SyncML

Design and Implementation of SyncML Data Synchronization System based on Session Manager

*　　　　　　　*　　　　　　1**　　　　　　**　　　　2**
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PDA,　　　　,　　,
(synchronization)　　　　. 2000　12　　　　,　　　, IBM
.　　　　　　　　SyncML　　　　　　　PIMS(Personal Information
Management System)　　　　　　　　　.
,　　　　　　SyncML　　　　　　.
PIMS
.　　　　　　　　　　　　　　　　　　　　　　,
.

: ,　　　　　,　　　　,

Abstract : Synchronization is the process of making replicated data on multiple devices be consistent, i.e., identical with each other. In Dec. 2000, major handheld computer manufacturers including Nokia, Ericsson, IBM published the SyncML protocol specification. In this paper, we describe the CNU SyncML server for PIMS(Personal Information Management System) service that we developed based on the SyncML specification. The server architecture and capabilities of the frames are presented along with the procedure of message processing by each frame. We put the CNU SyncML server to the conformance tests and interoperability tests to confirm its functionality. The session managing mechanism of the CNU SyncML server showed better performance than our previous implementations.

Key Words : SyncML(Synchronization Markup Language), PIMS, Data Synchronization Server, Session Manager

1.

(Internet)　　　　　　,　　　　　　　　(ISP, Internet Service
Provider)　　　　　　　　　　　　　　　.　　,　　　　　　　　(PIMS : Personal
Information Management System)　　　　　　　　　　　　　　　　　　,

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,

.

SyncML client   SyncML server

SyncML message(s)

Response(s) to messages

[1] SyncML

,
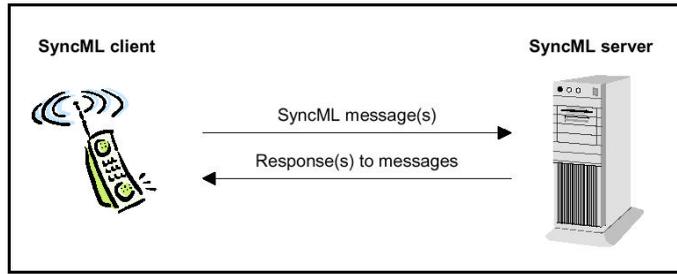
(synchronization)   ,   PDA(Personal Data Assistant)

[1,2].

[1]

	( )
Palm Computing	Hot Sync
Compaq	ActiveSync .
Starfish	StarTAC Mobile Organizer .
Synchrologic	4 . ✍ RealSync Server: PDA Email PIM ✍ Mobile Data Synchronization : ✍ Mobile Systems Management : ✍ Mobile File Distribution :

[1]   ,

.   ,   2000 2

IBM, Lotus, Motorola, Nokia, Palm, Psion, Starfish Software   SyncML(Synchronization Markup

Language)   [1]. SyncML   ,   ,

        , 2000 12 SyncML   1.0   1.0.1   .

 SyncML   600   ,   SyncML

       20   [2].

    SyncML 1.0.1

      .   SyncML   ,

,

.

,

.

. 2   SyncML   , 3

. 4   . 5

                                                        .

2. SyncML

                                                                                                . SyncML

          /   ,   [3].

SyncML   (Representation)   [4],

          (Synchronization)   [5],   [6]   .

SyncML   HTTP, WSP(Wireless Session Protocol), OBEX(OBject EXchange

Protocol)   , SyncML

                              .

                              .

2.1 SyncML

SyncML   (Data Representation Protocol)   ,   ,

                                              XML(Extensible Markup Language)   DTD(Document Type Definition)

          SyncML   [4,7].   XML

                        WBXML(Wireless Binary XML)   .
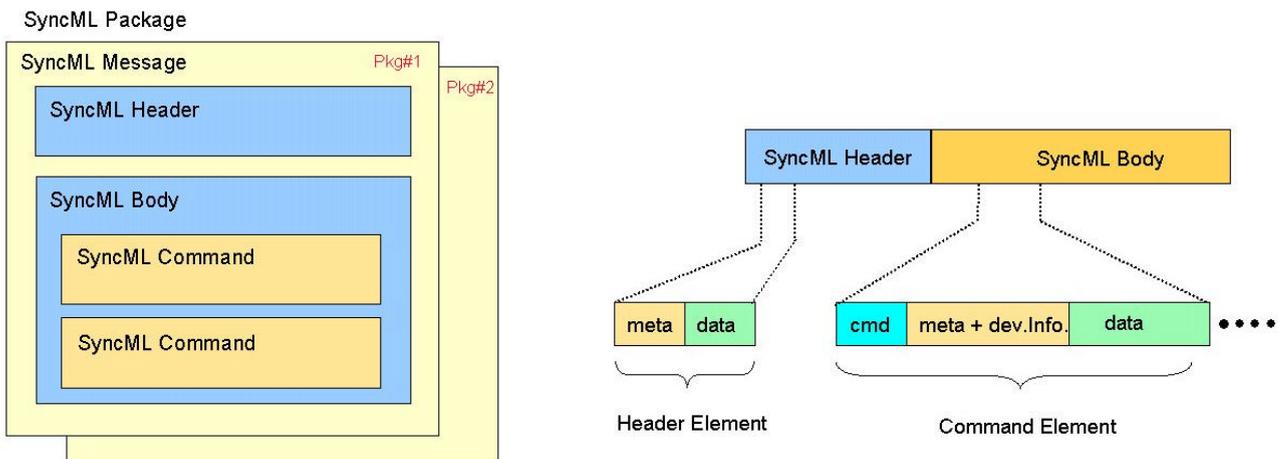
[2] SyncML

SyncML

          [2]   [8].   (SyncHdr)

      (SyncBody)   , [2]   5   SyncML   .   SyncML

            .

          .

[2] SyncML

		SyncML
		Archive, Chal, Cmd, Final, Lang, LocName, LocURI, MsgID, NoResp, NoResults, RespURI, SessionID, Source, Target
		SyncML
		SyncML, SyncHdr, SyncBody
		SyncML
		Data, Item, Meta
		Status
		Status
		SyncML Body
		Add, Alert, Atomic, Copy, Delete, Exec, Get, Map, MapItem, Put, Replace, Results, Search, Sequence, Sync

2.2 SyncML

SyncML   ,   ,   , SyncML

                                         [5].   SyncML   ,

                                                    SyncML

                            . SyncML   ,   ,   ,

                        DTD(Document Type Definition)   SyncML   ,

7   .

    ✍✍ Two-way Synchronization

                            , SyncML   .

    ✍✍ Slow Sync

                                                                                                        .

                        ,   .

    ✍✍ One-way Synchronization from Client Only

  SyncML   SyncML   ,

                        .

    ✍✍ Refresh Sync from Client Only

  SyncML   SyncML   ,

                        .

    ✍✍ One-way Synchronization from Server Only

  SyncML   SyncML   ,

                    .

    ✍✍ Refresh Sync from Server Only

  SyncML   SyncML   ,

                        .

✍✍ Server Alerted Sync

        6   ,

                                                 .

                                   .

3.

[3]   SyncML   .   ,

                          (Server Application)   ,

                    (Sync Adapter)   . SyncML   (Toolkit)   ,

            . Sync Agent   SyncML

       , Sync Engine   Sync Agent

        .   . Session Manager

                                          , Open DB Interface

                            .   (DLL)   ,

     HTTP   , DLL   JNI(Java Native Interface)   [9,10].

[3]

3.1 Sync Agent

Sync Agent   . ,   MIME

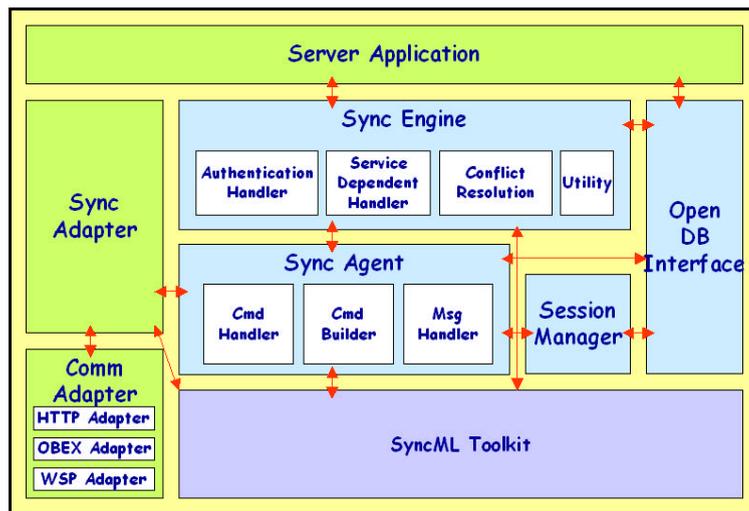   ,   . Sync

Agent   (parser)   ,   (Add),

    (Replace),   (Delete)   .   Sync Agent

                 . Sync Agent   Command Handler, Command Builder, Message Handler   3

            .

3.1.1 Command Handler

Command Handler   Sync

Engine   Open DB Interface, Session Manager

               .   Command Handler   .

3.1.2 Command Builder

Command Builder   ,

               .

3.1.3 Message Handler

Message Handler   ,

               .   Add, Replace,

Delete   Sync, Atomic, Sequence   .

Message Handler   ,

Request   .   Command Handler   SyncML

            Message Handler   , SyncBody

                                                               .

3.2 Sync Engine

Sync Engine   Service Dependent Handler, Conflict Resolution, Authentication Handler, Utility   4   .

3.2.1 Service Dependent Handler

SyncML   ,   ,   ,   .

      SyncML   , SyncML

                              .

                              ,   .

3.2.2 Conflict Resolution

                                                            ,   .

            ,

               .   (temporal conflict)   (semantic conflict)   [10].

         ,   .

                                    ,   .

3.2.3 Authentication Handler

SyncML   .

            SyncML   Basic   MD5   ,   .

                              .

3.2.4 Utility

                                                                                                                    .

,   .

Utility   .

3.3 Session Manager

SyncML   DLL

.

Session Manager   .

,   ,   Status   , Results

.

Session Manager   DLL   .   I/O

.   Session

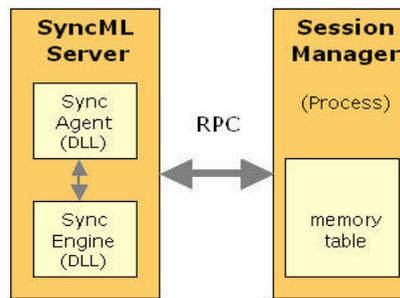Manager   . Session Manager

, RPC(Remote Procedure Call)   SyncML   [11]. [4]   RPC

SyncML   .

[4] RPC   SyncML

3.4   (ODBI)

,   PIMS (Personal Information Management System)

. PIMS

Open DB Interface   .   (contents)

"SYNC"   ,   .

[3]

ADDRESSBOOK, CALENDAR	PIMS
MAPINFO	
CHANGELOG	
ANCHOR	SyncML
USERINFO	(URI, Credential, Nonce)
NONCEPERDB	MimeType Nonce

7

3.5

SyncML   Windows 2000,   8i

              .   Visual C++ 6.0   ,   5   DLL   .   HTTP

                                    1.3.12   ,   Tomcat 3.0
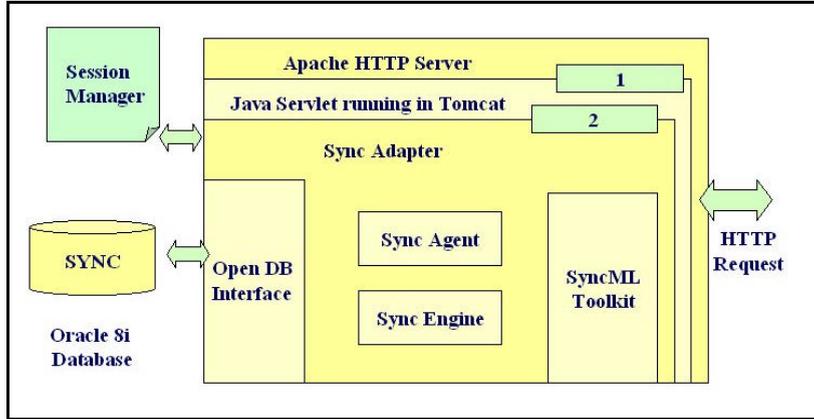
          Java Class   ,   Sync Agent   JNI(Java Native Interface)   [9].

[5] SyncML

3.6   SyncML

            SyncML   ,   PIMS   .

                                                            .

(1)   /   /

(2)   (2-way Sync)   .

(3)   DBAdapter   /   /   .

(4)   DBAdapter   SyncML   .

(5)   .

(6)   ,

(7)   Command Handler   ,   , Session Manager   ,

                        Sync Engine   Service Dependent Handler   .

(8) Service Dependent Handler   Open DB

                .   (conflict)   .

(9)   ChangeLog   .

(10)   Status   .

(11)   ChangeLog   /   /   .

(12) Map   , ChangeLog   .

(13)   SyncML   .

(14)   .

(15)   , ChangeLog   .

(16)   SyncML   Status   .
              ,   Map   .
(17)   Map   ,   Map   , ChangeLog   Status
              .

USERINFO 테이블		
User ID	Device ID	...
jylee	1	...
jylee	2	...

CHANGELOG 테이블					
User ID	Device ID	DB ID	GUID	Action Flag	Origin GUID
jylee	2	A	10052	R	
jylee	2	A	10053	A	
jylee	2	C	10030	C	10025

[6] Change Log Information

[6]   USERINFO   "jylee"   2   ,   2
         GUID   (R),   . [7]   SyncML   GUID   LUID
              . SyncML   Anchor
     [3]. Anchor   ISO 8601   UTC (Universal Time, Coordinated)
   [5],   Anchor   .   ,
                                                                        Anchor
Anchor   ,   (Slow
Sync)   .

Client Device			
Client Database:			
LUID		**Data**	
11		Car	
22		Bike	
33		Truck	
44		Shoes	

Server Device		
Server Database:		
GUID	**Data**	
1010101	Car	
2121212	Bike	
3232323	Truck	
4343434	Shoes	
Server Mapping Database:		
GUID	**LUID**	
1010101	11	
2121212	22	
3232323	33	
4343434	44	

[7]

4.

                                                                  (Conformance Test)   (Interoperability Test)
                   .   SyncML   SIC(SyncML Interoperability
Committee)
                                        . [8]   SyncML   [1]. SyncML
          SIC   SICS(SyncML Implementation Conformance Statement)   12
              SICS   .

Two-way with Client & Empty Server		
Two-way with Client Add & Server Add		
Two-way with Client Replace & Server Replace		
Two-way with Client delete & Server Delete		
Two-way with Client Add (shows empty server sync data)		
Two-way with Server Add (shows empty client sync data)		
Two-way with Server with large amount of data (shows multiple message)		
Two-way with Client with large amount of data (shows multiple message)		
Two-way with Server responding busy		
Two-way with Server not responding		
Two-way with Communication broken during sync		
Two-way Slow Sync		
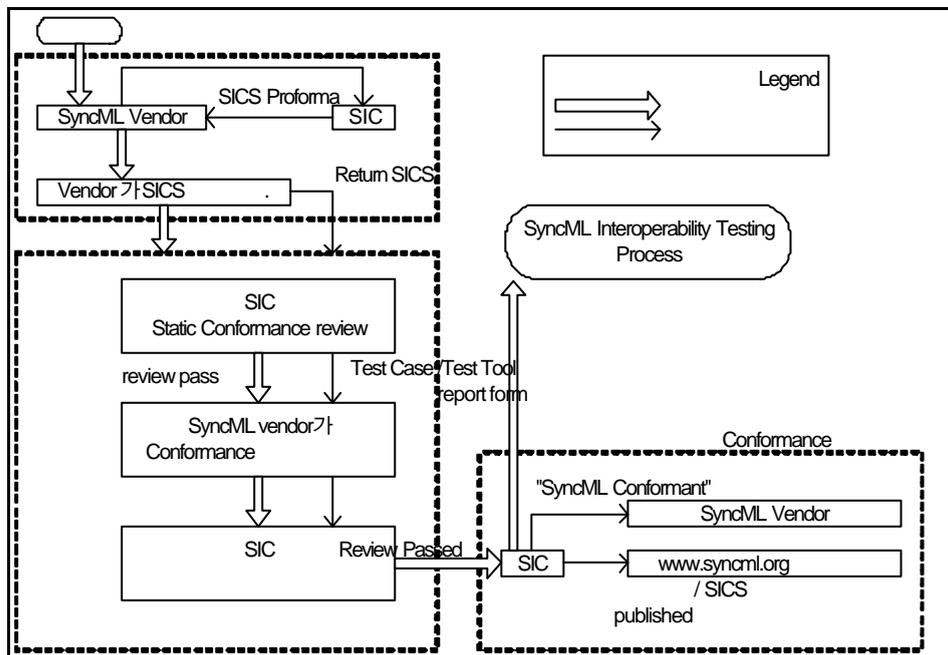
[8] SyncML

SyncML   (Interoperability Test)   SyncML Conformance   SyncFest   SyncML

                              .   SyncFest   ,   SyncFest

10

5.

　　　　CNU　SyncML　Server　　　　　　　　　　　　　　　　　　　　　　[　　5]　　　　　　　　　　　　　　　　　　　　　.

SyncML　　　　　　　　　　　　　　　　　　　　　　　CNU SyncML Server 2.0, CNU SyncML Server 3.0, CNU SyncML

Server 3.1　　　　　　　　　　　　　　　　. CNU SyncML Server 2.0　　Session Manager　　　　　　　　　　　　　　　　　　　,

　　　　　　　　　　　　　　　　　. CNU SyncML Server 3.0　　Session Manager

　　　　　　　　,

　　　　　　　　　　　. 　　　　　　, CNU SyncML Server 3.1　　Session Manager

　　　　　　　　　.

　　　　　　　　.　　,　　　　　　　　　　　　　　　　　　　　　　　　　　　　.　　　　　　　　　　　　　　　　　ADD,

REPLACE, DELETE　　　　　　　　,　　　　　　　　　　　　　　　PUT, GET　　　　,　　　　　　　　　　　　　　　　　.

[　　5]

	10
	2
	Two-way Sync
	Slow Sync
	One-way Sync from Client
	One-way Sync from Server
	Refresh Sync from Client only
	Refresh Sync from Server only
	500

[　　9]　　CNU SyncML Server　　　　　　　　　　　　　　　　　　　　　　　. CNU SyncML Server 3.1　　Session Manager

　　　　　　,　　　　　　　　　　　　　　,　　　　　,

　　　　　　　　Server 2.0　　　　　　　　　44% , CNU SyncML Server 3.0　　　　　　　　　　　　31%

　　　　　　.
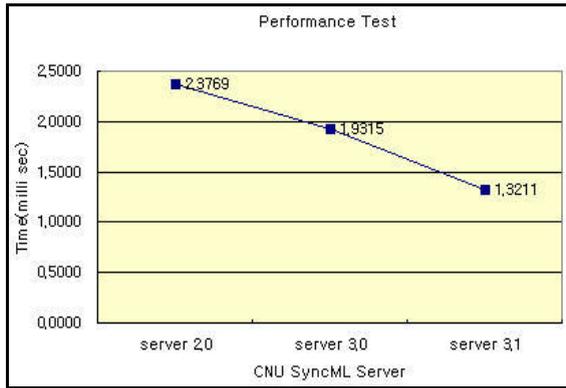
[9] CNU SyncML Server

SyncML Server   ,

                           .   ,

                                      ,

             ,

                     . CNU SyncML Server 3.1   Session Manager

      ,   .

6.

                                                                    ,   SyncML

             .   SyncML   SyncML   5

             .   SyncML   ,

                                      .   Sync Agent   Sync Engine

                                                                    ,

                                                                                  . Sync Engine

                                      ,   ,   Session

Manager   ,

             ,   ,   .

             SyncML

                                      .   C++

                              .

                                      ,   ,   .

7.

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[6] SyncML Initiative, SyncML HTTP Binding, version 1.0.1, June 15,2001

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    Jan, 2002

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    China, Oct.29, 2002

:
1990   2 :
1992   2 :
1992   2 ~   :
2000   12 :
        :   ,   ,

:
1984   2 :
1986   2 :
1996   2 :
1986   2 ~   :
        :   ,   ,   ,

:   (   )
1983   2 :
1990   12 :   Duke University
1993   5 :   Duke University

1983   ~1996 :
1996   ~   :
2000   :   NIST(National Institute of Standards and Technologies)
        :   ,   , Fault-tolerant

:
2000   2 :
2002   2 :
2002   2 ~   :
        :   ,

:
2000   2 :
2002   2 :
2002   2 ~   :
        :   ,