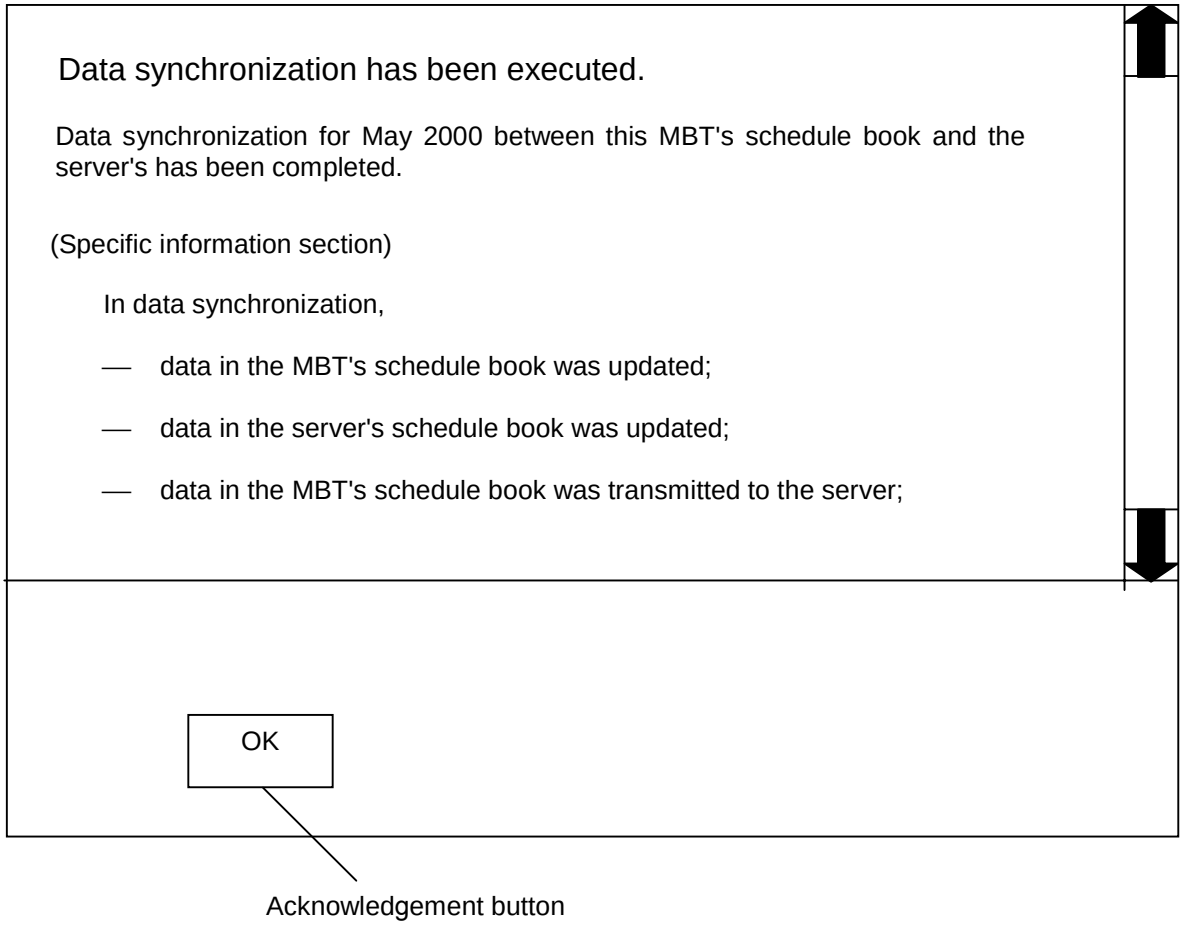

Figure B.2 - Example screen contents for feedback to the user (successful completion)

B.2.2 Notice of successful completion

According to sub clause 5.3.1, text messages are displayed in the above example.

The following text messages shown in Table B.2 are examples of notice of successful completion for data synchronization. Each message corresponds to the example message number shown in sub clause 5.3.1, and message descriptions may be changed appropriately, adapted to applications and languages.

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Table B.2 - General messages of notice of successful completion for data synchronization

Example message number	General message
0200	Data synchronization has been executed. / Data synchronization for May 2000 between this MBT's schedule book and the server's has been completed.
0211	In data synchronization, data in the MBT's schedule book was updated.
0221	In data synchronization, data in the server's schedule book was updated.
0231	In data synchronization, data in the MBT's schedule book was transmitted to the server.

B.2.3 User acknowledgement of successful completion

According to sub clause 5.3.2, in the above example, if the OK button is pressed, another screen content should be displayed.

The OK button should be presented in a consistent area in the above example.

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B.3 Feedback to the user (failure)

B.3.1 General

This sub clause provides an example of dialogue screen contents that is used to implement the functions defined in sub clause 5.4, as shown in Figure B.3.

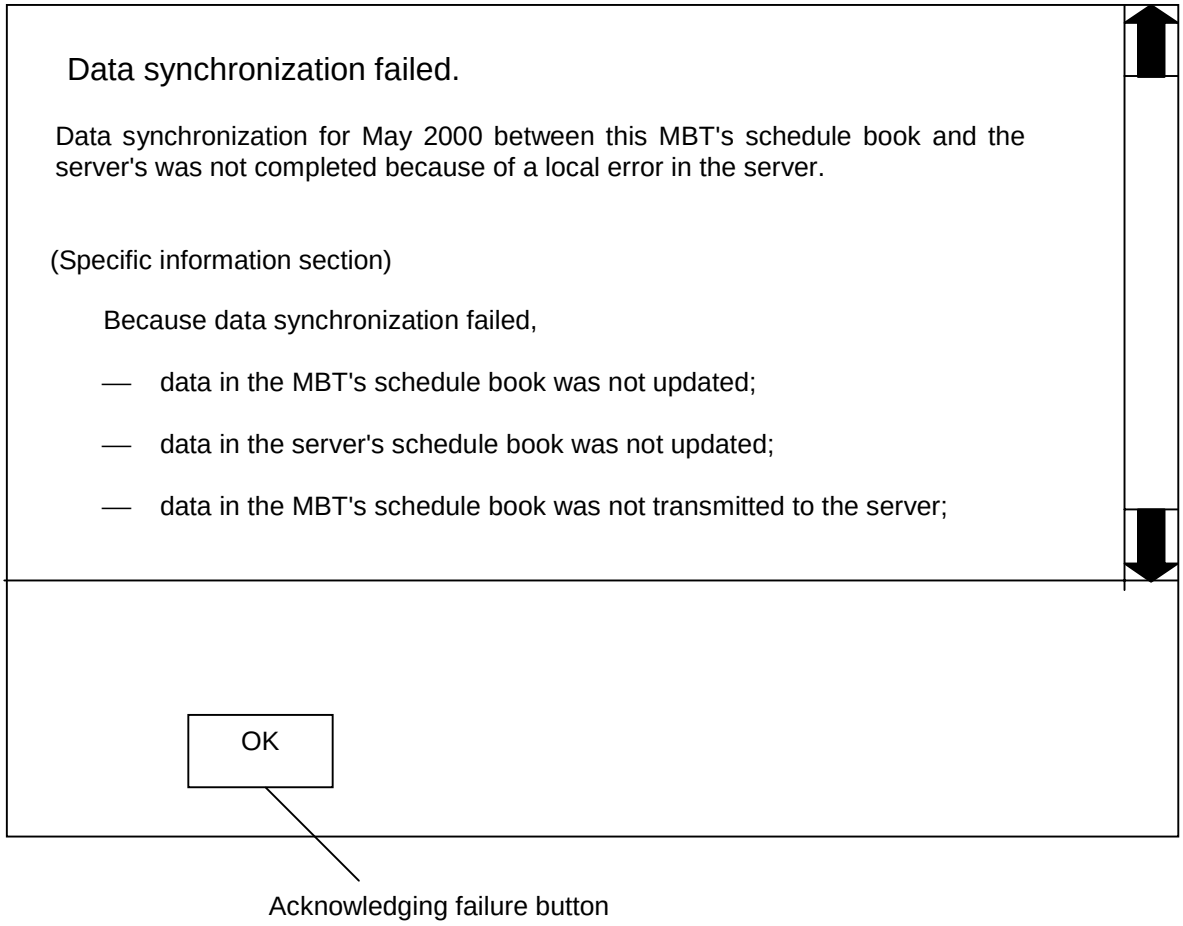

Figure B.3 - Example screen contents for feedback to the user (failure)

B.3.2 General notice of failure

According to sub clause 5.4.1, text messages are displayed in the above example.

The following text messages shown in Table B.3 are examples of general notice of failure for data synchronization. Each message corresponds to the example message number shown in sub clause 5.4.1, and message descriptions may be changed appropriately, adapted to applications and languages.

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Table B.3 - General messages of general notice of failure for data synchronization

Example message number	General message
0300	Data synchronization failed. / Data synchronization for May 2000 between this MBT's schedule book and the server's was not completed.
0311	Though data synchronization failed, data in the MBT's schedule book was already updated.
0312	Because data synchronization failed, data in the MBT's schedule book was not updated.
0321	Though data synchronization failed, data in the server's schedule book was already updated.
0322	Because data synchronization failed, data in the server's schedule book was not updated.
0331	Though data synchronization failed, data in the MBT's schedule book was already transmitted to the server.
0332	Because data synchronization failed, data in the MBT's schedule book was not transmitted to the server.

B.3.3 Detailed reasons for failure

According to sub clause 5.4.2, some text messages are displayed in the above example.

The following text messages shown in Table B.4 are examples of detailed reasons for failure for data synchronization. Each message corresponds to the example message number shown in sub clause 5.4.2, and message descriptions may be changed appropriately, adapted to applications and languages.

Table B.4 - General message of detailed reasons for failure for data synchronization

Example message number	General message
1001	Failed because of a local error in the server.
1002	Failed because of a transmission error.
1003	Failed for unknown reason.

B.3.4 Acknowledgement of failure

According to sub clause 5.4.3, in the above example, if the OK button is pressed, another screen content should be displayed.

The OK button should be presented in a consistent area in the above example.

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Annex C

(informative)

Technical information: PDX tags as a screen content description language

C.1 Overview of PDX tags

A screen content description language enables the MBT server application to arrange the screen contents of the MBT client. HTML (HyperText Markup Language) is commonly used to describe the format of a screen content. However HTML doesn't have all the tags that are needed to form the screen contents written in sub clauses 5.2, 5.3, and 5.4.

An example of a screen content description language with all the needed tags is PDX[C.1]. PDX tags used with HTML tags provide the following three functions for which the MBT server application is able to control resources of the MBT client. PDX tags provide the MBT server application the means to utilize/operate the MBT client's database by using P4script commands.

— PDX tags can reference the URL of the P4script file containing the P4script command, and the MBT server application makes the MBT client get the P4script command and execute it for utilizing/operating the MBT client's database.

— PDX tags can describe how to lay out components suitable for a small screen and then send the output to the screen.

— PDX tags can describe how to control access under the limited resources of the MBT client.

C.2 Sample program scripts written by using PDX tags with HTML tags

C.2.1 General

This sub clause shows sample program scripts written by using PDX tags with HTML tags, which determines the arrangement of the screen contents of the MBT client.

[C.1] The full/detailed information about PDX tags is given by referring to the following URL:

http://www.jbma.or.jp/~isoiec/sc35/wg4/project18021.htm

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C.2.2 User approval or disapproval

The sample program script shown in Figure C.1 can be used for determining the arrangement of the screen contents described in Figure B.1.

```
<HTML>
<HEAD>
   <TITLE>User approval or disapproval</TITLE>
   <PDXSETCONSISTENTAREA SIZE="40%" ALIGN="bottom">
</HEAD>
<BODY>
 <H3>Data synchronization will be executed.</H3><P>
 <PDXVSPACE SIZE="10P">
  When you press the Yes button, data synchronization between this MBT's schedule book and the server's
 will start for the entered year and month.<P>
 <PDXVSPACE SIZE="5P">
 (Specific information section)
 <DL>
  <DT>When data synchronization is executed,
  <DD> - data in the MBT's schedule book will be updated;
  <DD> - data in the server's schedule book will be updated;
  <DD> - data in the MBT's schedule book will be transmitted to the server;
 </DL>

 <PDXCONSISTENTAREA>
  <FORM ACTION="http://www.domain.name/dir/synchronization.cgi"
       METHOD="post">
   Enter the year and month for which to perform data synchronization.<P>
   <PDXTABAREA TAB1="20%" TAB2="50%">
    <PDXTAB>Year:
    <PDXTAB><INPUT TYPE="p4text" NAME="year" VALUE="2000"><P>
    <PDXTAB>Month:
    <PDXTAB><INPUT TYPE="p4text" NAME="month" VALUE="5">
   </PDXTABAREA>
   <PDXVSPACE SIZE="5P">
   Start data synchronization?<P>
   <PDXTABAREA TAB1="10%" TAB2="25%">
    <PDXTAB><INPUT TYPE=submit VALUE=Yes>
         <INPUT TYPE="hidden" NAME="result" P4SCRIPT="p4form.p4">
    <PDXTAB><A HREF="cancel.html">No</A>
   </PDXTABAREA>
  </FORM>
 </PDXCONSISTENTAREA>
</BODY>
</HEAD>
```

Figure C.1 - Sample program script for user approval or disapproval

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C.2.3 Feedback to the user (success)

The sample program script shown in Figure C.2 can be used for determining the arrangement of the screen contents described in Figure B.2.

```
<HTML>
<HEAD>
   <TITLE>Feedback to the user (success)</TITLE>
   <PDXSETCONSISTENTAREA SIZE="25%" ALIGN="bottom">
</HEAD>
<BODY>
  <H3>Data synchronization has been executed.</H3><P>
  <PDXVSPACE SIZE="10P">
  Data synchronization for May 2000 between this MBT's schedule book and the server's has been completed.<P>
  <PDXVSPACE SIZE="5P">
  (Specific information section)
  <DL>
    <DT>In data synchronization,
    <DD> - data in the MBT's schedule book was updated;
    <DD> - the data in the server's schedule book was updated;
    <DD> -  the data in the MBT's schedule book was transmitted to the server;
  </DL>

  <PDXCONSISTENTAREA>
    <PDXTABAREA TAB1="20%">
      <PDXTAB><A HREF="accept.html">OK</A>
    </PDXTABAREA>
  </PDXCONSISTENTAREA>
</BODY>
</HEAD>
```

Figure C.2 - Sample program script for feedback to the user (success)

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C.2.4 Feedback to the user (failure)

The sample program script shown in Figure C.3 can be used for determining the arrangement of the screen contents described in Figure B.3.

```
<HTML>
<HEAD>
   <TITLE>Feedback to the user (failure)</TITLE>
   <PDXSETCONSISTENTAREA SIZE="25%" ALIGN="bottom">
</HEAD>
<BODY>
 <H3>Data synchronization failed.</H3><P>
 <PDXVSPACE SIZE="10P">
 Data synchronization for May 2000 between this MBT's schedule book and the server's was not completed
 because of a local error in the server. <P>
 <PDXVSPACE SIZE="5P">
 (Specific information section)
 <DL>
  <DT>Because data synchronization failed,
  <DD> - data in the MBT's schedule book was not updated;
  <DD> - data in the server's schedule book was not updated;
  <DD> - data in the MBT's schedule book was not transmitted to the server;
 </DL>

 <PDXCONSISTENTAREA>
  <PDXTABAREA TAB1="20%">
   <PDXTAB><A HREF="confirm.html">OK</A>
  </PDXTABAREA>
 </PDXCONSISTENTAREA>
</BODY>
</HEAD>
```

Figure C.3 - Sample program script for feedback to the user (failure)

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Annex D

(Informative)

Technical information: P4script as a database operation language

D.1 Overview of P4script

A data operation language enables the MBT server application to utilize/operate the MBT client's database. P4script[D.1] is one of the data operation languages having similar characteristics to those of the Fourth(=4th) language. Its language model is a stack machine, its formula is in the Reverse Polish Notation, and this language is expressed by using only ASCII codes. P4script has three data types: number, character string, and list.

In P4script, 56 database commands for operating database are defined, as well as commands for calculating numbers, handling data, operating stack machine, controlling syntax, or outputting result. Database operation commands operate a DB as an abstract structure of the database.

D.2 Sample command written by using P4script language

This clause shows a sample command and a sample execution result written by using P4script language, which utilizes/operates the MBT client's database.

The sample P4script command shown in Figure D.1 can be used for executing the part of processes of data synchronization as the MBT server application. This P4script command is contained in the file named as “p4form.p4” used in Figure C.1. When the user presses the “Yes” button after he/she specifies parameters of year and month described in Figure B.1, this P4script command searches matched schedule data in the MBT’s schedule book.

```
$year $string! $month Sl $lm! $lm 1 = Ct { $string "0" Sa T } C $string $month Sa T 1
$string Li $slist! $slist ("^=") Lp T 1 $slist Li $mlist! $mlist ("TIME" "ACSString") Lp T
1 !dh 4096 Dfo $fh! De Cp . Q C $fh $mlist () Dq $lh! De Cp . Q C 0 . $lh 0 = Ct { 0 .
} Ce { $lh Dfz . Ib { $lh .dr } Iw $lh Dfc } C $fh Dfc
```

Figure D.1 - The sample P4script command

[D.1] The full/detailed information about P4script is given by referring to the following URL:

http://www.jbma.or.jp/~isoiec/sc35/wg4/project18021.htm

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After the P4script command shown in Figure D.1, the P4script execution result is sent to the server machine. The sample P4script execution result shown in Figure D.2 contains two matched schedule data and the machine can reference the execution result with the name “result”.

```
result=0+2+((“SCRT” 9 2 ”0”)(“LMTM” 6 15 ”20000416081446”)(“TIME” 7 10 (“20000511”””))(“MEMO” 1 8 ”Meeting”)(“ALON” 9 2 ”0”))+((“SCRT” 9 2 ”0”)(“LMTM” 6 15 ”20000418051848”)(“TIME” 7 10 (“20000512”””))(“MEMO" 1 14 ” Business trip”)(“ALON” 9 2 ”0”))
```

Figure D.2 - The sample P4script execution result

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