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ACCEPTANCE TESTS FOR THE RAE SCIENTIFIC DATABASE:
THE SCHEMA AND SUBSCHEMA COMPILER TESTS

by

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SUMMARY

The acceptance tests for the schema and subschema compilers of the RAE Scientific Database are described. The tests verified that legal and illegal schemas and subschemas were handled correctly.

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1 INTRODUCTION

The data handling problems of the RAE were researched and analysed in 1976 and, as a result, a project team was set up to determine the feasibility of a scientific Database Management System (DBMS) to be introduced on an establishment-wide basis¹. The impetus for this came from two sources; a section of Aerodynamics Department concerned with handling wind tunnel data, and Mathematics and Computation Department. The latter department, which provides the central computing facility, was well aware of the growth in central file store and associated problems. It was decided that a contract should be placed for the purpose of carrying out first a feasibility study to be followed, if feasibility was demonstrated, by a further contract for the design, development and supply of a DBMS to run under the George Operating System on the 1904A and 1906S computers. The contract was won by TRIAD Computing Systems Limited: the DBMS was handed over to the RAE in September 1978.

The DBMS consists of a set of utility programs and a library of routines which may be incorporated in FORTRAN programs. An overall view of the system is given in Ref 6 and the detailed user interface is specified in Ref 7.

It was clearly necessary to subject the DBMS to a set of rigorous acceptance tests before general release; about one man-year was devoted to preparing these tests by Mathematics and Computation Department (as compared with 3-4 man-years spent by TRIAD in writing the system). The tests were extensive, testing the facilities provided, including the handling of exception conditions, and measuring performance. In all, about thirty FORTRAN programs were written (averaging about 200 lines of code each) together with about one hundred schema and subschema descriptions.

This Memorandum describes one set of acceptance tests, prepared by the author, for the schema and subschema compilers; other tests, including more complex schema and subschema compiler tests, are described in Refs 2 to 5. Some of the database terminology relevant to this Memorandum is explained here.

A schema defines the global logical structure of the data which may exist in the database conforming to that schema. A subschema is an application program's view of a database ie the subschema is a subset of the schema for that database. Schemas and subschemas are written using a special language called a Data Description Language (DDL) and must be compiled (or translated) into a different form before the data they describe can be stored or retrieved. The successful compilation of a schema results in a file containing a set of tables

in which is recorded the composition of each record type and set type (a relationship between two record types) which may be stored in the database. The successful compilation of a subschema proves that the data structures defined in the subschema are mappable onto the schema specified at the time the compilation was initiated. The mapping of a subschema onto a schema is called logical binding.

In the DBMS for RAE the schema compilation is performed by running the Schema Compiler Utility, a George macro called SCHCOMP, as follows:

SCHCOMP a, b

where a is the file description of the file containing the schema to be compiled,
and b is the file description of the file to receive any error messages output by the compiler

The subschema compilation is performed by running the Subschema Compiler Utility, a George macro called SUBSCHCOMP, as follows:

SUBSCHCOMP a, b, c

where a is the file description of the file containing the subschema to be compiled,
b is the name of the schema to which the subschema is to be bound,
and c is the file description of the file to receive any error messages output by the compiler.

The Subschema Compiler Utility is used to prove subschemas before they are used by application programs. The Data Manipulation Language (DML) procedure READY performs the compilation of a subschema during a program run and this produces a set of tables which are assessed when the DML procedure OPEN is invoked.

The Schema Compiler Utility tests are described in section 2 and the Subschema Compiler Utility tests in section 3.

2 THE SCHEMA COMPILER TESTS

2.1 Legal syntax validation

The test involved compiling the schema SCAA1. The schema is illustrated in Fig 1 and the schema listings appear in Figs 2 to 4. The expected result of the test was:

- (a) an error free compilation
- (b) an entry for SCAA1 in the schema Dictionary
- (c) a schema object file, SCAA1 (/ SCH), comprising the system tables Database Record Schema and Database Set Schema. The correctness of the system tables was checked by running the Data Dictionary Utility^{6,7} on SCAA1 (/ SCH)

The schema SCAA1 includes:

- (a) a valid schema entry:
- (b) a number of record entries:
 - (i) at least one with LOCATION MODE IS CALC,
 - (ii) at least one with LOCATION MODE IS VIA,
 - (iii) containing all the different basic data item forms ie integer, floating point and character strings,
 - (iv) containing all the more complex forms of data sub-entry ie vectors, data aggregates and repeating groups,
 - (v) using a number of different forms of picture specification.
- (c) a number of set entries:
 - (i) at least one with a named record as owner,
 - (ii) at least one with SYSTEM as owner,
 - (iii) containing all order insertion forms,
 - (iv) containing ascending and descending sorted forms,
 - (v) containing sort keys of different data types,
 - (vi) containing search keys of different data types,
- (d) INCLUDE directives and COMMENT lines.

2.2 Illegal syntax handling

The schema for each test was derived by editing the 'master' schema, SCAA1. Each test involved compiling the test schema and noting the result.

The test for each illegality is described as follows:

- (a) the error condition to be tested for,
- (b) the actual error introduced into the schema,
- (c) the name of the resulting test schema,
- (d) the error message the schema compiler was expected to report

2.2.1 General illegalities

- 1(a) User defined name containing characters outside allowable set
- (b) In the record entry for RCAA1, RCAA1 was replaced by RCAA1
- (c) SCAA11
- (d) "illegal symbol"
- 2(a) Mis-spelling and omission of reserved words
- (b) In the record entry for RCAA2 LOCATION was replaced by LOCATON, and in the record entry for RCAA5 TYPE was omitted from the data sub-entry for DTAA7
- (c) SCAA12
- (d) "location expected" and "pic/type/occurs clause expected"
- 3(a) Invalid optional word
- (b) In the record entry for RCAA1 LOCATION was replaced by LOCATION METHOD IS
- (c) SCAA13
- (d) "location clause incorrect"
- 4(a) Invalid COMMENT format
- (b) In the third COMMENT line the first quotation marks were omitted
- (c) SCAA14
- (d) "error in string in COMMENT".
- 5(a) Invalid INCLUDE format
- (b) In the first INCLUDE the second set of quotation marks were omitted
- (c) SCAA15
- (d) "error in string in INCLUDE"
- 6(a) Mispunctuation
- (b) In the SET entry for STAA6 the space characters between SET and STAA6 were omitted
- (c) SCAA16
- (d) "major symbol expected"

2.2.2 Schema entry illegalities

- 1(a) No schema entry
- (b) The schema entry was omitted
- (c) SCAA17
- (d) "no schema entry"
- 2(a) More than one schema entry
- (b) A second schema entry, SCHEMA ROGUE, was inserted
- (c) SCAA18
- (d) "multiple schema entry"
- 3(a) Schema entry not the first entry
- (b) Schema entry was repositioned after record entries
- (c) SCAA19
- (d) "schema entry not first"
- 4(a) Schema name already present in schema dictionary
- (b) Schema SCAA1 was compiled twice
- (c) SCAA1
- (d) "schema name not unique"
- 5(a) No END-SCHEMA
- (b) END-SCHEMA was omitted
- (c) SCAA110
- (d) "no END-SCHEMA"

2.2.3 Record entry illegalities

- 1(a) Duplicate record name
- (b) In the record entry for RCAA4, RCAA4 was replaced by RCAA3
- (c) SCAA111
- (d) "record name not unique"
- 2(a) Data item defined by LOCATION MODE IS CALC non-existent
- (b) In the record entry for RCAA1, the data sub-entry for DTAA2 was omitted
- (c) SCAA112
- (d) "calc-key not in record"
- 3(a) Data item defined by LOCATION MODE IS CALC is present in another record
- (b) In the record entry for RCAA1, CALC DTAA2 was replaced by CALC DTAA6

- (c) SCAA113
 - (d) "calc-key not in record"
- 4(a) Set name defined by LOCATION MODE IS VIA non-existent
- (b) The set entry for STAA5 was omitted
 - (c) SCAA114
 - (d) "set STAA5 referenced but not declared"
- 5(a) Duplicate data item name in record
- (b) In the record entry for RCAA5 an extra data sub-entry was inserted as follows:
 - 01 DTAA7 TYPE INTEGER
 - (c) SCAA115
 - (d) "data item name not unique"
- 6(a) No data item names in record
- (b) All the data sub-entries in the record entry for RCAA8 were omitted
 - (c) SCAA116
 - (d) "no data names in record"
- 7(a) Level number exceeding permitted maximum
- (b) In the record entry for RCAA2 the following data sub-entries were appended:
 - 50 XYZ1 TYPE FLOAT
 - 100 XYZ2 TYPE INTEGER
 - 150 XY23 TYPE INTEGER
 - (c) SCAA117
 - (d) "level number incorrectly formed", "level number incorrectly formed" and "level number of DTAA13 too small for typed"
- 8(a) No OCCURS, TYPE or PICTURE clause
- (b) The OCCURS and TYPE clauses for data sub-entry DTAA23 in the record entry for RCAA8 were omitted
 - (c) SCAA118
 - (d) "level number of DTAA23 too large for typeless"
- 9(a) OCCURS clause (but no TYPE or PIC clauses) but no lower level data sub-entries
- (b) The 'level 2' lines for data sub-entry DTAA9 in the record entry for RCAA6 were omitted
 - (c) SCAA119
 - (d) "level number of DTAA9 too large for typeless"

- 10(a) TYPE clause not supported by RAE DBMS
 - (b) In the record entry for RCAA1 and in the data sub-entry DTAA2, TYPE INTEGER 24 was replaced by TYPE BINARY
 - (c) SCAA120
 - (d) "incorrect type clause"
- 11(a) Character PICTURE containing numeric specifiers
 - (b) In the record entry for RCAA3 and data sub-entry for DTAA4 the PICTURE clause was replaced by PIC "9(12)"
 - (c) SCAA121
 - (d) "picture/type mismatch"
- 12(a) Numeric PICTURE containing character specifiers
 - (b) In the record entry for RCAA4 and data sub-entry for DTAA6 the PICTURE clause was replaced by PIC "X(6)"
 - (c) SCAA122
 - (d) "picture/type mismatch"
- 13(a) Omission of 'parts' from a numeric PICTURE
 - (b) In the record entry for RCAA6 and data sub-entry for DTAA11 the PICTURE clause was replaced by PIC "-(4)VE9
 - (c) SCAA123
 - (d) "incorrect picture fault : 5"

2.2.4 Set entry illegalities

- 1(a) Duplicate set name
 - (b) Before the set entry for STAA5 the following was inserted:

SET STAA2 OWNER RCAA1 ORDER PRIOR
 MEMBER RCAA2
 - (c) SCAA124
 - (d) "set name not unique"
- 2(a) OWNER record not previously defined
 - (b) In the set entry for STAA10, RCAA7 was replaced by RCAA77
 - (c) SCAA125
 - (d) "owner record not declared"
- 3(a) OWNER clause omitted
 - (b) In the set entry for STAA4, OWNER RCAA4 was omitted
 - (c) SCAA126
 - (d) "owner omitted"

- 4(a) ORDER SORTED but no KEY clause
- (b) In the set entry for STAA6, KEY ASCENDING was omitted
- (c) SCAA127
- (d) "ordered but no sort key"
- 5(a) KEY clause but ORDER not SORTED
- (b) In the set entry for STAA6, ORDER SORTED was omitted
- (c) SCAA128
- (d) "sort key but not ordered"
- 6(a) MEMBER record not previously defined
- (b) In the set entry for STAA10, RCAA9 was replaced by RCAA7
- (c) SCAA129
- (d) "member record not declared"
- 7(a) MEMBER clause omitted
- (b) In the set entry for STAA6, MEMBER RCAA7 was omitted
- (c) SCAA130
- (d) "member omitted"
- 8(a) Owner and member names are the same
- (b) In the set entry STAA8, RCAA3 was replaced by RCAA7
- (c) SCAA131
- (d) "owner is member"
- 9(a) Sort key not present in member record
- (b) In the set entry for STAA6, DTAA21 was replaced by DTAA3
- (c) SCAA132
- (d) "sort key not in record"
- 10(a) Search key not present in member record
- (b) In the set entry for STAA5, DTAA14 was replaced by DTAA8
- (c) SCAA133
- (d) "search key not in record"
- 11(a) Key is of the wrong type
- (b) In the set entry for STAA5, SEARCH DTAA14 was replaced by SEARCH DTAA9
- (c) SCAA134
- (d) "key is typeless or vector"

3 THE SUBSCHEMA COMPILER TESTS

3.1 Legal syntax and legal binding validation

The test involved compiling the subschema SSAA1. The subschema is illustrated in Fig 5 and the subschema listings appear in Figs 6 to 8. The expected result of the test was:

- (a) an error free compilation
- (b) the logical binding of the subschema to the schema SCAA1 without errors

The subschema SSAA1 includes:

- (a) a valid subschema entry:
- (b) at least one synonym for a record name:
- (c) at least one synonym for a data item:
- (d) at least one synonym for a set name:
- (e) a number of record entries,
 - (i) at least one with LOCATION MODE IS CALC,
 - (ii) at least one with LOCATION MODE IS VIA,
 - (iii) containing all different data item forms,
 - (iv) necessitating different forms of type conversion,
 - (v) using a number of different forms of picture specification
- (f) a number of set entries:
 - (i) at least one with a named record as owner,
 - (ii) at least one with SYSTEM as owner,
 - (iii) at least one where the member record is formed by the concatenation of schema records, the schema records having a common owner,
 - (iv) at least one set owned by a partition of a schema record
- (g) INCLUDE directives and COMMENT lines

3.2 Illegal syntax handling

The subschema for each test was derived by editing the 'master' subschema, SSAA1. Each test involved compiling the test subschema and noting the result.

The test for each illegality is described as follows:

- (a) the error condition to be tested for,
- (b) the actual error introduced into the subschema,
- (c) the name of the resulting test subschema,
- (d) the error message the subschema compiler was expected to report

3.2.1 General illegalities

- 1(a) User defined name containing characters outside allowable set
 - (b) In the record entry for RCAA31, RCAA31 was replaced by RCAA [31]
 - (c) SSAA11
 - (d) "illegal symbol"
- 2(a) Mis-spelling of a reserved word
 - (b) In the record entry for RCAA31, RECORD was replaced by RECOORD
 - (c) SSAA12
 - (d) "item not in schema"
- 3(a) Invalid optional word
 - (b) In RENAME for STAA3, RENAME SET was replaced by RENAME THE SET
 - (c) SSAA13
 - (d) "name not in schema"
"set not found in schema"
- 4(a) Invalid COMMENT format
 - (b) The first quotation marks were omitted from the first COMMENT line
 - (c) SSAA14
 - (d) "error in string in COMMENT"
- 5(a) Invalid INCLUDE format
 - (b) The first quotation marks were omitted from the first INCLUDE line
 - (c) SSAA15
 - (d) "error in string in INCLUDE"

- 6(a) Mispunctuation
- (b) A semi-colon was inserted after STAA91 in the set entry for STAA91
- (c) SSAA16
- (d) "illegal symbol"

3.2.2. Subschema entry illegalities

- 1(a) No subschema entry
- (b) The subschema entry was omitted
- (c) SSAA17
- (d) "no subschema entry"
- 2(a) More than one subschema entry
- (b) SUBSCHEMA ROGUE was inserted after the subschema entry
- (c) SSAA18
- (d) "more than one subschema entry"
- 3(a) Subschema entry not the first entry
- (b) The subschema entry was repositioned after the record entries
- (c) SSAA19
- (d) "subschema not first"
- 4(a) No END-SUBSCHEMA
- (b) The END-SUBSCHEMA line was omitted
- (c) SSAA110
- (d) "no END-SUBSCHEMA"

3.2.3 Record entry illegalities

- 1(a) Duplicate record name
- (b) In the record entry for RCAA88, RCAA88 was replaced by RCAA44
- (c) SSAA111
- (d) "record name used twice"
- 2(a) Data item name defined by LOCATION MODE IS CALC is non-existent
- (b) In the record entry for RCAA11, CALC DTAA2 was replaced by CALC DTA2
- (c) SSAA112
- (d) "calc-key not in record"
- 3(a) Set name defined by LOCATION MODE IS VIA non-existent
- (b) The set entry for STAA22 was omitted
- (c) SSAA114
- (d) "VIA set STAA22 not declared"

- 4(a) Duplicate data item name in record
 - (b) In the record entry for RCAA88 the following data sub-entry was added
 - 01 DTAA24
 - (c) SSAA115
 - (d) "item name used twice"
- 5(a) No data item names in record
 - (b) In the record entry for RCAA31 the data sub-entry was omitted
 - (c) SSAA116
 - (d) "data item clause expected"
- 6(a) TYPE clause not supported by DBMS
 - (b) In the record entry for RCAA88 a type clause, TYPE FIXED, was added to the data sub-entry for DTAA22
 - (c) SSAA117
 - (d) "incorrect type clause"
- 7(a) Character PICTURE containing numeric specifiers
 - (b) In the record entry for RCAA31 the picture and type clauses, PIC "+9(2)V9(4)" TYPE CHARACTER, were added to the data sub-entry for DTAA44
 - (c) SSAA118
 - (d) "picture/type mismatch"
- 8(a) Numeric PICTURE containing character specifiers
 - (b) In the record entry for RCAA11 the picture and type clauses, PIC "X(12)" TYPE INTEGER 24, were added to the data sub-entry for DTAA2
 - (c) SSAA119
 - (d) "picture/type mismatch"
- 9(a) Omission of 'parts' from a numeric PICTURE
 - (b) In the record entry for RCAA88 the picture clause, PIC "9(6)VE", was added to the data sub-entry for DTAA24
 - (c) SSAA120
 - (d) "incorrect picture fault : 4"

3.2.4 Set entry illegalities

- 1(a) Duplicate set name
 - (b) In the set entry for STAA88, STAA88 was replaced by STAA22
 - (c) SSAA121
 - (d) "set name used twice"

- 2(a) OWNER clause omitted
- (b) In the set entry for STAA91, RCAA71 was replaced by RCA71
- (c) SSAA122
- (d) "owner record not declared"
- 3(a) MEMBER record not previously defined
- (b) In the set entry for STAA22, RCAA31 was replaced by RCA31
- (c) SSAA123
- (d) "member record not declared"
- 4(a) Owner and member names the same
- (b) In the set entry for STAA88, RCAA31 was replaced by RCAA71
- (c) SSAA124
- (d) "owner is member"

3.3 Illegal subschema binding handling

The subschema for each test was derived by editing the 'master' subschema, SSAA1. Each test involved compiling the test subschema and noting the result.

The test for each illegality is described as follows:

- (a) the error condition to be tested for,
- (b) the actual error introduced into the subschema
- (c) the name of the resulting test subschema
- (d) the error message the subschema compiler was expected to report

3.3.1 Subschema entry illegalities

- 1(a) Synonym required for a record name not in schema
- (b) A RENAME sub-entry, RENAME RECORD RCAA12, RCAA20 was inserted
- (c) SSAA125
- (d) "name not in schema"
- 2 (a) Synonym required for a data item name not in schema
- (b) In the RENAME sub-entry for DTAA4, DTAA4 was replaced by DTAA477
- (c) SSAA126
- (d) "name not in schema"
- 3(a) Synonym required for a set name not in schema
- (b) In the RENAME sub-entry for STAA3, STAA3 was replaced by STA3
- (c) SSAA127
- (d) "name not in schema"

3.3.2 Record entry illegalities

- 1(a) Record name present in schema and an attempt made to include further clauses
 - (b) The record entry for RCAA44 was replaced by
 RECORD RCAA44 LOCATION VIA STAA44
 01 DTAA6 TYPE INTEGER 24 PIC "9(6)"
 01 DTAA67 TYPE FLOAT
 - (c) SSAA128
 - (d) "record in schema cannot have sub-entries"
- 2(a) Record name not present in schema but no component data items are present
 - (b) In the record entry for RCAA31, the LOCATION clause and the data sub-entry were omitted
 - (c) SSAA129
 - (d) "record not found in schema"
- 3(a) Component data items are formed from schema record types that are not members of a set type with a common owner type
 - (b) A new record entry was inserted as follows:
 RECORD RCAA100 LOCATION VIA STAA100
 01 DTAA3
 01 DTAA7
 01 DTAA8
 01 DTAA13
 - (c) SSAA130
 - (d) "no binding set for RCAA100"
- 4(a) Location mode data item not a location mode in schema
 - (b) In the record entry for RCAA31, VIA STAA22 was replaced by
 CALC DTAA44
 - (c) SSAA131
 - (d) "calc-key is not a calc-key in schema"
- 5(a) No location mode established for record not in schema
 - (b) In the record entry for RCAA88 the LOCATION clause was omitted
 - (c) SSAA132
 - (d) "location clause missing"
- 6(a) Data item name representing a data item not in schema
 - (b) In the record entry for RCAA31 a data sub-entry was added as follows:
 01 DTAA48 TYPE FLOAT
 - (a) SSAA133
 - (d) "item not in schema"

- 7(a) Data item name representing a repeating group (without lower levels) not present in schema
- (b) In the record entry for RCAA31 a data sub-entry was added as follows:
- 01 NEWAG OCCURS 10 TIMES
- (c) SSAA134
- (d) "no lower level numbers"
- 8(a) Data item name used to represent a special repeating group in the subschema appears in the schema as a simple data item
- (b) INCLUDE "PARTSSZZ1" was replaced by INCLUDE "PARTSSZZ3" and PARTSSZZ1 was edited to PARTSSZZ3 as follows:
- In the record entry for RCAA72, DTAA60 was replaced by DTAA20
- (c) SSAA135
- (d) "occurs not allowed for schema item"
- 9(a) Variable vector occurrence factor not declared in subschema record
- (b) In the record entry for RCAA55 the data sub-entry for DTAA7 was omitted
- (c) SSAA136
- (d) "occurs data items not in record"

3.3.3 Set entry illegalities

- 1(a) Set name present in schema but an attempt made to include further clauses
- (b) In the set entry for STAA33 an OWNER clause and a MEMBER sub-entry were added as follows:
- OWNER SYSTEM
MEMBER RCAA44
SEARCH DTAA6
- (c) SSAA137
- (d) "schema set cannot have sub-entries"
- 2(a) Set name not present in schema and not completely defined in subschema
- (b) In the set entry for STAA88 the OWNER clause was omitted
- (c) SSAA138
- (d) "owner expected"
- 3(a) Set named not mappable onto occurrences of schema sets
- (b) The following was inserted as the first set entry
- SET STAA100 OWNER RCAA31
MEMBER RCAA72
- (c) SSAA139
- (d) "schema set does not exist for record RCAA10"

4 CONCLUSIONS

The schema compiler and the subschema compiler acceptance tests for the RAE Scientific Database have been described. The tests were designed to demonstrate that:

- (i) all legal syntactical forms are processed correctly by the schema and subschema compilers,
- (ii) illegal syntactical forms are processed correctly by the schema and subschema compilers with reasonable error recovery,
- (iii) the principles of legal logical binding to schemas are followed
- (iv) illegal logical binding constructs are processed correctly with reasonable error recovery

When the tests were run affirmative results were obtained.

These tests were a minimal set of tests for all the schema and subschema facilities but sufficient to ensure confidence in the soundness of the software. More complex schema/subschema bindings were tested separately and are described elsewhere².

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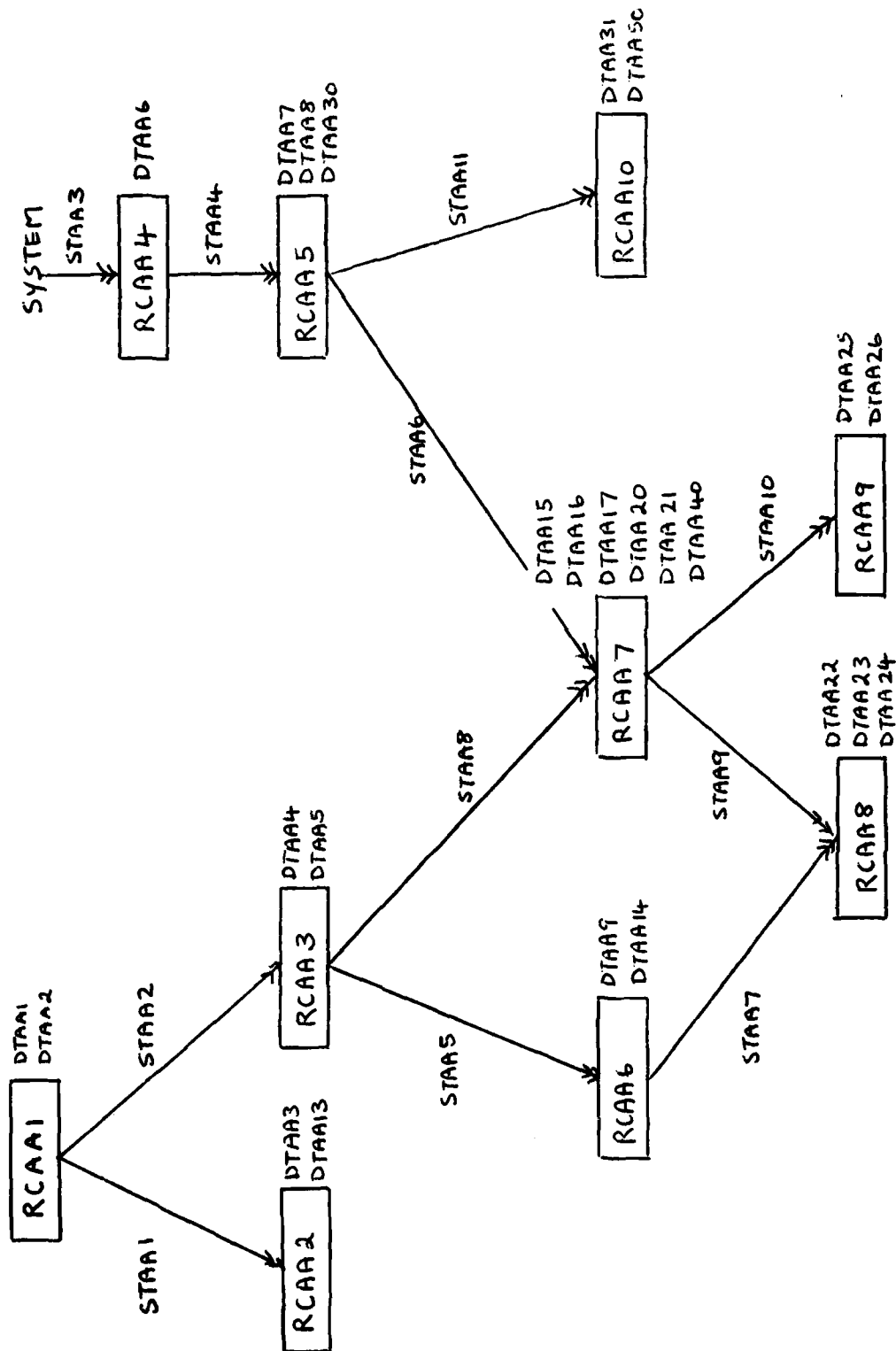


Fig 1

Fig 1 The schema SCAA1

Fig 2

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COMMENT"          THIS IS THE MASTER SCHEMA FOR THE SCHEMA DDL TESTS"
COMMENT"          IN THE RAE DATABASE ACCEPTANCE TRIALS"

SCHEMA SCAA1

COMMENT"          RECORD DEFINITIONS"
RECORD  RCAA1  LOCATION CALC  DTAA2
      01  DTAA1  PIC "X(24)"
      01  DTAA2  TYPE INTEGER 24

RECORD  RCAA2  LOCATION VIA  STAA1
      01  DTAA3  TYPE FLOAT 48
      01  DTAA13 TYPE INTEGER 24

RECORD  RCAA3  LOCATION VIA  STAA2
      01  DTAA4  TYPE CHARACTER 12  PIC "X(12)"
      01  DTAA5  TYPE INTEGER 24

RECORD  RCAA4  LOCATION VIA  STAA3
      01  DTAA6  TYPE INTEGER 24  PIC "9(6)"

RECORD  RCAA5  LOCATION VIA  STAA4
      01  DTAA7  TYPE INTEGER 24
      01  DTAA8  OCCURS DTAA7 TIMES  TYPE FLOAT  PIC "+9(6)V9(2)"
      01  DTAA30 TYPE FLOAT

RECORD  RCAA6  LOCATION VIA  STAA5
      01  DTAA9
      02  DTAA10  PIC "+V9(4)E+9(3)"  TYPE FLOAT 48
      02  DTAA11  TYPE FLOAT 48  PIC "-9(4)V99E-99"
      02  DTAA12  TYPE CHARACTER 4
      01  DTAA14  TYPE CHARACTER 4

INCLUDE"PARTSCZZ1"

RECORD  RCAA8  LOCATION VIA  STAA9
      01  DTAA22 TYPE INTEGER 24
      01  DTAA23 TYPE FLOAT OCCURS 10 TIMES
      01  DTAA24 TYPE FLOAT PICTURE "-V9(4)E+9(3)"

RECORD  RCAA9  LOCATION CALC  DTAA25
      01  DTAA25 TYPE INTEGER 24
      01  DTAA26 TYPE CHARACTER 12  PIC "X(12)"

RECORD  RCAA10 LOCATION VIA  STAA11
      01  DTAA31 OCCURS 40 TIMES
      02  DTAA32 TYPE INTEGER 24
      02  DTAA33 TYPE CHARACTER 4
      01  DTAA30 TYPE INTEGER 24

COMMENT"          SET DEFINITIONS"

INCLUDE"PARTSCZZ2"

SET  STAA4  OWNER RCAA4 ORDER LAST
      MEMBER RCAA5

SET  STAA5  OWNER RCAA3 ORDER SORTED
      MEMBER RCAA6 KEY ASCENDING DTAA14
      SEARCH DTAA14 SEARCH DTAA11

SET  STAA6  OWNER RCAA5 ORDER SORTED
      MEMBER RCAA7 KEY ASCENDING DTAA21
      SEARCH DTAA20

SET  STAA7  OWNER RCAA6
      MEMBER RCAA2

SET  STAA8  OWNER RCAA3 ORDER IMMATERIAL
      MEMBER RCAA7
      SEARCH DTAA21

SET  STAA9  OWNER RCAA7 ORDER FIRST
      MEMBER RCAA2
      SEARCH DTAA22

SET  STAA10 OWNER RCAA7 ORDER PRIOR
      MEMBER RCAA9
      SEARCH DTAA26

SET  STAA11 OWNER RCAA5 ORDER SORTED
      MEMBER RCAA10 KEY DESCENDING DTAA30

END-SCHEMA

```

Fig 2 Schema SCAA1

```

RECORD RCAA7 LOCATION VIA STAA6
01 STAA15 TYPE INTEGER 24
01 STAA16 TYPE FLOAT 96
01 STAA17 OCCURS 40 TIMES
02 STAA18 TYPE CHARACTER 4
02 STAA19 TYPE FLOAT
02 STAA27 TYPE INTEGER 48
01 STAA40 TYPE INTEGER 24
01 STAA21 TYPE INTEGER 24
01 STAA40 OCCURS STAA13 TIMES
02 STAA41 TYPE FLOAT
02 STAA42 TYPE FLOAT

```

Fig 3 PARTSCZZ1 (part of schema SCAA1)

```

001 STAA1 OWNER RCAA1 ORDER LAST
MEMBER RCAA2
001 STAA2 OWNER RCAA1 ORDER NEXT
MEMBER RCAA3
SEARCH STAA4
001 STAA3 OWNER SYSTEM ORDER LAST
MEMBER RCAA4

```

Fig 4 PARTSCZZ2 (part of schema SCAA1)

Fig 5

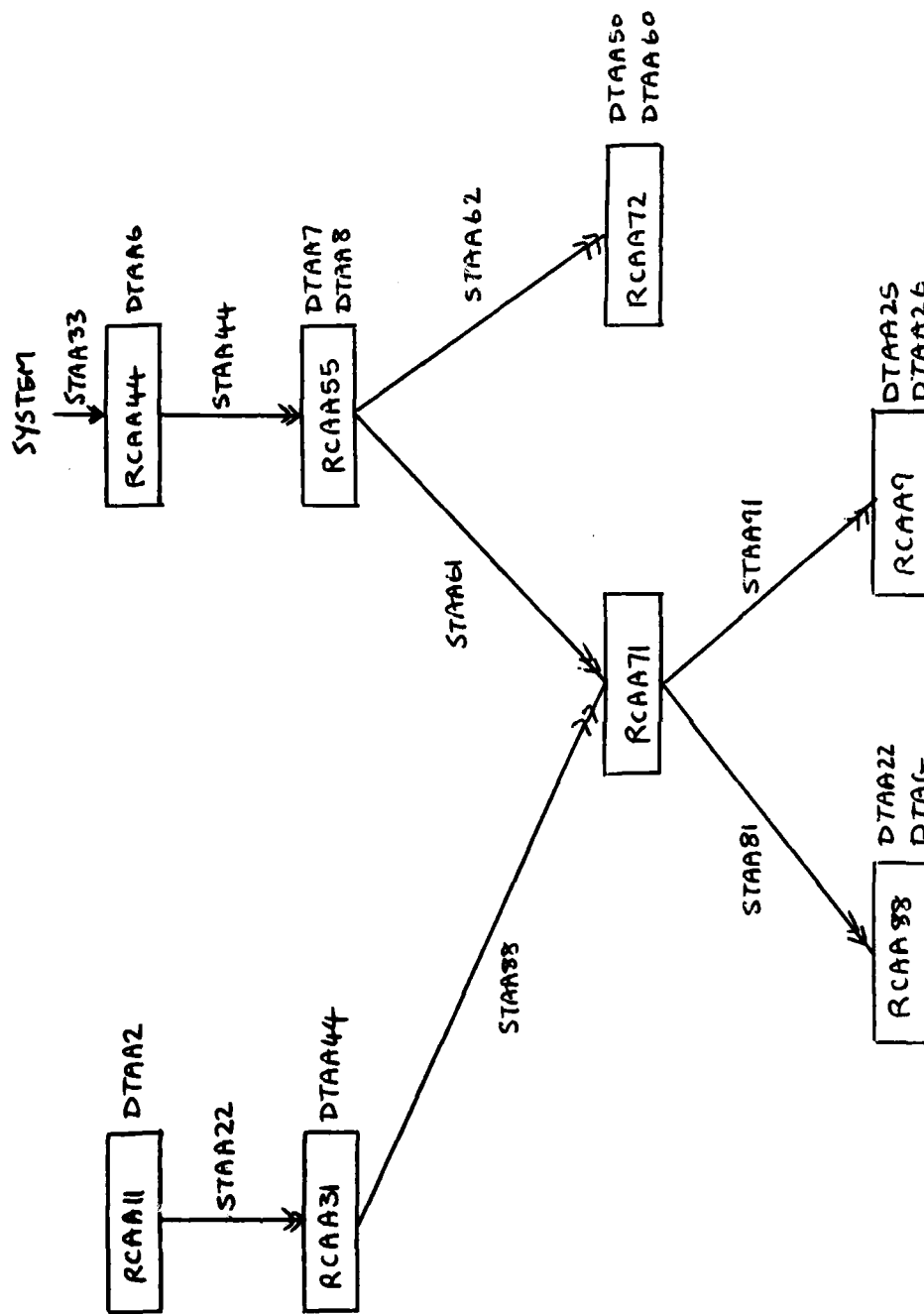


Fig 5 The subschema SSAA1

COMMENT" THIS IS A SUBSCHEMA CONFORMING TO THE SCHEMA SCAA1"
 COMMENT" AND IS TO BE USED FOR THE SUBSCHEMA DDL TESTS"
 COMMENT" IN THE RAE DATABASE ACCEPTANCE TRIALS"

SUBSCHEMA SSAAT

COMMENT" SYNONYMS USED IN THIS SUBSCHEMA "
 RENAME RECORD RCAA4,RCAA44
 RENAME DTAA4,DTAA44
 RENAME SET STAA3,STAA33

COMMENT" RECORDS IN THE SUBSCHEMA"

RECORD RCAA11 LOCATION CALC DTAA2
 01 DTAA2

RECORD RCAA11 LOCATION VIA STAA22
 01 DTAA44

RECORD RCAA44

RECORD RCAA55 LOCATION VIA STAA44
 02 DTAA7
 02 DTAA8

INCLUDE"PARTSS221"

RECORD RCAA88 LOCATION VIA STAA81
 01 DTAA22
 01 DTAA2
 02 DTAA23
 02 DTAA24

RECORD RCAA9

COMMENT" SETS IN THE SUBSCHEMA"

SET STAA22 OWNER RCAA11
 MEMBER RCAA31

SET STAA33

SET STAA44 OWNER RCAA44
 MEMBER RCAA55

SET STAA88 OWNER RCAA31
 MEMBER RCAA71

INCLUDE"PARTSS222"

SET STAA81 OWNER RCAA71
 MEMBER RCAA88

SET STAA91 OWNER RCAA71
 MEMBER RCAA9

END-SUBSCHEMA

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Figs 7&8

```
RECORD RCAA71 LOCATION VIA STAA61
01 STAA16 TYPE INTEGER 48 PICTURE "9(6)"
01 STAA19
01 STAA40

RECORD RCAA72 LOCATION VIA STAA62
01 STAA90
01 STAA60 OCCURS 40 TIMES
02 STAA32
02 STAA18
02 STAA27 TYPE PICAT 48 PICTURE "-V9(4)E+999"
02 STAA33
```

Fig 7 PARTSSZZ1 (part of subschema SSAA1)

```
SET STAA61 OWNER RCAA93
      MEMBER RCAA71

SET STAA62 OWNER RCAA93
      MEMBER RCAA72
```

Fig 8 PARTSSZZ2 (part of subschema SSAA1)

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