Appendix One

Description of Objects in the Replicated Database and IIRA

1.1 Description of Objects in the Replicated Database

1. Hosts-Obj

The purpose of this object is to implement the hierarchy that exists in the replication architecture. This object has the following schema:

Hosts-Obj (<u>Host-ID</u>, Host-Type, Region, MS-Instance-ReRU-ID)

In this schema:

- The Host-ID has distinct values. These values are assigned serially based on the following naming schema:

Host type	Serial No	The Region ID
MH	14	C2
CS	8	Z3
ZS	3	M2

For example, for MH, the Host-ID is MH15-C5, where the region-ID represents here the cell where MH registered. For CS, the Host-ID is CS05-Z03, where the region-ID represents here the zone where CS is located. For ZS, the Host-ID is ZS04-M02, where the region-ID represents the master area where ZS located.

The purpose of this method for naming is to avoid the duplication of the number assigned to host. For example, the number of the new MH with other one has joined another cell at the same time.

- The possible values for Host-type are Mobile host, Fixed host, Cell server, Zone server, and Master server. This data item is necessary because the propagation of recent updates to the fixed hosts including servers can take place at any time the host in the higher level has update to propagate, but propagation to MHs can take place only when the MH is connected with the cell server.

- The region is cell, zone, or master area. Its number is composed of the initial character and the number of the sub region in the whole area.

2. Objects-Details-Obj

It stores the details of the objects and their data items. It has the following schema:

Objects-Details-Obj (Object-ID, Object-Name, DataItem-ID, DataItem-Description)

3. Hosts-Replicated-Objects-Obj

This object stores the details of the replicated objects and data items for each host in the replicated system. The schema for this object as follows.

Hosts-Replicated-Objects-Obj(Host-ID, Object-ID, DataItem-ID, Max-TS)

In this schema, DataItem-ID is the number of an attribute in a given object. Max-TS is used in P2P propagation to store the maximum value for the Update-TS for updates in each object that are propagated previously to the other peer.

4. ReRU-Received-Instances-Obj

The purpose of this object is to store the information of the incoming instances from the higher level, which ship the recent resolved updates (ReRU) to the host in the lower level according to the values of MS-Instance-ReRU-ID that are missed from this host. The schema for this object is as follows.

ReRU-Received-Instances-Obj (Received-From (Host-ID), Higher-level-Instance-ID, Send-TS, MS-Instance-ReRU-ID, Receive-TS)

5. Data objects

This set represents the ordinary objects for storing the data of the replicated system. For example:

(i)   Items-Obj, Customers-Obj, and Invoices-Obj for sales management system.

(ii)   Patients-Admission-Obj, Symptoms-Obj, FollowUp-Obj, and medication-Obj for Healthcare system.

Each data object contains additional data items that are called Propagation Control Information (PCI). These data items are Global-ID, Host-ID, Update-No, Flag, and MS-

Instance-ReRU-ID. Thus, the schema for a data object contains ordinary data items plus PCI data items is as follows.

Data-Obj (Data item$_1$, Data item$_2$,…, Data item$_n$, Global-ID, Host-ID, Update-No, Flag, and MS-Instance-ReRU-ID

The description of PCI data items is given in the following table.

Notation	Description
Global-ID	A value that is assigned by MSR-IIRA for each update that indicates its order in the level of the whole system.
Host-ID	The ID of the host where update is generated
Update-No	A serial number assigned to each new update in a given object
Propagate-Flag	A single value data item to indicate whether the update is propagated to the higher level or not.
MS-Instance-ReRU-ID	The ID of the instance that shipped the stored ordered updates by MSR-IIRA to the lower levels

In the schema, all PCI data items except Update-ID can accept null values. When they have values, this means that the updates that are generated on the host are endorsed globally by the master server by ordering and giving them global ID. Also, it means that the MH has received recent resolved updates.

1.2 Description of database objects in the IIRA

In addition to the objects that are used to implement the four data structures, there are two objects for permanent storage for the details of the instances that either migrate to or received from other hosts. The first object is called Outgoing-Instances-Obj and it acts as an archive object that the IIRA benefits from it in registering and tracking the instances migrated to other hosts. The schema for this object is as follows.

Outgoing-Instances-Obj (Host-ID, Instance-ID, Send- TS, Host_Dest_ID)

The second object is called Incoming-Instances-Obj and it stores the details of the instance that are received from the lower level. The schema for this object is as follows.

Incoming-Instances-Obj (Host-ID, Instance-ID, Send- TS, Host_Dest_ID, ReceiveTS)

The ID of the last instance in these tables is used to assign the ID for the next instance.