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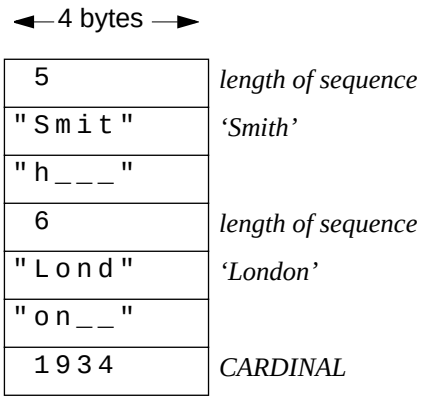
Sun XDR

External data representation ◊ Sun XDR (External Data Representation) [Santifaller 1991; Sun 1990] and Courier [Xerox 1981] are examples of standards defining a representation for the commonly used simple and structured data types including strings, arrays, sequences and records. The Sun XDR standard was developed by Sun for use in the messages exchanged between clients and servers in Sun NFS (see Chapter 8).The Courier standard was developed by Xerox and is used in the ANSA testbench (Chapter 5).

The type of a data item is not given with the data representation in the message in either of these standards. In contrast, the ASN.1 (Abstract Syntax Notation) standard [CCITT 1985] provides a notation for defining the type as part of the representation of each item. The Mach distributed operating system (Chapter 18) 'tags' each item of data in a message with its type. However, it is not necessary to label message items with their types when messages are used in a context in which sender and recipient have common knowledge of the order and types of the items in a message.

Figure 0.1 shows a message in the Sun XDR external data representation in which the entire message consists of a sequence of 4-byte objects using a convention that a cardinal or integer occupies one object and that strings of four characters also occupy an object. Arrays, structures and strings of characters are represented as sequences of bytes with the length specified. Characters are in ASCII code. A further convention defines which end of each object is the most significant and, when characters are packed, which of the four bytes comes first. The use of a fixed size for each object in a message reduces computational load at the expense of bandwidth.

Figure 0.1 XDR message.



The message is: 'Smith', 'London', 1934

References

[Santifaller 1991] Santifaller. M. (1991). *TCP/IP and NFS, Internetworking in a Unix Environment*. Reading MA: Addison-Wesley.

[Sun 1990] Sun Microsystems Inc. (1990). *Network Programming*. Sun Microsystems, Mountain View, CA. March

[Xerox 1981] Xerox Corporation (1981). *Courier: the remote procedure call protocol*. *Xerox Systems Integration Standards*. Stamford CT: Xerox Corporation.

[CCITT 1985] CCITT (1985). *Recommendation X.409*: Presentation Transfer Syntax and Notation. Red Book, vol. VIII, International Telecommunications Union, Place des Nations, 1211 Geneva, Switzerland.

Marshalling by hand: A simple way of marshalling by hand is to convert the items to an array of ASCII characters before transmission. For example, the marshalled message corresponding to Figure 0.1 might contain the following sequence of characters:

```
5 Smith 6 London 1934
```

In C programs, *sprintf* may be used to convert data items to an array of characters and *sscanf* may be used to retrieve the data items form an array of characters. For example, the sending program might include:

```
char *name = "Smith", place = "London"; int year = 1934;
sprintf(message, "%d %s %d %s %d",
    strlen(name), name, strlen(place), place, year);
```

The receiving program will then convert the characters in the incoming message into values for name, place and year. This method of marshalling is wasteful of bandwidth.