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The ICST-NBS Information Resource Dictionary System Command Language Prototype

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This publication is a report on the Information Resource Dictionary System (IRDS) Command Language prototype developed by the Institute for Computer Sciences and Technology of the National Bureau of Standards. It discusses the structure, source code, and operating environment of the IRDS Prototype, specifies the precise subset of the standard IRDS Command Language implemented, provides instructions for installing the Prototype software, and leads the reader through a typical user session.

Key words: command language; data dictionary; data dictionary system; Information Resource Dictionary System; IRDS; prototype.

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1. AN OVERVIEW OF THE IRDS PROTOTYPE

1.1 HISTORY

Specifications for the Information Resource Dictionary System (IRDS), the emerging standard for data dictionary software, have been under development since 1980 as a joint effort of the Institute for Computer Sciences and Technology of the National Bureau of Standards (ICST-NBS) and Technical Committee H4 of the Accredited Standards Committee X3 (X3H4) [1].

Because the IRDS specifications, in particular those for the IRDS Command Language, describe a system quite different from currently available commercial data dictionary systems, ICST-NBS decided to develop a prototype Command Language implementation. The initial goal was to produce an IRDS prototype that would serve as a tool allowing experimentation on, and testing of, both the overall IRDS capabilities and the particular Command Language syntax. Later, this IRDS prototype would be available for use by organizations wishing to become familiar with the upcoming standard.

The IRDS Prototype was developed and used for testing the Specifications during 1985-1986. This coincided with the period of public and Federal Government agency review of the IRDS. In 1986, ICST-NBS began distributing the IRDS Prototype source code to interested outside organizations. In 1988, ICST-NBS released a revised version of the IRDS Prototype that is compatible with the final, standard specifications.

1.2 OPERATING ENVIRONMENT

The Prototype uses SQL calls to the ORACLE[1] database management system to model the IRDS data structures and to provide the underlying data management. A set of C language programs interpret the Prototype commands and interface with the DBMS.

ORACLE was chosen as the DBMS because it was available, was appropriate for the task, and because it implemented the

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[1] ORACLE is a registered trademark of Oracle Corporation.

SQL standard. This use, however, should not be considered an endorsement or certification of the ORACLE product.

The Prototype is designed to be independent of the particular hardware environment and operating system of the system hosting the C compiler and Oracle DBMS.

1.3 DISTRIBUTION OF THE IRDS PROTOTYPE

The source code for the Prototype is available free of charge to interested organizations. The code is distributed on 5 1/4 inch, double-sided, double-density diskettes, stored in ASCII text file format. The files are readable by any computer using the DOS operating system.

ICST-NBS is distributing the Prototype to allow organizations to experiment with the emerging IRDS Standard Command Language. Users are encouraged to evaluate the Prototype software, and the underlying IRDS Specifications, for correctness, design philosophy, and desirable enhancements. Users are also asked to provide ICST-NBS with feedback concerning their experiences with the Prototype.

Users of the IRDS Prototype must agree to fully identify and credit ICST-NBS as the developer of the Prototype in any publications, talks, reports, or products that are based on work utilizing the Prototype.

The ICST-NBS IRDS Prototype is in the public domain, and no restrictions are placed on its use. It is not subject to copyright in the United States. ICST-NBS provides no warranty, and is exempt of any liability.

To find out more about the IRDS Prototype, or to request a copy of the source code, please contact:

IRDS Prototype Project
National Bureau of Standards
Information Systems Engineering Division
Building 225, Room A266
Gaithersburg, MD 20899

Tel: (301)975-3252

1.4 SCOPE AND USE OF THIS REPORT

The remainder of this report begins with a detailed depiction of a typical IRDS Prototype session, including a discussion of how to create new dictionaries. Chapter 3 follows with a description of the Prototype Command Language, including a description of the available commands, clauses, error messages, and allowable abbreviations. Chapter 4 discusses the structure of the SQL tables that store the IRD data and "implementor defined" parameter values used by the Prototype. In Chapter 5, the source code that implements the Prototype user interface is discussed. Much of the material in Chapters 4 and 5 may be of interest primarily to dictionary administrators. Finally, Chapter 6 presents a detailed set of instructions for installing the Prototype software.

This report deals only with the ICST-NBS Prototype. It does not provide a complete description of the IRDS Standard, the details of the Command Language, or any guidelines on IRDS usage. We recommend that users read the IRDS Technical Overview [2] as a tutorial and a general reference. A discussion, with many examples, of the complete Command Language is found in [3]. Guidelines for IRDS applications are presented in [4], and a guide on data entity naming conventions, within the framework of the IRDS, can be found in [5].

2. AN IRDS PROTOTYPE SESSION

Once the Prototype software has been installed, according to directions in Chapter 6, a user accesses the Prototype by running the executable file.

A session begins with the display of some package information giving the Prototype version number and the date that version was compiled. This is followed by the request:

```
IRDS_user_name :
```

The Prototype has no facilities for validating the user name that is entered; the information is used exclusively for audit purposes, such as for ADDED-BY attributes.

The Prototype then asks:

```
Is this a batch or interactive run (b/i)?
```

If the user enters "b", each user command is echoed, so the command string itself will be recorded as part of the batch output copy. An "i" specifies no echoing of the command string, and so is the normal response for a user working at a terminal.

Since each copy of the Prototype can support 25 discrete dictionaries, the Prototype will, in general, display at this point a menu of all previously created IRDs:

```
    Available IRDs are:

   a) <name of first IRD>
   b) <name of second IRD>
   c) <name of third IRD>
            .
            .
            .

Please specify your choice (letter)
```

The user must select one of the specified choices, even if he or she intends to create a new IRD.

The Prototype acknowledges the selection with

```
The current IRD is <name of IRD>
```

The Prototype then places the user "in" the selected IRD, and returns the prompt symbol ">". If the selected IRD is the one desired, the user can now begin working. If, on the other hand, the user wishes to create a new IRD, he or she does so at this point, using CREATE IRD (see section 3.3.1).

If there are no previously created IRDs to select from, the Prototype will not display the above menu of existing IRDs, but will generate an implicit CREATE IRD command, and display the following:

```
INFORMATION IXXXX: Creating 1st schema table
INFORMATION IXXXX: Creating 2nd schema table
INFORMATION IXXXX: Creating 3rd schema table
INFORMATION IXXXX: Creating 1st data table
INFORMATION IXXXX: Creating 2nd data table
INFORMATION IXXXX: Creating 3rd data table
INFORMATION IXXXX: All done.

The current IRD has no name.
What name do you want to give it?
```

The Prototype names the new IRD, displays

```
The current IRD is <name of IRD>
```

places the user in this IRD, and returns the prompt symbol ">".

It should be emphasized that the IRDS Command Language requires the use of the semicolon as the terminator of a command. The Prototype will take no action, and will remain in a wait state if the user forgets to place a semicolon at the end of a command.

3. THE IRDS PROTOTYPE COMMAND LANGUAGE

The IRDS Prototype currently implements the following 21 commands:

IRD Commands

ADD ENTITY
MODIFY ENTITY
DELETE ENTITY
ADD RELATIONSHIP
MODIFY RELATIONSHIP
DELETE RELATIONSHIP
MODIFY ENTITY ACCESS-NAME
MODIFY ENTITY DESCRIPTIVE-NAME
COPY ENTITY
OUTPUT IRD

IRD-Schema Commands

ADD META-ENTITY
MODIFY META-ENTITY
DELETE META-ENTITY
ADD META-RELATIONSHIP
MODIFY META-RELATIONSHIP
DELETE META-RELATIONSHIP
MODIFY META-ENTITY ACCESS-NAME
OUTPUT IRD-SCHEMA

Utility Commands

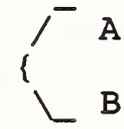
CREATE IRD
REMOVE IRD
EXIT
HELP

The HELP facility, in addition to providing users with on-line assistance, also serves to document the precise subset of the IRDS Command Language implemented in the current version of the Prototype.

The following sections present, for each implemented command, the subset of the Command Language syntax that has been included in the Prototype, along with one or more examples of the command's use. The format of the Prototype's response to a correctly specified command is also described, as are any differences between the Prototype implementation

and the Standard Command Language, as defined in the IRDS Specifications [1], and discussed in [2] and [3].

3.1 NOTATION

The construct  in the syntax listings below

represents a choice between the clauses A and B.

Words in capitals, such as ADD, ENTITY, and DESCRIPTIVE-NAME, are IRDS-defined words.

Angle brackets "<" and ">" enclose syntactic categories, e.g., "<access-name>" and "<attribute-clause>".

Square brackets "[" and "]" enclose optional items. A string of the form [, <C> ...] represents the occurrence of zero or more instances of syntactic category C.

3.2 IRD COMMANDS

3.2.1 ADD ENTITY

Syntax:

```
ADD ENTITY <access-name> ENTITY-TYPE = <entity-type>
  [ ENTITY DESCRIPTIVE-NAME = <descriptive-name>]
  [ WITH [ATTRIBUTES]  <attribute-clause>
                          [ , <attribute-clause> ... ] ] ;

  where <attribute-clause> is:
     <attribute-type> = <attribute>
                    or
        <attribute-group-type> =
          (     <component-attribute-type> = <attribute>
            [ , <component-attribute-type> = <attribute>
              ... ] )
```

Examples:

```
add entity u8 entity-type = system;

add entity u8 entity-type = system
    entity descriptive-name = example_system
```

```
    with comments = "this is an example system";

  add entity u8 entity-type = system
    with external-security = "none",
         location = "example book",
         identification-names =
           (alternate-name = "example",
            alternate-name-context = "here");
```

Prototype Response:

Entity <access-name> added.

3.2.2 MODIFY ENTITY

Syntax:

```
  MODIFY ENTITY <access-name>
    [ ENTITY DESCRIPTIVE-NAME  =  <descriptive-name> ]
    [ WITH [ ATTRIBUTES ] <attribute-clause>
                              [, <attribute-clause> ...] ;

  where <attribute-clause> is
    <attribute-type> = <attribute>
                    or
    <attribute-group-type> =
      (     <component-attribute-type> = <attribute>
         [, <component-attribute-type> = <attribute> ... ] )
```

Examples:

```
  modify entity PAYROLL-SYSTEM with
    external-security = "confidential",
    identification-names =
        (alternate-name = "PAYROLL-SYS",
         alternate-name-context = "DIVISION-100");

  modify entity AS
    entity descriptive-name = ACCOUNTING-SYSTEM;
```

Prototype Response:

```
Entity <access-name> modified.
```

3.2.3 DELETE ENTITY

Syntax:

```
DELETE ENTITY <access-name> [ , access-name ... ] ;
```

Examples:

```
delete entity u8a-30;

delete entity u8a-30, u8a-31, u8a-32;
```

Prototype Response:

```
Entity <access-name> deleted.
                .
                .
                .
Entity <access-name> deleted.
```

3.2.4 ADD RELATIONSHIP

Syntax:

```
ADD RELATIONSHIP

                        /‾ <relationship-type>
   <access-name-1>    {
                        \_ <relationship-class-type>

  [ NEW [ <entity-2-type> ] ]  <access-name-2>

    [  WITH [ATTRIBUTES]  <attribute-type> = <attribute>
              [ , <attribute-type> = <attribute> ... ] ] ;
```

Examples:

```
add relationship u8 system-contains-system u8a;

add relationship u8 contains new system u8a-30;

add relationship u8 system-contains-system new u8a-30;

add relationship u-8 processes payroll
  with access-method = "protected", frequency =
                                    "bi-monthly";
```

Prototype Response:

```
Relationship <access-name-1> <relationship-type>
             <access-name-2> added.
```

3.2.5 MODIFY RELATIONSHIP

Syntax:

```
MODIFY RELATIONSHIP

                      /‾<relationship-type>
  <access-name-1>   {
                      \_<relationship-class-type>

    <access-name-2>

    [  WITH [ATTRIBUTES]  <attribute-type> = <attribute>
            [ , <attribute-type> = <attribute> ... ] ] ;
```

Example:

```
modify relationship u8 processes payroll with
  frequency = "50", access-method = "direct";
```

Prototype Response:

```
Relationship <access-name-1> <relationship-type>
             <access-name-2> modified.
```

3.2.6 DELETE RELATIONSHIP

Syntax:

```
DELETE RELATIONSHIP

                      /‾ <relationship-type>
  <access-name-1> {
                      \_ <relationship-class-type>

    <access-name-2>

                        /‾ <relationship-type>
  [ , <access-name-1> {
                        \_ <relationship-class-type>

      <access-name-2>

                              ... ] ;
```

Examples:

```
delete relationship u8 system-contains-system u8-30;

delete relationship u8 contains u8-25, u8 contains u8a;
```

Prototype Response:

```
Relationship <access-name-1> <relationship-type>
                             <access-name-2> deleted.
                          .
                          .
                          .
Relationship <access-name-1> <relationship-type>
                             <access-name-2> deleted.
```

3.2.7 MODIFY ENTITY ACCESS-NAME

Syntax:

```
MODIFY ENTITY ACCESS-NAME FROM <old-name> TO <new-name> ;
```

Example:

```
modify entity access-name from u8-20 to test1;
```

Prototype Response:

```
Entity access-name modified from <old-name> to
                                        <new-name>.
```

3.2.8 MODIFY ENTITY DESCRIPTIVE-NAME

Syntax:

```
MODIFY ENTITY DESCRIPTIVE-NAME FROM <old-name>
                                    TO <new-name> ;
```

Example:

```
modify entity descriptive-name from
    Old-Long-Name-1234567890 to New-Long-Name-1234567890;
```

Prototype Response:

```
Entity descriptive-name modified from <old-name> to
                        <new-name> for <access-name>.
```

3.2.9 COPY ENTITY

Syntax:

```
COPY ENTITY <access-name-1> [ WITH RELATIONSHIPS ]
  TO <access-name-2>
    [ ENTITY DESCRIPTIVE-NAME = <descriptive-name> ] ;
```

Examples:

```
copy entity u8-20-10 with relationships to New-u8-20-10;

copy entity Tape_recording to Memoirs
         entity descriptive-name = Life_and_Times;
```

Prototype Response:

```
Entity <access-name-1> copied to
                              entity <access-name-2>.
```

3.2.10 GENERAL OUTPUT

Syntax:

```
  OUTPUT IRD

                 _
                / ALL ENTITIES
               /  ENTITIES [WITH] ACCESS-NAME = <scan-mask>
              /                        [, <scan-mask> ... ]
    SELECT   {   ENTITIES [WITH] DESCRIPTIVE-NAME =
              \             scan-mask [, <scan-mask> ... ]
               \ ENTITIES DIRECTLY RELATED TO <access-name>
                \_                     [, <access-name> ... ]

      [WHERE
        < conditional expression using "(", ")", "AND", "OR"
          and subexpressions:
            ENTITY-TYPE = <entity-type> [, <entity-type>...]
            ENTITY ASSIGNED ACCESS-NAME <rel-op>
                                              <access-name>
            ENTITY ASSIGNED DESCRIPTIVE-NAME <rel-op>
                                            <descriptive-name>
            <attribute-type> <rel-op> <attribute> > ]

              _
             / ALL
            /  ENTITY ACCESS-NAME
     SHOW  {   ENTITY DESCRIPTIVE-NAME
            \  ALL ATTRIBUTES
             \_ ALL RELATIONSHIPS

    ;
```

A <scan-mask> may use, in addition to explicitly specified characters, the substitution characters "*" and "?". Substitution character "*" matches any sequence of characters, including the null sequence; substitution character "?" matches any single character other than null. The term <rel-op> refers to one of the operators:

"=", equal to,
"/=", not equal to,
">", greater than,
"<", less than,
">=" or "/<", greater than or equal to,
"<=" or "/>", less than or equal to.

Examples:

```
output ird  select all  show all;

output ird
  select entities with  access-name = *database*, dbms*
    where  entity-type = file
  show entity access-name;
```

Prototype Response:

For each of the entities in a hypothetical IRD reported on by OUTPUT IRD SELECT ALL SHOW ALL; the Prototype would generate a display looking something like:

```
Entity = H-I

Descriptive-Name = Health-Insurance

Entity-Type = SYSTEM


                      Attributes

Added-By = Goldfine
Last-Modified-By = Kirk
          o
          o
          o
System-Category = Personnel


                   Attribute-Groups

Date-Time-Added
  System-Date = 19860720
  System-Time = 152654
Date-Time-Last-Modified
  System-Date = 19860723
  System-Time = 093150
```

```
                    Relationships

H-I SYSTEM-PROCESSES-FILE H-I-Carrier
  ACCESS-METHOD = Direct
  FREQUENCY = Weekly
J_Smith USER-RUNS-SYSTEM H-I
  FREQUENCY = Daily
          o
          o
          o
```

At the end of the output, the following message is displayed:

```
IRD output completed.
```

3.3 IRD-SCHEMA COMMANDS

3.3.1 ADD META-ENTITY

Syntax:

```
ADD META-ENTITY <meta-entity-name> META-ENTITY-TYPE =
                                        <meta-entity-type>
  [ WITH [META-ATTRIBUTES]
      <meta-attribute-type> = <meta-attribute>
   [, <meta-attribute-type> = <meta-attribute> ... ] ] ;
```

Examples:

```
add meta-entity COLOR meta-entity-type = attribute-type;

add meta-entity COLOR meta-entity-type = attribute-type
  with purpose = "this is attribute-type is used to
define the color of a DOCUMENT";
```

Prototype Response:

```
Meta-entity <meta-entity-name> added.
```

3.3.2 MODIFY META-ENTITY

Syntax:

```
MODIFY META-ENTITY <meta-entity-name>
  WITH [META-ATTRIBUTES]  <attribute-type> = <attribute>
                [, <attribute-type> = <attribute> ... ] ;
```

Examples:

```
modify meta-entity PUBLICATION
  with purpose = "this entity-type refers only to formally
published documents" ;

modify meta-entity COLOR
    with  maximum-number-of-occurrences = 7,
          format = string ;
```

Prototype Response:

```
Meta-entity <meta-entity-name> modified.
```

3.3.3 DELETE META-ENTITY

Syntax:

```
DELETE META-ENTITY <meta-entity-name>
  [WITH META-RELATIONSHIPS] ;
```

Example:

```
delete meta-entity u8a-30;
```

Prototype Response:

```
Meta-entity <meta-entity-name> deleted.
```

3.3.4 ADD META-RELATIONSHIP

Syntax:

```
ADD META-RELATIONSHIP

                        /‾ <meta-relationship-type>
  <meta-entity-1>   {
                        \_ <meta-relationship-class-type>

    <meta-entity-2>   [ POSITION = <n> ]

      [WITH [META-ATTRIBUTES]
        <meta-attribute-type> = <meta-attribute>
       [, <meta-attribute-type> = <meta-attribute> ... ] ] ;
```

Example:

```
add meta-relationship
  document-contains-program connects document
    position = 1  with purpose = "example";
```

Prototype Response:

```
Meta-relationship <meta-entity-1>
  <meta-relationship-type> <meta-entity-2> added.
```

3.3.5 MODIFY META-RELATIONSHIP

Syntax:

```
MODIFY META-RELATIONSHIP

                        /‾ <meta-relationship-type>
  <meta-entity-1>   {
                        \_ <meta-relationship-class-type>

    <meta-entity-2>   [ POSITION = <n> ]

      [WITH [META-ATTRIBUTES]
        <meta-attribute-type> = <meta-attribute>
       [, <meta-attribute-type> = <meta-attribute> ... ] ] ;
```

Example:

```
modify meta-relationship
  document-contains-program connects program  position = 2
    with purpose = "another example";
```

Prototype Response:

```
Meta-relationship <meta-entity-1>
  <meta-relationship-type> <meta-entity-2> modified.
```

3.3.6 DELETE META-RELATIONSHIP

Syntax:

```
DELETE META-RELATIONSHIP

                      /‾<meta-relationship-type>
  <meta-entity-1>   {
                      \_ <meta-relationship-class-type>

    <meta-entity-2>   [ POSITION = <n> ] ;
```

Example:

```
delete meta-relationship
  document-contains-program connects program
    position = 2;
```

Prototype Response:

```
Meta-relationship <meta-entity-1>
  <meta-relationship-type> <meta-entity-2> deleted.
```

3.3.7 MODIFY META-ENTITY ACCESS-NAME

Syntax:

```
MODIFY META-ENTITY ACCESS-NAME
  FROM <meta-entity-access-name-1>
    TO   <meta-entity-access-name-2> ;
```

Example:

modify meta-entity access-name from document to report;

Prototype Response:

```
Meta-entity access-name modified from
  <meta-entity-access-name-1>
      to <meta-entity-access-name-2>.
```

3.3.8 OUTPUT IRD-SCHEMA

Syntax:

```
OUTPUT IRD-SCHEMA

          _
         / ALL
SELECT {   <meta-entity-name>
         \_          [,  <meta-entity-name> ... ]

          _
         / ALL
        /  ALL META-ATTRIBUTES
SHOW   {   META-ATTRIBUTES
        \             <meta-attribute-type>
         \_               [, <meta-attribute-type> ... ]

;
```

Example:

output ird-schema select document show all;

Prototype Response:

For this command, the Prototype would generate a display looking something like:

```
Meta-Entity = DOCUMENT

Meta-Entity-Type = ENTITY-TYPE
```

```
                    Meta-Attributes

Added-By = BASIC-FUNCTIONAL-SCHEMA
Meta-Entity-Substitute-Name = DOC
Connectable = YES
        o
        o
        o
System-Generated = NO
System-Lock = ON


                Meta-Attribute-Groups

DATE-TIME-ADDED
  SYSTEM-DATE = 19860720
  SYSTEM-TIME = 152654
DATE-TIME-LAST-MODIFIED
  SYSTEM-DATE = 19860723
  SYSTEM-TIME = 093150


                  Meta-Relationships

DOCUMENT  ENTITY-TYPE-CONTAINS-ATTRIBUTE-TYPE
                                              ADDED-BY
    Implementation-Lock = OFF
            o
            o
            o
    System-Lock = ON
DOCUMENT  ENTITY-TYPE-CONTAINS-ATTRIBUTE-TYPE
                                          CLASSIFICATION
    Implementation-Lock = OFF
            o
            o
            o
    System-Lock = OFF
       o
       o
       o
DOCUMENT  ENTITY-TYPE-CONTAINS-ATTRIBUTE-GROUP-TYPE

                                     IDENTIFICATION-NAMES
    Implementation-Lock = OFF
            o
            o
            o
```

```
     System-Lock = OFF
 DOCUMENT-CONTAINS-DOCUMENT
            RELATIONSHIP-TYPE-CONNECTS-ENTITY-TYPE
                                                  DOCUMENT
     Implementation-Lock = OFF
            o
            o
            o
     System-Lock = OFF
        o
        o
        o
 USER-RESPONSIBLE-FOR-DOCUMENT
              RELATIONSHIP-TYPE-CONNECTS-ENTITY-TYPE
                                                  DOCUMENT
     Implementation-Lock = OFF
            o
            o
            o
     System-Lock = OFF
```

At the end of the output, the following message is displayed:

```
IRD-SCHEMA output completed.
```

NOTE: Care should be taken in issuing the command:

output ird-schema select all show all;

This command will cause the display of the entire IRD-Schema, which will include the Minimal Schema and, unless it has been redefined, the Basic Functional Schema. Over 350,000 characters of text are generated in the display of the Minimal and Basic Functional Schemas.

3.4 UTILITY COMMANDS

3.4.1 CREATE IRD

Syntax:

CREATE IRD <IRD-name> IRD-SCHEMA IS STANDARD ;

Example:

```
create ird production-2  ird-schema is standard;
```

The term "standard" in the Prototype's CREATE IRD command refers to a combination of the Minimal Schema and the Basic Functional Schema of the IRDS Standard.

Prototype Response:

```
INFORMATION IXXXX: Creating 1st schema table
INFORMATION IXXXX: Creating 2nd schema table
INFORMATION IXXXX: Creating 3rd schema table
INFORMATION IXXXX: Creating 1st data table
INFORMATION IXXXX: Creating 2nd data table
INFORMATION IXXXX: Creating 3rd data table
INFORMATION IXXXX: All done.
```

3.4.2 REMOVE IRD

Syntax:

```
REMOVE IRD <IRD-name> ;
```

Example:

```
remove ird  test-04;
```

Prototype Response:

```
IRD <IRD-name> removed.
```

The Specifications for the IRDS Command Language do not contain a REMOVE IRD command. However, the ability to create new IRDs certainly implies the need to remove them. Hence the Prototype was implemented with this command.

3.4.3 EXIT

Syntax:

```
EXIT ;
```

Example:

```
exit;
```

Prototype Response:

Return to calling program or operating system.

3.4.4 HELP

Syntax:

```
HELP [ <command> ] ;
```

Examples:

```
help;

help add meta-relationship;
```

Prototype Response:

For HELP;, a list of the currently available commands.

For HELP <command>;, a description of the syntax of that command, and some examples of command usage.

3.5 ERROR MESSAGES

The Prototype generates all the appropriate error messages specified in the IRDS Standard. In addition, certain error conditions that are not documented in the Specifications are recognized by the Prototype. These conditions cause the generation of self explanatory error messages beginning with "EXXXXX:".

3.6 COMMAND LANGUAGE ABBREVIATIONS

The Prototype accepts abbreviations for a set of IRDS-words that are defined in the Standard and that are part of the Command Language. An abbreviation can be used anywhere in place of its corresponding full formulation.

IRDS-word	Abbreviation
ACCESS-NAME	NAME
ALTERNATE-NAME	ANAME
ASSIGNED	ASSGN
ATTRIBUTES	ATTRB
ATTRIBUTE-TYPE	ATYPE
COPY	CPY
CREATE	CRE
DELETE	DEL
DESCRIPTIVE-NAME	DNAME
ENTITY-TYPE	ETYPE
META-ATTRIBUTES	MATRBS
META-ENTITY	MENTY
META-ENTITY-TYPE	METYPE
META-RELATIONSHIP	MREL
META-RELATIONSHIPS	MRELS
MODIFY	MOD
OUTPUT	OUT
RELATIONSHIP	REL
RELATIONSHIPS	RELS
RELATIONSHIP-TYPE	RTYPE

The Prototype also accepts the set of meta-entity substitute-names, such as DOC for DOCUMENT and SYS-CON-SYS for SYSTEM-CONTAINS-SYSTEM, defined as part of the "standard" schema. Appendices A and B of the IRDS Technical Overview [2] contain a complete list of these substitute-names.

4. THE IRDS PROTOTYPE SCHEMA

4.1 THE STRUCTURE OF THE SQL TABLES

Each IRD has associated with it eleven SQL tables, which contain all the IRD and IRD-schema data for that dictionary. These tables are:

- META-ATTRIBUTE-TYPE
- META-ATTRIBUTE-GROUP/META-ATTRIBUTE-TYPE
- META-ENTITY-TYPE/META-ATTRIBUTE-TYPE
- META-ENTITY-TYPE/META-ATTRIBUTE-GROUP-TYPE
- META-ENTITY/META-ATTRIBUTE
- META-ENTITY/META-ATTRIBUTE-GROUP
- META-RELATIONSHIP-TYPE/META-ATTRIBUTE-TYPE
- META-RELATIONSHIP/META-ATTRIBUTE
- ENTITY/ATTRIBUTE
- ENTITY/ATTRIBUTE-GROUP
- RELATIONSHIP/ATTRIBUTE

The following sections present the SQL definitions for each of these tables.

4.1.1 The META-ATTRIBUTE-TYPE Table

The META-ATTRIBUTE-TYPE table (MATYPE) stores the descriptive information defining the Prototype's meta-attribute-types, as specified in section 9.3 of Module 1 of the IRDS Specifications [1]. Each row of the table corresponds to a meta-attribute-type; the columns could be said to correspond to meta-meta-attribute-types. Once the Prototype source code is compiled, MATYPE is fixed, in that there is no provision in the Standard for a user to be able to redefine meta-attribute-types. Since it is fixed, MATYPE is stored once, and is shared by all IRDs using the given executable.

Definition:

```
create table MATYPE

(meta_attribute_type_name                    char (65),
 internal_name                               char (30),
 description                                 char (240),
 format                                      char (7),
 minimum_length                              integer (2),
```

```
 maximum_length                          integer (5),
 default_                                char (20),
 constraints                             char (240),
 repeating                               char (3),
 system_maintained                       char (3),
 fixed                                   char (3),
 required                                char (3),
 uniqueness_rules                        char (3) )
```

4.1.2 The META-ATTRIBUTE-GROUP-TYPE/META-ATTRIBUTE-TYPE Table

The META-ATTRIBUTE-GROUP-TYPE/META-ATTRIBUTE-TYPE (MAGTYPE_MATYPE) table describes the association between the meta-attribute-group-types and their component meta-attribute-types in the Prototype's IRD-schema, as specified in section 9.6 and Table 3 of Module 1 of the IRDS Specifications. Each row of the table corresponds to a component meta-attribute-type of a meta-attribute-group-type; each column corresponds to a meta-attribute-type. MAGTYPE_MATYPE is fixed, stored once, and shared by all IRDs.

Definition:

```
create table MAGTYPE_MATYPE

(magtype                                 char (64),
 internal_name                           char (30),
 matype                                  char (64),
 pos                                     integer (2),
 sys_chars                               char (2) )
```

4.1.3 The META-ENTITY-TYPE/META-ATTRIBUTE-TYPE Table

The META-ENTITY-TYPE/META-ATTRIBUTE-TYPE (METYPE_MATYPE) table describes the correspondence between the meta-entity-types and their associated meta-attribute-types in the Prototype's IRD-schema, as specified in section 9.4 and Table 1 of Module 1 of the IRDS Specifications. Each row of the table corresponds to a meta-entity-type; each column corresponds to a meta-attribute-type. METYPE_MATYPE is fixed, stored once, and shared by all IRDs.

Definition:

```
create table METYPE_MATYPE
(me_type                                char (40),
 defined_by                             char (2),
 alt_mname                              char (1),
 common                                 char (2),
 connectable                            char (1),
 e_class                                char (1),
 fmt                                    char (2),
 i_lock                                 char (1),
 integer_limit                          char (3),
 inverse                                char (1),
 last_changed_by                        char (1),
 origin                                 char (3),
 phase_class                            char (2),
 line_count_limit                       char (3),
 line_length_limit                      char (3),
 max_lngth                              char (2),
 max_dname_lngth                        char (2),
 max_dname_lngth_def                    char (1),
 max_name_lngth                         char (2),
 max_name_lngth_def                     char (1),
 max_name_limit                         char (3),
 max_occ_def                            char (1),
 max_occ_limit                          char (3),
 min_lngth                              char (2),
 min_dname_lngth                        char (2),
 min_dname_lngth_def                    char (1),
 min_name_lngth                         char (2),
 min_name_lngth_def                     char (1),
 i_count                                char (2),
 mod_count                              char (1),
 pic                                    char (1),
 purpose                                char (1),
 seq                                    char (2),
 sig_attrbs                             char (2),
 st_name                                char (1),
 string_length_limit                    char (3),
 sys_gened                              char (2),
 sys_lock                               char (2),
 validation_type                        char (1),
 var_lngth_limit                        char (3),
 rule_desc                              char (1),
 max_dname_lngth_lim                    char (3),
 max_menty_ass_name_lim                 char (3),
 max_menty_ass_dname_lim                char (3),
 r_name                                 char (4),
```

```
 r_mname                                    char (4),
 mode_                                      char (1),
 sys_maint                                  char (1),
 grp_txt_alwd                               char (3),
 var                                        char (1) )
```

4.1.4 The META-ENTITY-TYPE/META-ATTRIBUTE-GROUP-TYPE Table

The META-ENTITY-TYPE/META-ATTRIBUTE-GROUP-TYPE (METYPE_MAGTYPE) table describes the correspondence between the meta-entity-types and their associated meta-attribute-group-types in the Prototype's IRD-schema, as specified by section 9.7 and Table 4 of Module 1 of the IRDS Specifications. Each row corresponds to a meta-entity-type; each column corresponds to a component meta-attribute-type of a meta-attribute-group-type. METYPE-MAGTYPE is fixed, stored once, and shared by all IRDs.

Definition:

```
create table METYPE_MAGTYPE
(metype                                     char (64),
 data_range                                 char (1),
 data_value                                 char (1),
 added                                      char (2),
 modified                                   char (2) )
```

4.1.5 The META-ENTITY/META-ATTRIBUTE Table

The META-ENTITY/META-ATTRIBUTE (MENTY_MATT) table stores all meta-attributes associated with all meta-entities in the Prototype's IRD-schema. Each row corresponds to a meta-entity; each column corresponds to a meta-attribute-type. When a new IRD is created, the table is initially populated with the meta-entities in the Minimal Schema and the Basic Functional Schema, as specified in section 10.2.1 of Module 1 and section 5.1 of Module 2 of the IRDS Specifications. As new meta-entities are added to the IRD-schema, they are entered into this table.

Definition:

```
create table MENTY_MATT
(me_type                                    char (35),
 menty                                      char (64),
```

```
id_number                                integer (3),
internal_name                            char (30),
menty_variation_name                     char (8),
menty_revision_number                    integer (1),
menty_ass_dname                          char (64),
defined_by                               char (32),
alt_mname                                char (32),
common                                   char (3),
connectable                              char (3),
e_class                                  char (8),
fmt                                      char (7),
i_lock                                   char (3),
integer_limit                            integer (22),
inverse                                  char (64),
last_changed_by                          char (32),
origin                                   char (8),
phase_class                              char (12),
line_count_limit                         integer (5),
line_length_limit                        integer (3),
max_lngth                                integer (5),
max_dname_lngth                          integer (3),
max_dname_lngth_def                      integer (3),
max_name_lngth                           integer (3),
max_name_lngth_def                       integer (3),
max_name_limit                           integer (3),
max_occ_def                              integer (3),
max_occ_limit                            integer (3),
min_lngth                                integer (2),
min_dname_lngth                          integer (2),
min_dname_lngth_def                      integer (2),
min_name_lngth                           integer (1),
min_name_lngth_def                       integer (1),
i_count                                  integer (9),
mod_count                                integer (9),
pic                                      char (64),
purpose                                  char (65535),
seq                                      char (3),
sig_attrbs                               integer (2),
st_name                                  char (31),
string_length_limit                      integer (3),
sys_gened                                char (3),
sys_lock                                 char (3),
validation_type                          char (5),
var                                      char (31),
var_lngth_limit                          integer (2),
rule_desc                                char (1),
max_dname_lngth_lim                      integer (2),
max_menty_ass_name_lim                   integer (2),
```

```
 max_menty_ass_dname_lim                integer (2),
 r_name                                 char (1),
 r_mname                                char (1),
 mode_                                  char (8),
 sys_maint                              char (3),
 grp_txt_alwd                           char (3) )
```

4.1.6 The META-ENTITY/META-ATTRIBUTE-GROUP Table

The META-ENTITY/META-ATTRIBUTE-GROUP (MENTY_MAG) table stores all meta-attribute-groups associated with all meta-entities in the Prototype's IRD-schema. Each row corresponds to a meta-entity; each column corresponds to a component meta-attribute-type of a meta-attribute-group-type. When a new IRD is created, the table is initially populated with the meta-entities in the Minimal Schema and the Basic Functional Schema, as specified in section 10.2.1 of Module 1 and section 5.1 of Module 2 of the IRDS Specifications. As new meta-entities are added to the IRD-schema, they are entered into this table.

Definition:

```
create table MENTY_MAG
(menty                                  char (64),
 menty_var_name                         char (8),
 menty_rev_num                          integer,
 added$date                             char (8),
 added$time                             char (6),
 modified$date                          char (8),
 modified$time                          char (6) )
```

4.1.7 The META-RELATIONSHIP-TYPE/META-ATTRIBUTE-TYPE Table

The META-RELATIONSHIP-TYPE/META-ATTRIBUTE-TYPE (MRTYPE_MATYPE) table describes the correspondence between the meta-relationship-types and their associated meta-attribute-types in the Prototype's IRD-schema, as specified in section 9.5 and Table 2 of Module 1 of the IRDS Specifications. Each row corresponds to a meta-relationship-type; each column corresponds to a meta-attribute-type. MRTYPE_MATYPE is fixed, stored once, and shared by all IRDs.

Definition:

```
create table MRTYPE_MATYPE
(mrtype                                    integer (2),
 metype1                                   char (35),
 metype2                                   char (35),
 mrel_class_type                           char (9),
 mrel_type                                 char (64),
 grp_pos                                   char (2),
 i_lock                                    char (2),
 max_occ                                   char (1),
 origin                                    char (3),
 pos                                       char (1),
 purpose                                   char (1),
 seq_parm                                  char (1),
 sing                                      char (1),
 sys_lock                                  char (2) )
```

4.1.8 The META-RELATIONSHIP/META-ATTRIBUTE Table

The META-RELATIONSHIP/META-ATTRIBUTE (MREL_MATT) table stores all meta-attributes associated with all meta-relationships in the Prototype's IRD-schema. Each row corresponds to a meta-relationship; each column corresponds to a meta-attribute-type. When a new IRD is created, the table is initially populated with the meta-relationships defined in the Minimal Schema and the Basic Functional Schema, as specified in section 10.3 of Module 1 and section 6 of Module 2 of the IRDS Specifications. As new meta-relationships are added to the IRD-schema, they are entered into this table.

Definition:

```
create table MREL_MATT
(mrtype                                    integer (2),
 menty1                                    char (64),
 menty1_var                                char (8),
 menty1_rev_num                            integer,
 menty2                                    char (64),
 menty2_var                                char (8),
 menty2_rev_num                            integer,
 grp_pos                                   integer (2),
 i_lock                                    char (3),
 max_occ                                   integer (3),
 origin                                    char (8),
 pos                                       integer (1),
```

```
 purpose                                  char (65535),
 seq_parm                                 char (3),
 sing                                     char (8),
 sys_lock                                 char (3) )
```

4.1.9 The ENTITY/ATTRIBUTE Table

The ENTITY/ATTRIBUTE (ENTY_ATT) table stores all attributes associated with all entities in the application IRD. Each row corresponds to an entity; each column corresponds to an attribute-type defined in the schema of the application IRD. The table is empty when the IRD is created. As entities are added to the IRD, they are entered into this table. When new attribute-types are defined in the schema, corresponding columns are added to the table, making the table dynamic with respect to columns as well as rows.

The following definition is not an extract from the Prototype source code, but is equivalent to that more dynamic definition:

Definition:

```
create table ENTY_ATT
(entity_type                              char (64),
 entity_name                              char (32),
 var_name                                 char (8),
 rev_num                                  integer,
 descriptive_name                         char (64),
 added_by                                 char (32),
 allowable_value                          char (32),
 classification                           char (32),
 code_list_location                       char (32),
 comments                                 char (240),
 data_class                               char (32),
 data_type                                char (16),
 description                              char (5000),
 dict_partition_name                      char (32),
 document_category                        char (32),
 external_security                        char (32),
 internal_format                          char (32),
 ird_schema_phase_name                    char (32),
 justification                            char (5),
 last_modified_by                         char (32),
 length                                   integer,
 location                                 char (32),
 mod_count                                integer,
```

```
 integer_of_records                    integer,
 num_lines_code                        integer,
 precision                             integer (2),
 record_category                       char (32),
 scale                                 integer (2),
 system_category                       char (32),
 usage                                 char (32) )
```

4.1.10 The ENTITY/ATTRIBUTE-GROUP Table

The ENTITY/ATTRIBUTE-GROUP (ENTY_AG) table stores all attribute-groups associated with all entities in the application IRD. Each row corresponds to an entity; each column corresponds to a component attribute-type of an attribute-group-type defined in the schema of the application IRD. The table is empty when the IRD is created. As entities are added to the IRD, they are entered into this table. When new attribute-group-types are defined in the schema, corresponding columns are added to the table, making the table dynamic with respect to columns as well as rows.

The following definition is equivalent to the definition found in the source code:

Definition:

```
create table ENTY_AG
(entity_name                           char (32),
 var_name                              char (8),
 rev_num                               integer,
 alw_range$high_of_range               char (32),
 alw_range$low_of_range                char (32),
 duration$duration_type                char (32),
 duration$duration_value               char (22),
 d_t_added$system_date                 char (8),
 d_t_added$system_time                 char (6),
 d_t_mod$system_date                   char (8),
 d_t_mod$system_time                   char (6),
 id_names$alternate_name               char (32),
 id_names$alt_name_context             char (32) )
```

4.1.11 The RELATIONSHIP/ATTRIBUTE Table

The RELATIONSHIP/ATTRIBUTE (REL_ATT) table stores all attributes associated with all relationships in the application IRD. Each row corresponds to a relationship; each col-

umn corresponds to an attribute-type defined in the schema of the application IRD. The table is empty when the IRD is created. As relationships are added to the IRD, they are entered into this table. When new attribute-types are defined in the schema, corresponding columns are added to the table, making the table dynamic with respect to columns as well as rows.

Definition:

```
create table REL_ATT
(relationship_type                    char (64),
 entity1                              char (32),
 var_name1                            char (8),
 rev_num1                             integer,
 entity2                              char (32),
 var_name2                            char (8),
 rev_num2                             integer,
 relationship_class_type              char (64)
 relationship_type                    char (64),
 entity1                              char (32),
 var_name1                            char (8),
 rev_num1                             integer,
 entity2                              char (2),
 var_name2                            char (8),
 rev_num2                             integer,
 relationship_class_type              char (64),
 access_method                        char (32),
 default_view                         char (3),
 frequency                            char (32),
 relative_position                    integer (22) )
```

4.2 IMPLEMENTOR DEFINED VALUES IN THE IRDS PROTOTYPE

The IRDS Standard Specifications [1] characterize many of the meta-meta-attributes and meta-attributes in the above tables as "implementor defined" or "installation specified" when applied to specific meta-attribute-types or meta-entities. The following sections list the values used in the Prototype for these meta-meta-attributes and meta-attributes.

4.2.1 Values For Meta-Attribute-Types

ADDED-BY
  Maximum Length = 32

DECODED-VALUE
  Maximum Length = 32

ENCODED-VALUE
  Maximum Length = 32

GROUP-POSITION
  Maximum Length = 2

HIGH-VALUE
  Maximum Length = 22

INTEGER-LIMIT
  Maximum Length = 22

INVERSE-NAME
  Maximum Length = 32

LAST-MODIFIED-BY
  Maximum Length = 32

LINE-COUNT-LIMIT
  Maximum Length = 5

LOW-VALUE
  Maximum Length = 22

MAXIMUM-NUMBER-OF-OCCURRENCES
  Maximum Length = 3

MAXIMUM-NUMBER-OF-OCCURRENCES-DEFAULT
  Maximum Length = 3

MAXIMUM-NUMBER-OF-OCCURRENCES-LIMIT
  Maximum Length = 3

META-ENTITY-SUBSTITUTE-NAME
  Maximum Length = 32

MINIMUM-ATTRIBUTE-LENGTH
  Maximum Length =

NUMBER-OF-INSTANCES
  Maximum Length = 22

NUMBER-OF-TIMES-MODIFIED
  Maximum Length = 22

ORIGIN
  Minimum Length = 6
  Maximum Length = 8

PICTURE
  Maximum Length = 32

PURPOSE
  Minimum Length = 1
  Maximum Length = 5000

SEQUENCE-PARAMETER
  Minimum Length = 2
  Maximum Length = 3

SIGNIFICANT-ATTRIBUTES
  Maximum Length = 2

START-NAME
  Maximum Length = 8

VARIATION
  Maximum Length = 2

VARIATION-LENGTH-LIMIT
  Maximum Length = 2

4.2.2 Values For Meta-Entities

The following are the implementor defined meta-attributes for the "Standard IRD-Schema" meta-entities:

Each meta-entity has either MINIMAL-SCHEMA or BASIC-FUNCTIONAL-SCHEMA, as appropriate, as its Added-By meta-attribute.

Entity-Types

Each entity-type has for its Meta-Entity-Substitute-Name the value given in sections A.1 and B.1 of the IRDS Technical Overview [2].

For each entity-type:

  Maximum-Entity-Assigned-Access-Name-Length = 32
  Maximum-Entity-Assigned-Descriptive-Name-Length = 64

Minimum-Entity-Assigned-Access-Name-Length = 1
Minimum-Entity-Assigned-Descriptive-Name-Length = 1

Relationship-Types and Relationship-Class-Types

Each relationship-type and relationship-class-type has for its Meta-Entity-Substitute-Name the value given in sections A.2 and B.2 of the IRDS Technical Overview.

Attribute-Types

ADDED-BY
Maximum-Attribute-Length = 32
Minimum-Attribute-Length = 1

DEFAULT-VIEW
Meta-Entity-Substitute-Name = DEF-VIEW
Maximum-Attribute-Length = 3
Minimum-Attribute-Length = 2

IRD-PARTITION-NAME
Maximum-Attribute-Length = 32
Minimum-Attribute-Length = 1

LAST-MODIFIED-BY
Meta-Entity-Substitute-Name = LAST-MOD-BY
Maximum-Attribute-Length = 32
Minimum-Attribute-Length = 1

NUMBER-OF-TIMES-MODIFIED
Meta-Entity-Substitute-Name = NO-TIMES-MOD
Maximum-Attribute-Length = 22
Minimum-Attribute-Length = 1

IRD-SCHEMA-PHASE-NAME
Meta-Entity-Substitute-Name = S-PH-NAME
Maximum-Attribute-Length = 32
Minimum-Attribute-Length = 1

SYSTEM-DATE
Maximum-Attribute-Length = 8
Minimum-Attribute-Length = 8

SYSTEM-TIME
Maximum-Attribute-Length = 6
Minimum-Attribute-Length = 6

ACCESS-METHOD
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

ALLOWABLE-VALUE
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

ALTERNATE-NAME
  Meta-Entity-Substitute-Name = ALT-NAME
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

ALTERNATE-NAME-CONTEXT
  Meta-Entity-Substitute-Name = ALT-NAME-CONTEXT
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

CLASSIFICATION
  Meta-Entity-Substitute-Name = CLASS
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

CODE-LIST-LOCATION
  Meta-Entity-Substitute-Name = CODE-LOC
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

COMMENTS
  Maximum-Attribute-Length = 240
  Minimum-Attribute-Length = 1

DATA-CLASS
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

DATA-TYPE
  Maximum-Attribute-Length = 16
  Minimum-Attribute-Length = 5

DESCRIPTION
  Meta-Entity-Substitute-Name = DESC
  Maximum-Attribute-Length = 5000
  Minimum-Attribute-Length = 1

DOCUMENT-CATEGORY
  Meta-Entity-Substitute-Name = DOC-CAT
  Maximum-Attribute-Length = 32

```
  Minimum-Attribute-Length = 1

DURATION-TYPE
  Meta-Entity-Substitute-Name = DUR-TYPE
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

DURATION-VALUE
  Meta-Entity-Substitute-Name = DUR-VAL
  Maximum-Attribute-Length = 22
  Minimum-Attribute-Length = 1

EXTERNAL-SECURITY
  Meta-Entity-Substitute-Name = SEC
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

FREQUENCY
  Meta-Entity-Substitute-Name = FREQ
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

HIGH-OF-RANGE
  Meta-Entity-Substitute-Name = HIGH
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

INTERNAL-FORMAT
  Meta-Entity-Substitute-Name = INTF
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

JUSTIFICATION
  Meta-Entity-Substitute-Name = JUS
  Maximum-Attribute-Length = 5
  Minimum-Attribute-Length = 4

LENGTH
  Maximum-Attribute-Length = 22
  Minimum-Attribute-Length = 1

LOCATION
  Meta-Entity-Substitute-Name = LOC
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

LOW-OF-RANGE
  Meta-Entity-Substitute-Name = LOW
```

```
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

NUMBER-OF-LINES-OF-CODE
  Meta-Entity-Substitute-Name = NO-LINES-CODE
  Maximum-Attribute-Length = 22
  Minimum-Attribute-Length = 1

NUMBER-OF-RECORDS
  Meta-Entity-Substitute-Name = NO-OF-RECS
  Maximum-Attribute-Length = 22
  Minimum-Attribute-Length = 1

PRECISION
  Maximum-Attribute-Length = 2
  Minimum-Attribute-Length = 1

RECORD-CATEGORY
  Meta-Entity-Substitute-Name = REC-CAT
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

RELATIVE-POSITION
  Meta-Entity-Substitute-Name = REL-POS
  Maximum-Attribute-Length = 22
  Minimum-Attribute-Length = 1

SCALE
  Meta-Entity-Substitute-Name = SCL
  Maximum-Attribute-Length = 2
  Minimum-Attribute-Length = 1

SYSTEM-CATEGORY
  Meta-Entity-Substitute-Name = SYS-CAT
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

USAGE
  Maximum-Attribute-Length = 32
  Minimum-Attribute-Length = 1

IRDS-Defaults

EXISTING-IRDS-DEFAULTS
  Format = STRING
  Maximum-Attribute-Length = 32
  Maximum-Entity-Assigned-Descriptive-Name-Length = 64
```

```
  Maximum-Entity-Assigned-Descriptive-Name-Length-
                                                Default = 64
  Maximum-Entity-Assigned-Access-Name-Length = 32
  Maximum-Entity-Assigned-Access-Name-Length-Default = 32
  Maximum-Number-Of-Occurrences = 10
  Maximum-Number-Of-Occurrences-Default = 10
  Minimum-Attribute-Length = 1
  Minimum-Entity-Assigned-Descriptive-Name-Length = 1
  Minimum-Entity-Assigned-Descriptive-Name-Length-
                                                Default = 1
  Minimum-Entity-Assigned-Access-Name-Length = 1
  Minimum-Entity-Assigned-Access-Name-Length-Default = 1
  Significant-Attributes = 1
  Standard-Mode = YES
```

IRDS-Limits

EXISTING-IRDS-LIMITS

```
  Integer-Limit = 10000000000000000000000
  Line-Count-Limit = 32767
  Line-Length-Limit = 80
  Maximum-Entity-Assigned-Access-Name-Length-Limit = 32
  Maximum-Entity-Assigned-Descriptive-Name-Length-Limit = 64
  Maximum-Meta-Entity-Assigned-Access-Name-Length-Limit = 32
  Maximum-Meta-Entity-Assigned-Descriptive-Name-Length-
                                                Limit = 64
  Maximum-Number-Of-Occurrences-Limit = 10
  String-Length-Limit = 72
  Variation-Name-Limit = 8
```

5. THE IRDS PROTOTYPE SOURCE CODE

5.1 OVERVIEW

The C language Prototype program translates IRDS commands into SQL commands and sends these to the Oracle database management system, where the database representing the IRD is maintained. The program performs various consistency checks, some of which include calls to the DBMS to access data. Formatting of the output and some of the entity selection is done at the C program level. The remainder of the selection is done through the DBMS facilities.

5.2 DICTIONARY SUBROUTINES

When the user executes the IRDS prototype, the C program looks for the Oracle table DICTIONARY_NAMES to get a list of available IRDs. If no such table is found, the subroutine SET_DICT will call MK_DICT to create the necessary tables. MK_DICT creates and fills DICTIONARY_NAMES and those tables that are fixed. MK_DICT also creates a set of tables that are modifiable, adding prefix A_ to the name of each such table. MK_DICT then fills the new schema level tables, the data for which comes from the file IRDS.TBL. The IRD level tables are then created using the information contained in the schema level tables. The user is then asked to name the new IRD.

If the DICTIONARY_NAMES table exists but is empty, then the Prototype assumes that the static tables and a set of dictionary tables have already been created and filled. In this case, the user is asked to name the IRD.

If there is data in the DICTIONARY_NAMES table, then the list of IRDs is displayed to the user for the user's selection.

When the user executes a CREATE IRD command, the program executes the subroutine CRE_DICT, which finds a prefix to use and then creates a new IRD. The subroutine SET_DICT, which is responsible for making sure that the user is placed in the correct IRD, is executed before the user is given a prompt.

5.3 PARSING THE COMMANDS

Preliminary parsing of each IRDS command is performed by the subroutine GETCOM. GETCOM calls subroutines READCOM and INDEXCOMM. READCOM reads in a command from the standard input. INDEXCOMM takes the string of input from READCOM and divides it into words which are stored in the global array WORD. INDEXCOMM also determines which command was typed in, and records this in the global variable NCOMMAND.

Subroutine DO_COMMAND, called after GETCOM, calls subroutine CK_SYNTAX. CK_SYNTAX calls subroutine MATCH_TEMPLATE, giving it the template for the specific command and the array of words that INDEXCOMM produces. MATCH_TEMPLATE checks, word-by-word, that the template matches the array of words given. MATCH_TEMPLATE will not do any backtracking, instead counting on having unique choices when there are several options.

MATCH_TEMPLATE assumes that the following characters, when they appear in a template, mean special things:

[ ] { | } # ` '

These special meanings are as follows:

- [and] surround a part of the command that is optional.
- The construct { a | b | c } matches exactly one of a, b, or c, where a, b, and c do not have to be simple.
- ` a ' will match 0 or more a's, where a does not have to be simple. The check for another a is made before the check for what comes after the ' in the template, and this should be considered when writing templates.
- The character # is followed by a number, 1 through 9, which is the index to be used into an array of linked lists. The word at this position in the input is added to the linked list which has the given index.

Linked lists are used so that instances of the same type of structure can be stored together into fixed places in the array. For example, a list of attributes specified in an ADD or MODIFY command can all be in one place. These linked lists are dynamic, but because what is stored in them gets translated and stored into non-dynamic structures later,

there is a limit, about 100, to the number of items that can be in a list.

Output commands are not completely parsed by MATCH_TEMPLATE, which counts on subroutine WHERE_S to more thoroughly parse any WHERE clause. WHERE_S makes sure that the attribute-types used do exist, and also does other similar checks. WHERE_S uses backtracking to find the correct parse.

5.4 COMMAND SUBROUTINES

After a command has been read in and parsed, the linked list of values from the parse is passed by DO_COMMAND to the subroutine for that command. Each command has a corresponding subroutine, and each subroutine has, as its name, an abbreviation of the name of the command. The subroutines do the required consistency checking, and translate the command into a SQL command or a series of SQL commands, which are then executed. Examples of constraints that are checked are: modifying only existing entities, adding only one entity with a given access-name, and adding an attribute for an entity only if the entity's type is meta-related to the attribute's type with an entity-type-contains-attribute-type meta-relationship. Some of the checks involve retrieving information out of the Oracle database using SQL commands executed through subroutine calls. Some of the checks and actions are common to several commands, and thus have been written as separate subroutines.

5.5 OCI SUBROUTINES

The Oracle Call Interface, OCI, subroutines are the subroutines supplied by the DBMS. They all start with an O and are described in Oracle's Pro*C User's Guide. These subroutines allow SQL commands to be executed against a database in Oracle.

5.6 HLI SUBROUTINES

The Prototype's C program contains a special set of subroutines, the name of each member of which starts with HLI_. This is an attempt at a consistent interface to the DBMS that both eliminates the repeated writing of certain sequences of calls to Oracle's OCI subroutines, and also

checks for errors. Not all of the calls to the OCI subroutines in the rest of the code have been replaced, but the number has been reduced. This effort has helped to place the direct interface to the DBMS into a limited area of the source code.

5.7 GLOBAL VARIABLES

There are a few variables that were made global because of their frequent use in different subroutines. These global variables are defined at the top of each source code file. Two of the variables, CURSOR and LDA, were defined for the Oracle subroutines to use. WORD is an array of 100 strings that will hold the input after it has been split up into words. NWORDS is the number of words in the array WORD. PREFIX indicates which IRD a user has activated. NCOMMAND records the type of the current command (e.g., ADD ENTITY or OUTPUT IRD). There are a few global variables that are defined near the definition of a subroutine, and which are used only in that subroutine or set of subroutines.

5.8 PROGRAM DATA STRUCTURES

In each of the source code files, types are defined before the global variables are defined. Most of the types defined are structures. There are separate structures that store information about entities, relationships, and attributes, and similar ones that store information at the schema level.

There are a few static variables. The space for these is allocated in the global area, but the variables can be used only where they are defined. The static variables were used to save values between calls to a subroutine, without making the program responsible for the values.

Constants are defined in the file IRDS.CON. and are all in uppercase. One set of constants is used to allow the variable NCOMMAND to be assigned the name of a command instead of an integer or a string. Using an integer directly as the name of a command is confusing, and using a string would require a sequence of ELSE IF statements to determine which command subroutine to call. There is a set of constants to be used to set the length of strings, but these

constants have not been used consistently enough to allow them to be increased without the likelihood of problems arising.

6. INSTALLATION INSTRUCTIONS

The following are needed to install and run the Prototype:

1. A copy of the Oracle Database Management System

2. A "C" Compiler

3. Two 5 1/4 inch diskettes, supplied by ICST-NBS. These diskettes are written in DOS double-sided double-density format, and contain five ASCII text files. The files are:

```
irdsa.c  _)
irdsb.c    > ---  the source code
irdsc.c  _)

irds.con     ---  the settable constants

irds.tbl     ---  the IRD-schema tables
```

To install the Prototype, the following steps should be performed in the order given:

1. Transfer the files from the diskettes to the host computer.

2. Choose or create an Oracle account for the IRDS tables.

3. Change the

```
#define  ORACLE_UID  "irds/irds"
```

   statement in irds.con by replacing "irds/irds" with the Oracle userid/password to be used by the IRDS.

4. Change the

```
#define  TABLEFILE  "dra1:[kirk.irds.joe]irds.tbl"
```

   statement in irds.con by replacing

```
"dra1:[kirk.irds.joe]irds.tbl"
```

with the complete name of the file that irds.tbl is stored in.

5. Compile irdsa.c, irdsb.c, and irdsc.c, using any standard "C" compiler. The Prototype uses Oracle version 4 or version 5 HLI subroutines, so the HLI libraries must be linked.

6. Run the executable. The first time it is run it will create and fill the tables it needs.

Other than in connection with 3 and 4 above, or in conjunction with a deliberate modification of the source code itself, it's probably not advisable to change any of the constants in irds.con. If you do change any of the constants, the source code must be recompiled. A newly compiled version can use the tables created by a previous version.

If you encounter any problems installing or using the Prototype, please contact Tammy Kirkendall at (301)975-3253 or Alan Goldfine at (301)975-3252.

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11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

This publication is a report on the Information Resource Dictionary System (IRDS) Command Language prototype developed by the Institute for Computer Sciences and Technology of the National Bureau of Standards. It discusses the structure, source code, and operating environment of the Prototype, specifies the precise subset of the standard IRDS Command Language implemented, provides instructions for installing the Prototype software, and leads the reader through a typical user session.

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command language; data dictionary; data dictionary system; Information Resource Dictionary System; IRDS; prototype.

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