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Chapter 1

Mnesia_Session User’s Guide

1.1 Introduction

This book describes Mnesia_Session. It is an interface to the Mnesia Database Management System and is a part of the Erlang/OTP, which is a control system platform for building telecommunications applications.

Mnesia is written in Erlang and is intended for use in conjunction with Erlang applications. The Mnesia_Session application enables access to the Mnesia DBMS from foreign programming languages (i.e. other languages than Erlang). The Mnesia_Session interface is defined in IDL (an Interface Definition Language standardized by OMG (the Object Management Group)). Access is enabled via the following protocols:

- IIOP (Internet Inter ORB Protocol) standardized by OMG.
- the proprietary distribution protocol of Erlang Erl_Interface.

Details of these features are described in the following sections.

1.1.1 Scope and Purpose

This manual is included in the OTP document set. It describes the syntax, but not the semantics, of how Mnesia is accessed via the Mnesia_Session interfaces. Programming constructs are described, and numerous programming examples are included to illustrate the use of Mnesia_Session.

1.1.2 Pre-requisites

Readers of this manual are assumed to be familiar with system development principles and database management systems. Readers are also assumed to be familiar with the Erlang programming language in general and the Mnesia, Orber and IC applications in particular.
1.2 Overview

1.2.1 Interfaces

The interfaces of the Mnesia Session application are defined in IDL (Interface Definition Language). The IDL module mnesia consists of two interfaces:

- The connector (and possibly corba_connector) is started statically when starting the Mnesia Session application.
- The session (and corba_session) which is started dynamically at the request of a client.

When a Mnesia Session client needs to access the Mnesia DBMS it locates a connector on some Erlang node and starts a session there by applying the connect function on the connector.

Once the client has started a session it may use it to perform various Mnesia functions. The functions are performed locally on the Erlang node where the session resides. Most of Mnesia's functions have location transparent behavior, but some of them (e.g. start/0) do not.

The Mnesia Session interfaces makes it possible to access the administration and dirty functionality of Mnesia. To use transactions and/or Memosyne queries it is up to the user to define the needed interface in IDL. Implementing a user specified interface allows an opportunity to skip the general handling of erlang::term, which can sometimes be troublesome when using foreign languages, for both mnesia_session and the mnesia_corba_session.

See the IDL specification [page 5] for functions which are available. The specification resembles the Mnesia API as much as possible. Please, read the Mnesia documentation set regarding the semantics used in the interface.

All the functions in the session (and corba_session) API return Status which indicates if the operation was successful or not. Most of the functions have an out parameter with a string reason describing the error, if one occurs.

**Note:**
The return value Status should be checked after each call, and it should be matched against the Status enum ok. For some functions, the end_of_table also means that the operation was successful.

1.2.2 Communication protocols

The IDL specification of Mnesia Session has two alternatives when compiling. These can be found in the mnesia_session/include directory:

- mnesia_session.idl
- mnesia_corba_session.idl

The mnesia_session.idl file must be compiled with IC (OTP's own IDL compiler). The generated stub files use the proprietary distribution protocol of Erlang (erl_interface/jinterface) to carry out the communication between clients and servers of connectors and sessions. On the server side Mnesia Session is implemented in Erlang using Mnesia's public API. On the client side Erlang, Java or C may be used.

The mnesia_corba_session.idl file may be compiled with any Corba compliant IDL compiler (e.g. Orbix, JacORB, TelO RB, IC, ...). The generated stub files uses ILOP (a protocol standardized by OMG) to carry out the communication between clients and servers of connectors and sessions. On the server
side MnesiaSession is implemented in Erlang using Mnesia's public API. On the client side a wide range of programming languages are available: Java, Smalltalk, C++, Erlang etc.

1.2.3 Sessions

When the MnesiaSession application is started, an Erlang process with the registered name mnesia_connector is created. The following example illustrates how a session is started:

```erlang
% erl
1> application:start(mnesia_session).
ok
2> Name = mnesia_connector, mnesia_connector
3> Connector = erlang:whereis(Name).
<0.34.0>
4> Session = mnesia_connector:connect(Connector).
<0.35.0>
5> ok = mnesia_connector:disconnect(Connector, Session).
ok
```

**Note:**
In the example given, both the client and server reside (in Erlang) on the same node.

See the Orber and IC documentation about the language mapping between Erlang, Java, C and IDL.

1.2.4 CORBA Sessions

If the MnesiaSession application has been started with the configuration parameter enable_corba set to true, a mnesia_corba_connector object is also created (in addition to the mandatory mnesia_connector process), and registered in Orber. The following simplified example illustrates how a corba_session can be started:

```erlang
% erl -mnesia_session enable_corba true
1> application:start(mnesia_session).

2> NS = corba:resolve_initial_references("NameService").
3> NC = lename_component:set_id(lename_component:create(),
   "mnesia_corba_connector").
4> Name = lename:insert_component(lname:create(), 1, NC).
5> Connector = 'CosNaming:NamingContext':resolve(NS, Name).
6> Session = mnesia_corba_connector:connect(Connector).
7> mnesia_corba_connector:disconnect(Connector, Session).
```
More information about CORBA conventions and usage can be found in the Orber and IC documentation.

Since Orber uses Mnesia internally, some of the functions in the Mnesia API are not available via IIOP. Examples of such functions are:

- start;
- stop;
- create_schema; and,
- delete_schema.

See the IDL specification [page 5] for the exact specification.

Some other functions are not supported due to the problem of representing void objects of unknown types. The dirty_match_object functionality has been replaced with the simpler function dirty_match_all which returns all records in a table.

### 1.2.5 Erlang, C and Java Sessions

These sessions are faster and more flexible variants than the CORBA session. The protocol implemented by the generated stubs is Erlang native external communication protocol, there is no ORB and IIOP engaged. Due to these facts the clients will run 10 to 20 times faster than in CORBA session case, depending on the amount of data stored and the mnesia record seeking times.

### 1.2.6 User-defined Interfaces

To be able to send records over the IIOP protocol, the records must be defined as structures in an IDL specification, and compiled with IC in order to enable registering of the types in Orber’s InterFace Repository (IFR). The records are mapped to the type any in Corba.

We recommend that all records are defined as IDL structures. This also applies when the erl_interface protocol is used (even though it may work without it). By including the header files produced in the code generation, several useful type definitions are made available for the application.

The generic dirty access functions in the API of Mnesia_Session is merely included for the convenience of application developers and it may be tempting to organize the application code around these functions. The application interface between its clients and servers should however be carefully designed according to the needs of the application, regardless of the Mnesia_Session interface.

Instead of sending records back and forth between the server and client nodes as in the generic get-/put-oriented interface of Mnesia_Session, it may (in many cases) be a better application design, to perform the application logic on the same (Erlang) node as the residing data. Besides the obvious performance advantage, it makes the applications more independent of future changes in the data model of the application.
1.3 IDL Specification of Mnesia (CORBA) Session

1.3.1 mnesia_session.idl

```
#include <erlang.idl>

module mnesia{

    // Status - a general type for keeping track of
    // the outcome of the session related functions.

    enum Status {
        ok,  // The operation was successful and
        // the all out parameters except 'reason'
        // contains valid data.
        end_of_table, // End of table has been reached.
        // This return code is only used by
        // a few functions, such as dirty_slot/4,
        // dirty_first/3, dirty_next/4 ...
        timeout, // This return code is only used by
        // wait_for_table.
    }
```
error // Miscellaneous error.
   // Operation did not succeed and the out
   // parameter 'reason' contains a description
   // of the error. The other out parameters
   // contains garbage.

   // In future releases we will probably expand this enum
   // with more precise error codes like no_exists, badarg etc.
};

   // Record - an erlang record, i.e. a tagged tuple with the
   // following layout: {tab_name, key, attr_1, ... attr_N}

typedef erlang::term Record;
typedef sequence <Record> Recordlist;

   // TableName - a name of a table. Note that the character '_'
   // should be avoided if the table is intended to be used
   // via the Corba Session.

typedef string TableName;
typedef sequence <TableName> TableList;

   // Key - a key of a record

typedef erlang::term Key;
typedef sequence <Key> KeyList;

   // Indecies - list of index positions.
   // In the sample record above, attr_1 has position 3

typedef sequence <long> Indices;

   // AttrNames - a list of attribute names

typedef sequence <string> AttrNames;

   // RecordName - Type information

typedef string RecordName;

   // Node - an Erlang node, e.g. "name1@host[.org.country]"

typedef string Node;
typedef sequence <Node> NodeList;

   // Storage - table storage type

enum Storage {ram_copies, disc_copies, disc_only_copies};

   // SetOrBag - table type
enum SetOrBag {set, bag};
// AccessMode - controls the accessibility of a table
enum AccessMode {read_only, read_write};
// Checkpoints - a list of checkpoint names
typedef sequence <string> Checkpoints;

// TableDef - initial specification of a table
struct TableDef
{
    SetOrBag type;
    AccessMode mode;
    NodeList ram_copies;
    NodeList disc_copies;
    NodeList disc_only_copies;
    Indices index_list;
    AttrNames attributes;
    RecordName record_name;
};

// CheckpointDef - initial specification of a checkpoint
struct CheckpointDef
{
    string cpName;
    TableList max;
    TableList min;
    boolean allow_remote;
    boolean ram_overrides_dump;
};

// TableInfo - information about a table
struct TableInfo
{
    AccessMode mode;
    AttrNames attributes;
    long arity;
    Checkpoints checkpoints;
    NodeList ram_copies;
    NodeList disc_copies;
    NodeList disc_only_copies;
    Indices indexlist;
    long load_order;
    boolean local_content;
    NodeList master_nodes;
long memory;
long size;
Storage storage_type;
SetOrBag type;
Node where_to_read;
NodeList where_to_write;
RecordName record_name;

// Not supported: cookie, snmp, subscribers, version, wild_pattern
};

////////////////////////////////////////////////////
// SystemInfo - information about the Mnesia system
// Some info can always be determined, but
// other info is only valid if Mnesia is running.

struct SystemInfo
{
    // The following information is always determined by
    // system_info/2:
    boolean auto_repair;
    string backup_module;
    string event_module;
    NodeList db_nodes;
    string debug;
    string directory;
    boolean dump_log_load_regulation;
    long dump_log_time_threshold;
    boolean dump_log_update_in_place;
    long dump_log_write_threshold;
    NodeList extra_db_nodes;
    boolean is_running;
    string schema_location;
    boolean use_dir;
    // Not supported: log_version, protocol_version, version

    // The following information is only valid if Mnesia is running.
    // Check 'is_running' before the info is accessed and regard the
    // values as undefined if 'is_running' is false.
    Checkpoints checkpoints;
    boolean fallback_activated;
    TableList local_tables;
    TableList master_node_tables;
    NodeList running_db_nodes;
    TableList tables;
    long transaction_failures;
    long transaction_commits;
    long transaction_restarts;
    long transaction_log_writes;

    // Not supported: held_locks, lock_queue, communication protocol,
interface session
{
    // Dirty access functions

    Status dirty_write ( in TableName tab,
                        in Record object,
                        out string reason);

    Status dirty_read ( in TableName tab,
                        in Key key,
                        out Recordlist result,
                        out string reason);

    Status dirty_update_counter ( in TableName tab,
                                  in Key key,
                                  in long val,
                                  out long newval,
                                  out string reason);

    Status dirty_delete ( in TableName tab,
                          in Key key,
                          out string reason);

    Status dirty_delete_object ( in TableName tab,
                                  in Record object,
                                  out string reason);

    Status dirty_slot ( in TableName tab,
                         in long slot,
                         out Recordlist result,
                         out string reason);

    Status dirty_first ( in TableName tab,
                         out Key next_key,
                         out string reason);

    Status dirty_next ( in TableName tab,
                       in Key key,
                       out Key next_key,
                       out string reason);
};
<table>
<thead>
<tr>
<th>Function</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>dirty_all_keys</code></td>
<td><code>in TableName tab,</code> <code>out KeyList keys,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>dirty_match_all</code></td>
<td><code>in TableName tab,</code> <code>out Recordlist result,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>dirty_index_read</code></td>
<td><code>in TableName tab,</code> <code>in Key key,</code> <code>in long pos,</code> <code>out Recordlist result,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>create_table</code></td>
<td><code>in TableName tab,</code> <code>in TableDef tabDefs,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>delete_table</code></td>
<td><code>in TableName tab,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>add_table_copy</code></td>
<td><code>in TableName tab,</code> <code>in Node node,</code> <code>in Storage type,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>del_table_copy</code></td>
<td><code>in TableName tab,</code> <code>in Node node,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>move_table_copy</code></td>
<td><code>in TableName tab,</code> <code>in Node from,</code> <code>in Node to,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>add_table_index</code></td>
<td><code>in TableName tab,</code> <code>in long attrname,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>del_table_index</code></td>
<td><code>in TableName tab,</code> <code>in long attrname,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>change_table_copy_type</code></td>
<td><code>in TableName tab,</code> <code>in Node node,</code> <code>in Storage type,</code> <code>out string reason);</code></td>
</tr>
<tr>
<td><code>change_table_access_mode</code></td>
<td><code>in TableName tab,</code> <code>in AccessMode mode,</code> <code>out string reason);</code></td>
</tr>
</tbody>
</table>
// Table load
Status wait_for_tables( in TableList tabs,
in long timeout,
out TableList failed_tabs,
out string reason);

Status force_load_table( in TableName tab,
out string reason);

Status change_table_load_order(in TableName tab,
in long load_order,
out string reason);

Status set_master_nodes1( in NodeList nodes,
out string reason);

Status set_master_nodes2( in TableName tab,
in NodeList nodes,
out string reason);

// Database management
Status backup1( in string filename,
out string reason);

Status backup2( in erlang::term opaque,
in string modulename,
out string reason);

Status install_fallback1( in string filename,
out string reason);

Status install_fallback2( in erlang::term opaque,
in string modulename,
out string reason);

Status uninstall_fallback( out string reason);

Status dump_log( out string reason);

Status dump_tables( in TableList list,
out string reason);

Status activate_checkpoint( in CheckpointDef cpdef,
out string reason);

Status deactivate_checkpoint(in string cpName,
out string reason);
Status backup_checkpoint1( in string cpName,  
in string filename,  
out string reason);

Status backup_checkpoint2( in string cpName,  
in erlang::term opaque,  
in string modulename,  
out string reason);

///////////////////////////////////////////////////////////  
// Miscellaneous  
///////////////////////////////////////////////////////////

Status load_textfile( in string filename,  
out string reason);

Status dump_to_textfile(in string filename,  
out string reason);

Status table_info( in TableName tab,  
out TableInfo info,  
out string reason);

Status system_info( out SystemInfo info,  
out string reason);

///////////////////////////////////////////////////////////  
// match_object functions is not supported due to the fact that  
// erlang::term is represented as an 'any' object and can not  
// be handled in an ordinary way in corba  
///////////////////////////////////////////////////////////

Status dirty_match_object( in TableName Tab,  
in Record pattern,  
out Recordlist result,  
out string reason);

Status dirty_index_match_object(in TableName Tab,  
in Record pattern,  
in long pos,  
out Recordlist result,  
out string reason);

///////////////////////////////////////////////////////////  
// Functions that deals with starting and stopping the Mnesia  
// application or operates when Mnesia is not running is not  
// supported in the corba interface due to fact that Orber  
// needs a running Mnesia in order to operate.  
///////////////////////////////////////////////////////////

Status create_schema( in NodeList nodes,  
out string reason);

Status delete_schema( in NodeList nodes,  
out string reason);
1.4 Session Examples

1.4.1 Example Introduction

In this and the following chapter several examples of the usage of the Mnesia_Session interface will be introduced. The examples will first be written in Erlang and than the same functionality will be shown in a foreign language.

The examples will contain some basic operations, create_table, write and read records both via the mnesia_session and the mnesia_corba_session interfaces.

Data Definition

A simple database has been created, with people as the subject. The person record containing other data types will be demonstrated in the rest of the examples. To begin with we define the data types that will be used in IDL.

```erlang
// A simple example on different structures used to access mnesia from
// the outside
//
// If the tables and structures should be accessed through a corba
// interface, they need to be defined in a IDL specification so that
// the mnesia_session interface can access the types needed to use
// corba type any.
```
module persons
{
    enum Sex {male, female};

    struct data
    {
        Sex sex;
        long age;
        long phone;
    };

    struct person
    {
        string name;    // Used as key
        data personData;  // A reference to other data structure
        string married_to;  // A relation
        sequence <string> children; // A list
    };
};

Observe that the struct person, when mapping from IDL to Erlang, is prefixed with the module name followed by '.'. In this example, the table name would be persons.person. If this is not wanted the struct definition should be placed on the top level, i.e. above the module definition.

1.4.2 A Session Example in Erlang

A simplified example of a client written in Erlang to access Mnesia via the session interface is shown below.

Compile the person data definitions with:

erlc +'{be, erl_genserv}' person.idl

Include the necessary files:

%% Include to get the mnesia types, used in create table
-include_lib("mnesia_session/include/mnesia.hrl").

%% Include my own definitions
-include("persons.hrl").

Find the connector and create a private session:

start_session(Node) ->
    ConnPid = rpc:call(Node, mnesia_session_lib, lookup_connector, []),
    % Use the factory to create a session
    SessPid = mnesia_connector:connect(ConnPid),
    {ConnPid, SessPid}.
In this example, we used `mnesia_session_lib:lookup_connector/0` but it is also possible to use `erlang:whereis(mnesia_connector)`. In Erlang, objects are represented as processes. To access the method of the object, call the method where the first argument is the object reference, as in `mnesia_connector:connect(ConnPid)`.

All functions in the IDL specification have an additional first argument which is the object reference. More information is given in the IC and Orber documentation.

To create a table with the structure defined in the IDL definition, we use the function `create_person_table`.

Define the table properties and call the function:

```erlang
create_person_table(ObjKey) ->
  %% Define the table properties
  Attrs = [atom_to_list(F) || F <- record_info(fields, persons_person)],
  TabDef = #mnesia_TableDef{type = bag, mode = read_write, 
    ram_copies = [],
    disc_copies = [],
    disc_only_copies = [],
    index_list = [4], %% Index on married_to 
    attributes = Attrs,
    %% OBSERVE that the record_name must be 
    %% exactly the same as the name of the 
    %% structure/record 
    record_name = "persons_person"},

  Res = mnesia_session:create_table(ObjKey, "persons", TabDef),
  case Res of 
  {ok, ""} ->
    ok;
  Else->
    io:format("ERROR: ~s~n", [Else])
  end.
```

The example insert and a read operation looks like:

```erlang
insert_person(SessionKey, Name, Sex, Age, Phone, Mt, Ch) when list(Name), atom(Sex), integer(Age),
  integer(Phone), list(Mt), list(Ch) ->
  Data = #persons_data{sex = Sex, age = Age, phone = Phone},
  Person = #persons_person{name = Name, personData = Data, 
    married_to = Mt, children = Ch},

  {ok, ""} = mnesia_session:dirty_write(SessionKey, "persons", Person),
  Person.

get_person(SessionKey, Name) when list(Name) ->
  {ok, RObj, ""} = 
    mnesia_session:dirty_read(SessionKey, "persons", Name),
  hd(RObj).
```
1.4.3 A Session Example in Java

Compile the person data definitions:

```erlc +'{be, java}' person.idl```

Import the necessary files.

```import com.ericsson.otp.ic.*;```

Find the connector and create a private session:

```public static mnesia._sessionStub start_session(String args[]) {
    String SNode = new String(args[0]);
    String PNode = new String(args[1]);
    String Cookie = new String(args[2]);

    mnesia._connectorStub mccRef = null;
    mnesia._sessionStub mcsRef = null;

    try {
        mccRef = new mnesia._connectorStub(SNode + "0", PNode, Cookie,
                                             "mnesia_connector");

        com.ericsson.otpi.Pid mccPid = mccRef.connect();

        mcsRef = new mnesia._sessionStub(SNode + "1", PNode, Cookie, mccPid);

        return mcsRef;
    }
    catch(Exception se) {
        System.out.println("Unexpected exception: " + se.toString());
        se.printStackTrace();
        return null;
    }
}
```

To create a table with the structure defined in the IDL definition, we use the function `create_person_table`. Define the table properties and call the function.

```public static void create_person_table(mnesia._sessionStub mcsRef) {
    try {
        String name = "persons";
        mnesia.TableDef def = new mnesia.TableDef();
        def.type = mnesia.SetOrBag.bag;
        def.mode = mnesia.AccessMode.read_write;
    ```
def.ram_copies = new String[0];
def.disc_copies = new String[0];
def.disc_only_copies = new String[0];
int[] idxs = new int[1];
idxs[0] = 4;
def.index_list = idxs;
String[] attrs = new String[4];
attrs[0] = "name";
attrs[1] = "personData";
attrs[2] = "married_to";
attrs[3] = "children";
def.attributes = attrs;
def.record_name = "persons_person"; // The used IDL type

StringHolder reason;
reason = new StringHolder();

if(mnesia.Status.ok != mcsRef.create_table(name, def, reason))
   System.out.println("Create Table Error " + reason.value);
}
catch(Exception se)
{
   System.out.println("Unexpected exception: ", se.toString());
   return;
}

The example insert and a read operation looks like:

public static void insert_person(mnesia._sessionStub mcsRef,
String name,
persons.Sex sex,
int age,
int phone,
String mt,
java.lang.String[] children)
{
   persons.data data;
data = new persons.data(sex, age, phone);
persons.person person = new persons.person();
person.name = name;
person.personData = data;
person.married_to = mt;
person.children = children;

try
{
   StringHolder reason = new StringHolder();
   Term object = new Term();
   persons.personHelper.insert(object, person);

   if(mnesia.Status.ok != mcsRef.dirty_write("persons", object, reason))
      System.out.println("Insert person Error " + reason.value);
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```java
public static persons.person
    get_person(mnesia._sessionStub mcsRef, String name)
{
    try {
        StringHolder reason = new StringHolder();
        Term key = new Term();
        mnesia.RecordlistHolder res = new mnesia.RecordlistHolder();
        key.insert_string(name);

        if(mnesia.Status.ok == mcsRef.dirty_read("persons",
            key, res, reason))
            {
            if(res.value.length > 0)
                {
                persons.person rec1 =
                    persons.personHelper.extract(res.value[0]);
                
                return rec1;
            } else
                return null;
            } else
            {
            System.out.println("Insert person Error " + reason.value);
            return null;
            }
    } catch(Exception se)
    {
        System.out.println("Unexpected exception: " + se.toString());
        return null;
    }
}

Note: the usage of ETERM differs a little to the CORBA case, when using Java it mapps to the Term class which inherits from Any class.

1.4.4 A Session Example in C

Compile the person data definitions:

erlc +'{be, c_genserv}' person.idl
Include the necessary files.

```c
#include <erl_interface.h>
#include "mnesia_session.h"
#include "mnesia_connector.h"
#include "persons.h"
#include <ic.h>
```

Find the connector and create a private session:

```c
erlang_pid start_session(CORBA_Environment * env)
{
    erlang_pid session_pid;
    session_pid = mnesia_connector_connect(NULL, env);
    if(env->_major != CORBA_NO_EXCEPTION)
        handle_error("connector_connect", env);
    return session_pid;
}
```

To create a table with the structure defined in the IDL definition, we use the function `create_person_table`. Define the table properties and call the function.

```c
void create_person_table(CORBA_Environment * env)
{
    int err;
    char * reason;
    mnesia_Status result;
    mnesia_TableDef tabdef;
    mnesia_Indices idxs;

    long idx_list[1] = {4};
    char * attrs[4] = {"name", "personData", "married_to", "children"};

    tabdef.type = mnesia_bag;
    tabdef.mode = mnesia_read_write;

    tabdef.ram_copies._maximum = 0;
    tabdef.ram_copies._length = 0;
    tabdef.ram_copies._buffer = NULL;

    tabdef.disc_copies._maximum = 0;
    tabdef.disc_copies._length = 0;
    tabdef.disc_copies._buffer = NULL;

    tabdef.disc_only_copies._maximum = 0;
    tabdef.disc_only_copies._length = 0;
    tabdef.disc_only_copies._buffer = NULL;

    tabdef.index_list._maximum = 5;
    tabdef.index_list._length = 1;
```
tabdef.index_list._buffer = idx_list;

tabdef.attributes._maximum = 5;
tabdef.attributes._length = 4;
tabdef.attributes._buffer = attrs;

tabdef.record_name = "persons_person"; /* The name of the stored type/struct */

result = mnesia_session_create_table(NULL, "persons", &tabdef, &reason, env);

if(env->_major != CORBA_NO_EXCEPTION)
{
    fprintf(stderr,"error in create_table: %d
", env->_major);
    exit(1);
}
else if(result != mnesia_ok)
{
    fprintf(stderr, "Create table failed with reason %s", reason);
}
CORBA_free(reason);
}

The example insert and a read operation looks like:

void insert_person(CORBA_Environment * env,
        char *name, persons_Sex sex, int age,
        int phone, char * mt, persons_person_children * ch)
{
    ETERM *person, *children, *temp;
    int err, i;
    char * reason;
    mnesia_Status result;
    extern char * oe_persons_Sex[];

    children = erl_mk_empty_list();

    if(ch != NULL)
        for(i = 0; i < ch->_length; i++)
        {
            temp = erl_mk_string(ch->_buffer[i]);
            children = erl_cons(temp, children);
            erl_free_term(temp);
        }

    person = erl_format("{persons_person,~s,{persons_data,~a,~i,~i},~s,~w}",
        name, oe_persons_Sex[sex], age, phone, mt, children);

    result = mnesia_session_dirty_write(NULL, "persons", person, &reason, env);

    if(env->_major != CORBA_NO_EXCEPTION)
void get_person(CORBA_Environment * env, char * name, persons_person * person)
{
    int err, i;
    char * reason;
    mnesia_Status result;
    mnesia_Recordlist *rec_list;
    ETERM * key;

    key = erl_mk_string(name);

    result = mnesia_session_dirty_read(NULL, "persons", key, &rec_list, &reason, env);
    if(env->_major != CORBA_NO_EXCEPTION)
    {
        fprintf(stderr,"error in get_person: %d ", env->_major);
        exit(1);
    }
    else if(result != mnesia_ok)
    {
        fprintf(stderr, "Get person failed with reason %s", reason);
        exit(-1);
    }

    if(rec_list->_length > 0)
    {
        /* Only interested in the first match */
        decode_person(rec_list->_buffer[0], person);
        for(i=0; i < rec_list->_length; i++)
            erl_free_term(rec_list->_buffer[i]);
    }
    else
    {
        fprintf(stderr, "Insert person failed empty_list returned ");
    }
}

{    fprintf(stderr,"error in insert_person: %d ", env->_major);
    exit(1);
}
else if(result != mnesia_ok)
{
    fprintf(stderr, "Insert person failed with reason %s", reason);
    exit(-1);
}

erl_free_term(children);
erl_free_term(person);
CORBA_free(reason);
}
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```erlang
exit(-1);
}
CORBA_free(rec_list);
CORBA_free(reason);
erl_free_term(key);
}
```

**Note:** the usage of `ETERM` differs when using C as the user must develop their own code to create and extract information from the `ETERM` structures, whereas, CORBA does this automatically.

### 1.5 CORBA Session Examples

#### 1.5.1 A CORBA Session in Erlang

Following is a simplified example of a client written in Erlang to access Mnesia via the CORBA session interface. The type definitions are the same as in the previous chapter [page 13].

To begin with include the necessary files.

```erlang
%% Include to get the mnesia types, used in create table
-include_lib("mnesia_session/include/mnesia.hrl").

%% Include to get the corba types i.e. any
-include_lib("orber/include/corba.hrl").

%% Include my own types
-include("persons.hrl").
```

Find the connector and create a private session.

```erlang
start_corba_session(Host, Port) ->
    %% Lookup the initial corba name sever
    Addr = "iiop://" ++ atom_to_list(Host) ++ ":" ++ integer_to_list(Port),
    NS = corba:resolve_initial_references_remote("NameService", [Addr]),

    %% Create a corba name object
    NC = lname_component:set_id(lname_component:create(),
                              "mnesia_corba_connector"),
    N = lname:insert_component(lname:create(), 1, NC),

    %% Lookup the object reference to the factory mnesia_corba_connector
    Cok = 'CosNaming_NamingContext':resolve(NS, N),

    %% Use the factory to create a session
    Sok = mnesia_corba_connector:connect(Cok),
    {Cok, Sok}.
```
In Erlang, objects are represented as processes. To access the method of the object, call the method where the first argument is the object reference, as in \texttt{mnesia\_connector:connect(ConnPid)}. All functions in the IDL specification have an additional first argument which is the object reference, more information is given in the IC and Orb
ter documentation.

To create a table with the structure defined in the IDL definition, we use the function \texttt{create\_person\_table}.

Define the table properties and call the function:

\begin{verbatim}
create\_person\_table(ObjKey) ->

  %% Define the table properties
  Attrs = [atom_to_list(F) || F <- record_info(fields, persons_person)],
  TabDef = mnesia\_TableDef\{type = bag, mode = read\_write,
    ram\_copies = [],
    disc\_copies = [],
    disc\_only\_copies = [],
    index\_list = [4],
    attributes = Attrs,
    record\_name = "persons\_person"},

  Res = mnesia\_corba\_session:create\_table(ObjKey, "persons", TabDef),
  case Res of
     {ok, "} ->
      ok;
     Else ->
      io:format("ERROR: ~s~n", [Else])
  end.

In this example the insert and a read operation looks like:

insert\_person(SessionKey, Name, Sex, Age, Phone, Mt, Ch) ->
  Data = \#persons\_data\{sex = Sex, age = Age, phone = Phone\},
  Person = \#persons\_person\{name = Name, personData = Data,
    married\_to = Mt, children = Ch\},

  Any = \#any\{type\_code = persons\_person:tc(), value = Person\},
  {ok, "} = mnesia\_corba\_session:dirty\_write(SessionKey, "persons", Any),
  Person.

get\_person(SessionKey, Name) ->
  Obj = \#any\{type\_code = \{tk\_string, 0\}, value = Name\},
  {ok, RObjs, "} =
    mnesia\_corba\_session:dirty\_read(SessionKey, "persons", Obj),
  RObj = hd(RObs),
  RObj\#any.value.

Notice the usage of the \texttt{any} type in both the read and write operations. \texttt{erlang::term} in the IDL specification is represented as the CORBA type \texttt{any} when using the CORBA session interface. The \texttt{any} type is represented as a 2-tuple containing type-code and value, the user must in Erlang insert the type-code.
\end{verbatim}
1.5.2 A CORBA Session in Java

This example is the same but using Java and OrbixWeb.

For this example to work, the following specifications need to be compiled:

- compilation of the user defined IDL specifications
- `${OTP_ROOT}/lib/mnesia_session-Version/src/mnesia_corba_session.idl`
- `${OTP_ROOT}/lib/ic-Version/include/erlang.idl`
- `${OTP_ROOT}/lib/orber-Version/COSS/CosNaming/cos_naming.idl`
- `${OTP_ROOT}/lib/orber-Version/examples/Stack/InitialReferences.idl`

Import CORBA and CosNaming Classes:

```java
import CosNaming._NamingContextRef;
import CosNaming.Name;
import IE.Iona.Orbix2._CORBA;
import IE.Iona.Orbix2.CORBA.*;
```

Find the connector and create a private session.

```java
public static mnesia._corba_sessionRef start_corba_session(String args[])
{
    mnesia._corba_sessionRef mcsRef = null;
    mnesia._corba_connectorRef mccRef = null;
    CORBA._InitialReferencesRef init;
    _NamingContextRef nsContext;
    Name name;
    _ObjectRef initRef, nsRef, objRef;
    Orber.InitialReference ir = new Orber.InitialReference();

    String srvHost = new String(args[0]);
    Integer srvPort = new Integer(args[1]);
    try
    {
        // For an explanation about initial reference handling see
        // the "Interoperable Naming Service" specification.

        // Create Initial reference (objectkey "INIT").
        String s = ir.stringified_ior(srvHost, srvPort.intValue());
        initRef = _CORBA.Orbix.string_to_object(s);
        init = CORBA.InitialReferences._narrow(initRef);
        // Fetch name service reference.
        nsRef = init.get("NameService");
        nsContext = CosNaming.NamingContext._narrow(nsRef);
        // Create a name
        name = new Name(1);
        name.buffer[0] =
            new CosNaming.NameComponent("mnesia_corba_connector", "");
        try
        {
            objRef = nsContext.resolve(name);
        }
    }
}
```
1.5: CORBA Session Examples

```java
} catch (UserException n)
{
    System.out.println("Unexpected exception: "+ n.toString());
    return null;
}

mccRef = mnesia.corba_connector._narrow(objRef);

// Create and return the session reference
mcsRef = mccRef.connect();
return mcsRef;
}
catch (SystemException se)
{
    System.out.println("Unexpected exception: "+ se.toString());
    se.printStackTrace();
    return null;
}
```

Create the person table

```java
public static void create_person_table(mnesia._corba_sessionRef mcsRef)
{
    String name = "persons";
    mnesia.TableDef def = new mnesia.TableDef();
    def.type = mnesia.SetOrBag.bag;
    def.mode = mnesia.AccessMode.read_write;
    def.ram_copies = new mnesia.NodeList(0);
    def.disc_copies = new mnesia.NodeList(0);
    def.disc_only_copies = new mnesia.NodeList(0);
    mnesia.Indices idxs = new mnesia.Indices(1);
    idxs.buffer[0] = 4;
    def.index_list = idxs;
    mnesia.AttrNames attrs = new mnesia.AttrNames(4);
    attrs.buffer[0] = "name";
    attrs.buffer[1] = "personData";
    attrs.buffer[2] = "married_to";
    attrs.buffer[3] = "children";
    def.attributes = attrs;
    def.record_name = "persons_person"; // The used IDL type

    StringHolder reason;
    reason = new StringHolder();
    try
    {
        if (mnesia.Status.ok != mcsRef.create_table(name, def, reason))
            System.out.println("Create Table Error "+ reason.value);
    }
    catch (SystemException se)
    {
        System.out.println("Unexpected exception: "+ se.toString());
        return;
    }
}
```
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The insert operation. Observe the encapsulation of person in the mnesia.Record. Java or OrbixWeb will handle the type encoding.

```java
public static void insert_person(mnesia._corba_sessionRef mcsRef,
        String name,
        int sex,
        int age,
        int phone,
        String mt,
        _sequence_String children)
{
    persons.data data;
    data = new persons.data(sex, age, phone);
    persons.person person = new persons.person();
    person.name = name;
    person.personData = data;
    person.married_to = mt;
    person.children = children;

    try
    {
        StringHolder reason = new StringHolder();
        mnesia.Record object = new mnesia.Record();
        object.insert(person);
        if(mnesia.Status.ok != mcsRef.dirty_write("persons", object, reason))
            System.out.println("Insert person Error " + reason.value);
    }
    catch(SystemException se)
    {
        System.out.println("Unexpected exception: " + se.toString());
        return;
    }
}
```

A read operation. Observe the extraction of person from the received mnesia.Recordlist and the key object handling.

```java
public static persons.person get_person(mnesia._corba_sessionRef mcsRef, String name)
{
    try
    {
        StringHolder reason = new StringHolder();
        mnesia.Key key = new mnesia.Key();
        mnesia.Recordlist res = new mnesia.Recordlist();
        key.insertString(name);
        if(mnesia.Status.ok == mcsRef.dirty_read("persons",
```
key, res, reason))
{
    if(res.length > 0)
    {
        persons.person rec1 = new persons.person();
        res.buffer[0].extract(rec1);
        return rec1;
    }
    else
    {
        System.out.println("Insert person Error " + reason.value);
        return null;
    }
}
catch(SystemException se)
{
    System.out.println("Unexpected exception: " + se.toString());
    return null;
}
Mnesia_Session Reference Manual

Short Summaries

- Erlang Module mnesia_session [page 30] – Mnesia_Session

mnesia_session

No functions are exported.
Mnesia is written in Erlang and intended to be used for Erlang applications. The Mnesia Session application enables access to the Mnesia DBMS from foreign programming languages (i.e., other languages than Erlang). The Mnesia Session interface is defined in IDL (an Interface Definition Language standardized by OMG (the Object Management Group)).

This module is automatically generated from the IDL specification mnesia_session.idl and is documented in the IDL specification.

Configuration parameters

Mnesia Session reads the following application configuration parameters:

- `-mnesia_session corba.connector.name Name`. This parameter controls which initial name Mnesia Corba Connector is bound. This parameter is only used when the `enable_corba` is set to true. The name is validated by using `lname:check_name(Name)`. See the `orber` application for details. The default name is `'/CU.CosNaming.NameComponent', 'IDL.CosNaming/NameComponent:1.0', 'mnesia_corba_connector', []`.

- `-mnesia_session debug Level`. Controls the debug level of Mnesia Session. Possible values are:
  - none: No trace outputs at all. This is the default.
  - verbose: Activates tracing of important debug events.
  - debug: Activates all events at the verbose level and traces of all debug events.
  - trace: Activates all debug events both verbose and debug as well as trace events that provide internal printouts. This level is only intended for debugging of small toy systems since many large events may be generated.

- `-mnesia_session enable_corba true | false`. This flag enables Mnesia Session to access Mnesia via CORBA. If CORBA access is enabled, the application Orber must be started in order to start Mnesia Session. The default is false.

First the SASL application parameters are checked, then the command line flags are checked, and finally, the default value is chosen.

See Also

mnesia(3), orber(3), application(3)