A STRUCTURED FORMAT FOR TRANSMISSION OF MULTI-MEDIA DOCUMENTS

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August 1980

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PREFACE

This is the first edition of this format specification and should be
treated as a request for comments, advice, and suggestions. A great
deal of prior work has been done on computer aided message systems and
some of this is listed in the reference section. This specification was
shaped by many discussions with members of the ARPA research community,
and others interested in the development of computer aided message
systems. This document was prepared as part of the ARPA sponsored
Internetwork Concepts Research Project at ISI.

                                                            Jon Postel

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1. INTRODUCTION

This document describes a format for transmitting structured data
representations of multimedia documents. This format is intended to be
used with the Internet Message Protocol in an internetwork message
delivery system. That system is designed to transmit messages between
processes in host computers called Message Processing Modules (MPMs).
MPMs are located in several networks and together constitute an
internetwork message delivery system. The Internet Message Protocol
defines a message as being composed of an Identification, a Command, and
a Document. This report is intended to define the format of such
Documents. The reader is assumed to be familiar with the Internet
Message Protocol [1].

1.1. Motivation

   Computer applications are being implemented which interact with users
   in a variety of media (text, graphics, facsimile, speech). As
   computer devices become available to process multimedia information it
   becomes desirable to use computers to exchange multimedia information
   between programs and users via various mechanisms including computer
   mail.

1.2. Scope

   This format is intended to be used for the transmission of multimedia
   documents in the internetwork message delivery system, but it is
   thought that it has a wider applicability.

1.3. Terminology

   The messages are routed by a process called the Message Processing
   Module or MPM. Messages are created and consumed by User Interface
   Programs (UIPs) in conjunction with users.

   The basic unit transferred between MPMs is called a message. A
   message is made up of a transaction identifier (which uniquely
   identifies the message), a command (which contains the necessary
   information for delivery), and document. The document is a data
   structure.

   For a personal letter the document body corresponds to the contents of

   the letter; the document header corresponds to the date line,
   greeting, and signature.

   For an inter-office memo the document body corresponds to the text;
   the document header corresponds to the header of the memo.

   The commands correspond to the information used by the Post Office or
   the mail room to route the letter or memo. Some of the information in
   the command is supplied by the UIP.

1.4. Document Description

   The document is composed of fields. Each field will carry an
   identifying name. Typical fields are DATE, TO, SUBJECT, and BODY.
   Most of the fields will be very simple, some will be complex. The
   body field may be quite complex. For example, the DATE is a very
   constrained character string specifying the date and time in ISO
   format. A more complex example is the TO field which is a list of
   mailboxes, where a mailbox is itself a property list of address
   information items. The BODY may be simply a character string, or a
   very structured collection of data representing information in
   different media.

   The BODY may be structured to indicate a controlled presentation of
   multimedia information. There is provision for the inclusion of text,
   graphics, facsimile, and voice information in the body of documents.
   The presentation of information units may sequential, independent, or
   simultaneous.

1.5. Other Work

   This protocol the benefited from the earlier work on message protocols
   in the ARPA Network [2,3,4,5,6], and the ideas of others about the
   design of computer message systems [7,8,9,10,11,12,13,14,15,16,17,18].

                    2.   SPECIFICATION

The structured format of a document is built on the basic data elements
used in the Internet Message Protocol [1].

2.1. Document

  The document is a property list of <name,value> pairs called fields.
  A few fields are specifically required and many are optional. Some of
  the field values are simple and a few are quite complicated. In
  particular the body value may be highly structured.

  Older message systems have considered the document to be divided into
  a header and a body, and have used keywords to indicate specific
  header fields (e.g., date, to, subject). Roughly speaking, this
  functionality is provided in this new structured format by considering
  the name part of the <name,value> pair to be a keyword. In addition,
  this new structured format eliminates the separate treatment of the
  body.

  It is impossible to foresee the many forms documents will take so the
  standard for a document header must be flexible. The approach here is
  to define a set of basic fields and allow addition of whatever fields
  are necessary. Features added in this fashion may not be understood
  by others.

  The minimum document is a property list of the following fields:

     Name   Value
     ----   -----
     DATE   date string (name)
     SENDER   a mailbox
     SUBJECT   subject string (text)
     BODY   a data structure

  A typical document is a property list containing the following fields:

     Name   Value
     ----   -----
     DATE   date string (name)
     SENDER   a mailbox
     FROM   list of mailboxes
     TO   list of mailboxes
     CC   list of mailboxes
     SUBJECT   subject string (text)
     BODY   a data structure

An elaborate document might contain the following fields:

```
Name          Value
----          -----
DATE          date string (name)
SENDER        a mailbox
FROM          list of mailboxes
TO            list of mailboxes
CC            list of mailboxes
BCC           list of mailboxes
REPLY-TO      list of mailboxes
SUBJECT       subject string (text)
COMMENTS      comment string (text)
MESSAGE-ID    message identifier of this message (text)
IN-REPLY-TO   message identifier of previous message (text)
REFERENCES    message identifiers of other messages (text)
KEYWORDS      key terms used in this message (text)
BODY          a data structure
```

One of the key objects is the mailbox. It appears in the sender,
from, to, cc, bcc, and reply-to fields. The mailbox is a property
list of objects that combine to specify a destination recipient for a
message. Most of the <name,value> pairs that make up a mailbox are
identical to those used in the deliver command in the Internet Message
Protocol [1]. A few additional <name,value> pairs are defined for use
in a mailbox in the document context. In particular, there is a field
for the real name of a person in contrast to the "user name" which
identifies a computer account.

In addition there is a field to specify a distribution group name.
Such group names are used to indicate that a document is being sent to
a group of recipients. This essentially presents an alternate form
for a mailbox which consists of the single <name,value> pair for the
group name. There is no required relationship between a group name
mailbox and other mailboxes in the same list.

For example, all of the following situations are allowed:

   . a mailbox list consisting of a single mailbox specifying a
      particular user,

   . a mailbox list consisting of a single mailbox with a group name,

   . a mailbox list consisting of a mailbox with a group name and a
      mailbox specifying a particular user, with either the user in or
      not in the group,

   . a mailbox list consisting of a mailbox with a group name and a

          several mailboxes specifying a particular users, with some users
          in the group and some not,

       . a mailbox list consisting of several mailboxes specifying group
          names and a several mailboxes specifying a particular users, with
          some users in the groups and some not.

2.2. Message Objects

   In the documents of messages, we use a set of objects such as mailbox
   or date. These objects are encoded in basic data elements. Some
   objects are simple things like integers or character strings, other
   objects are more complex things like lists or property lists. The
   following is a list of the objects used in messages. The object
   descriptions are in alphabetical order.

   Account

      The account information. Represented by a name element.

   Address

      Address is intended to contain the minimum information necessary to
      identify a user, and no more (compare with mailbox).

      An address is a property list which contains the following
      <name,value> pairs:

         name   description
         ----   -----------
         NET   network name
         HOST   host name
         USER   user name

      or:

         name   description
         ----   -----------
         MPM   mpm-identifier
         USER   user name

   Answer

      A yes (true) or no (false) answer to a question. Represented by a
      boolean element.

BCC

   A list of mailboxes. The addresses of those who receive "blind
   carbon copies" of the message.

Body

   A data structure. This may be as simple as a character string
   (represented by a name or text element), or complex structure of
   lists. It may be encrypted in part or in whole. Section 3.3
   describes some possible structured bodies.

C

   A character. Represented by a name element.

CC

   A list of mailboxes. When copies of a message are sent to others in
   addition to the addresses in the To object, those to whom the copies
   are sent will have their addresses recorded here.

City

   A city. Represented by a name element.

Comments

   A comment string. Represented by a text element.

Count

   A count of items of some sort. Represented by a integer element.

Country

   A country. Represented by a name element.

   Date

      The date and time are represented according to the International
      Standards Organization (ISO) recommendations [19,20,21]. Taken
      together the ISO recommendations 2014, 3307, and 4031 result in the
      following representation of the date and time:

        yyyy-mm-dd-hh:mm:ss,fff+hh:mm

      Where yyyy is the four-digit year, mm is the two-digit month, dd is
      the two-digit day, hh is the two-digit hour in 24 hour time, mm is
      the two-digit minute, ss is the two-digit second, and fff is the
      decimal fraction of the second. To this basic date and time is
      appended the offset from Greenwich as plus or minus hh hours and mm
      minutes.

      The time is local time and the offset is the difference between
      local time and Coordinated Universal Time (UTC). To convert from
      local time to UTC algebraically subtract the offset from the local
      time.

      For example, when the time in
              Los Angeles is 14:25:00-08:00
              the UTC is   22:25:00

      or when the time in
              Paris is   11:43:00+01:00
              the UTC is   10:43:00

   Device

      A device name. Represented by a name element.

   Document

      A property list of fields.

   Distribution Group

      An distribution group is a property list which contains the
      following <name,value> pair:

        name   description
        ----   -----------
        GROUP   document distribution group name

      This construct is used so that a distribution group will be a
      special case of a mailbox.

Facsimile Structure

   A facsimile data structure. Represented by a property list.

File

   A file name. Represented by a name element.

Format

   A format indicator. Represented by a name element.

From

   A list of mailboxes. The From is the name of the author of a
   document.

Graphics Structure

   A graphics data structure. Represented by a property list.

Group

   A document distribution group name. Represented by a name element.

Host

   A host name. Represented by a name element.

Ident

   The identifier of a person, usually their initials. Represented by
   a name element.

In-Reply-To

   The message identifier of previous message. Represented by a text
   element.

Internet Address

   This identifies a host in the ARPA internetwork environment. The
   internet address is a 32 bit number, the higher order 8 bits
   identify the network, and the lower order 24 bits identify the host
   on that network [22]. For use in this format the internet address
   is divided into eight bit fields and the value of each field is
   represented in decimal digits. For example, the ARPANET address of
   ISIE is 167837748 and is represented as 10,1,0,52. Further, this

   representation may be extended to include an address within a host,
   such as the TCP port of an MPM, for example, 10,1,0,52,0,45.

  Keywords

   The key terms used in this message. Represented by a text element.

  Mailbox

   This is the destination address of a user of the internetwork mail
   system. Mailbox contains information such as network, host,
   location, and local user identifier of the recipient of the message.
   The mailbox may contain information in addition to the minimum
   required for delivery.

   As an example, when one sends a message to someone for the first
   time, he may include many items to aid in identifying the correct
   recipient. However, once he gets a reply to this message, the reply
   will contain an Address (as opposed to Mailbox) which may be used
   from then on.

     A mailbox is a property list. A mailbox might contain the
     following <name,value> pairs:

        name   description
        ----   -----------
        MPM   mpm-identifier
        NET   network name
        HOST   host name
        PORT   address of MPM within the host
        USER   user name (computer account name)
        PERSON   the real name of a person
        GROUP   document distribution group
        ORG   organization name
        CITY   city
        STATE   state
        COUNTRY country
        ZIP   zip code
        PHONE   phone number

   The minimum mail box is an Address or a Distribution Group.

  Message-ID

   The message identifier of this message. This is not related to the
   MPM message identification, but is a UIP long term document
   identifier. Represented by a text element.

MPM-Identifier

   The internetwork address of an MPM. This may be the ARPA Internet
   Address or an X.121 Public Data Network Address [23]. The
   mpm-identifier is a property list which has one <name,value> pair.
   This unusual structure is used so that it will be easy to determine
   the type of address used.

Net

   A network name. Represented by a name element.

NLS Block

   The information in an NLS node. Represented by a property list.

NLS Node

   An NLS block and substructure. Represented by a property list.

NLS Substructure

   A list of NLS nodes. Represented by a list.

Org

   An organization name. Represented by a name element.

Paragraph

   A paragraph of text. Represented by a text element.

Parcel

   The basic unit of voice data. Represented by a bitstr element.

Person

   The real name of a person. Represented by a name element.

Password

   A password. Represented by a name element.

Phone

   A phone number. Represented by a name element.

   Pointer

      A pointer to information stored outside this data structure. A
      property list containing the information necessary to locate the
      external data, the information necessary to gain access to the
      external data, and the information necessary to apply the correct
      interpretation to the external data. For example, this might
      include:

         name   description
         ----   -----------
         NET   network name
         HOST   host name
         FILE   file name
         USER   user name (computer account name)
         PASSWORD   password
         ACCOUNT   account
         FORMAT   format

   Port

      The address of MPM within the host. Represented by a name element.

   Presentation Descriptor

      A property list of <name,value> pairs, where the name is an order
      indicator, and the value is a presentation element. The order
      indicators are SEQUENTIAL, SIMULTANEOUS, and INDEPENDENT.

   Presentation Element

      A property list of media structures.

   Protocol

      The name of the coding scheme used for a medium. Represented by a
      name element.

   References

      The message identifiers of other messages. Represented by a list of
      text elements.

   Reply-To

      A list of mailboxes. Sometimes it will be desired to direct the
      replies of a message to some address other than the from or the
      sender. In such a case the reply-to object can be used.

R 450 Block

  The unit of Rapicom 450 data (585 bits). Represented by a bitstr
  element.

Sender

  A mailbox. The sender will contain the address of the individual
  who sent the message. In some cases this is NOT the same as the
  author of the message. Under such a condition, the author should be
  specified in the from object.

SID

  An NLS statement indetifier. Represented by a integer element.

State

  A state name. Represented by a name element.

Subject

  The subject of the message. Represented by a text element.

Text Structure

  A text data structure. Represented by a property list.

To

  A list of mailboxes. To identifies the addressees of the message.

User

  A user name (computer account name). Represented by a name element.

Version

  A version number. Represented by a index element.

Vocoder

  A vocoder name. Represented by a name element.

Voice Structure

  A voice data structure. Represented by a property list.

   X121 Address

     This identifies a host in the Public Data Network environment. When
     used as a part of identifier, it identifies the originating host of
     a message. The X121 address is a sequence of up to 14 digits [23].
     For use in this format the X121 address is represented in decimal
     digits.

   ZIP

     A zip code. Represented by a name element.

2.3. Body Structures

  2.3.1. Simple Elements

     The body could simply be a single data element. For example a
     single text element can represent a lengthy character string.

         <body> := TEXT

         or

         text:"this is the actual text of the body"

  2.3.2. Structured Text

     The body could be thought of as paragraphs, where each paragraph is
     represented by a text element. The paragraphs are then the elements
     of a list.

         <body> := LIST (<paragraph>, <paragraph>, ...)

           <paragraph> := TEXT

         or

         list:(text:"paragraph one", text:"paragraph two", ...)

  2.3.3. NLS File Example

     It is possible to represent the data from NLS files in this format.
     NLS is a large multipurpose system which operates on structured data
     files. The files are tree structured, and there is data associated
     with each node of the tree. There are several fields associated
     with each node as well.

An NLS file is:

```
  proplist(                                               file
    name:"FILENAME", name:<file>                   name of file
    name:"CREATION-DATE", name:<date>        creation date and time
    name:"VERSION", index:<version>           file version number
    name:"SID-COUNT", integer<count>            current SID count
    name:"LAST-WRITER", name:<ident>          last writer of file
    name:"OWNER", name:<ident>                     owner of file
    name:"LAST-WRITE-TIME", name:<date>     last write date and time
    name:"LEFT-NAME-DELIM-DEFAULT", name:<c>         default name
    name:"RIGHT-NAME-DELIM-DEFAULT", name:<c>          delimiters
    name:"SUBSTRUCTURE", <nls-substructure>         substructure
  )endlist
```

An NLS substructure is:

```
  list:(                                          substructure
    <nls-node>                            node is defined below
      .
      .
      .
  )endlist
```

An NLS node is:

```
  proplist:(                                               node
    name:"BLOCK", <nls-block>               block defined below
    name:"SUBSTRUCTURE", <nls-substructure>        substructure
  )endlist
```

An NLS block is:

```
  proplist:(                                              block
    name:"LEFT-NAME-DELIM", name:<c>        left name delimiter
    name:"RIGHT-NAME-DELIM", name:<c>      right name delimiter
    name:"SID", integer:<sid>                        SID number
    name:"CREATOR", name:<ident>              statement creator
    name:"CREATION-TIME", name:<date>     creation date and time
    name:"DATA", <data>                       data defined below
  )endlist
```

    NLS data is:

      proplist:(data
        name:"<a data name>", <type depends on data name>
                        .   .
                        .   .
                        .   .
)endlist

    For text, data is:

      proplist:(data
        name:"TEXT", text:"text of statement"   text
)endlist

2.3.4. Multimedia Structures

    One can conceive of graphical information being displayed along with
    a running commentary, much as seminars use slides. A slide and its
    description are tied together. The coordination of such a
    presentation is central to its understanding. This synchronization
    should be captured within the document structure.

    There are three fundamentally different types of time ordered
    control which are needed within the document structure. These are:

        Simultaneous
        Sequential
        Independent

    Simultaneous data is intended for synchronous presentation. The
    implication is that this data is presented in parallel.

    Sequential data items will be presented one at a time, in the order
    listed. The ordering is strictly left to right.

    Independent data can be presented in any time order. It is not
    ordered in any manner.

    The data is broken into small information units called presentation
    elements or PEs. The PEs can be combined in structures to control
    the presentation order. A PE is a property list of elements
    representing information of various media. For example:

        <pe> := proplist(
                name:"VOICE", <voice-structure>,
                name:"GRAPHICS", <graphics-structure>
)endlist

    PEs are combined into larger controled presentations by
    presentation-descriptors or PDs. A PD is a property list which
    specifies the type of time ordering of the PEs in its list.

        <pd> := <<seq>> | <<sim>> | <<ind>>

        <<seq>> := name:"SEQUENTIAL", <pe>

        <<sim>> := name:"SIMULTANEOUS", <pe>

        <<ind>> := name:"INDEPENDENT", <pe>

    A PE is a property list of the media <name,value> pairs, or PDs.

        <pe> := <<text>> | <<voice>> | <<facsimile>>
              | <<graphics>> | <pd>

        <<text>> := name:"TEXT", <text structure>

        <<voice>> := name:"VOICE", <voice structure>

        <<facsimile>> := name:"FACSIMILE", <facsimile structure>

        <<graphics>> := name:"GRAPHICS", <graphics structure>

    If more than one <name,value> pair is present within a PE the media
    are presented on different output devices in the order specified by
    the PE's parent PD. The order of appearance within the proplist is
    important only in the event that the parent PD specified sequential
    ordering.

    The structure of multimedia messages which use this scheme will be
    demonstrated by a few simple examples chosen to illustrate a basic
    text document and the different ordering options. The last example
    will suggest some more exotic uses.

     Plain Text Message

       A simple text body could be represented in a single text data
       structure. To give the simplest example of a structured body we
       show a simple text body represented in the multimedia structure.

          <body> := <pd>

            <pd> := <<seq>>

              <<seq>> := name:"SEQUENTIAL", <pe>

                <pe> := name:"TEXT", <text structure>

          or

          proplist: (name:"SEQUENTIAL",
                    proplist:(
                      name:"TEXT", <text structure>
)endlist
)endlist

     Simultaneous Ordering

       This ordering option is used to indicate when separate streams are
       to be presented in parallel. For example, assume GRAPHICS and
       VOICE data were to be presented using simultaneously.

          <body> := <pd>

            <pd> := <<sim>>

              <<sim>> := name:"SIMULTANEOUS", <pe>

                <pe> := name:"VOICE", <voice structure>
                        name:"GRAPHICS", <graphics structure>

          or

          proplist:(
            name:"SIMULTANEOUS",
              proplist:(
                name:"VOICE", <voice structure>
                name:"GRAPHICS", <graphics structure>
)endlist
)endlist

Sequential Ordering

This option is used to indicate sequential time ordering. The
media in the sub-tree below this PD are not separate streams.
Using again the example above, assume GRAPHICS and VOICE data were
to be presented using sequential ordering.

```
<body> := <pd>

  <pd> := <<seq>>

    <<seq>> :=  name:"SEQUENTIAL", <pe>

      <pe> := name:"VOICE", <voice structure>
              name:"GRAPHICS", <graphics structure>

or

proplist:(
  name:"SEQUENTIAL",
    proplist:(
      name:"VOICE", <voice structure>
      name:"GRAPHICS", <graphics structure>
    )endlist
)endlist
```

Independent Ordering

It is apparent that some output devices are very slow in
comparison to others. An example which demonstrates this is
facsimile. The majority of facsimile devices are slow. A
detailed picture transmitted at 9600 baud takes minutes to print.
It is inconvenient for the user to wait on such a device when the
voice or text information which accompanies it is short.

For example, if the document a facsimile image and the text
"Hello Frank, here's a copy of that picture you requested." The
user need not wait for the picture. The facsimile machine might
be spooled, in which case he would pick up the picture later. In
a sense the picture was time independent of the text.

```
      <body> := <pd>

        <pd> := <<ind>>

          <<ind>> :=  name:"INDEPENDENT", <pe>

            <pe> := name:"FACSIMILE", <facsimile structure>
                    name:"TEXT", <text structure>

      or

      proplist:(
        name:"INDEPENDENT",
          proplist:(
            name:"FACSIMILE", <facsimile structure>
            name:"TEXT", <text structure>
          )endlist
      )endlist
```

   A Stream Example

      By making use of the structure and the sequential ordering option
      it is possible to initiate a stream. The stream will proceed at
      its own pace until concluded.

```
        <body> := <pd>

          <pd> := <<seq>>

            <<seq>> :=  name:"SEQUENTIAL", <pe>

              <pe> := <pd>

                <pd> := <<sim>>

                  <<sim>> :=  name:"SIMULTANEOUS", <pe>

                    <pe> := name:"VOICE", <voice structure>
                            name:"GRAPHICS", <graphics structure>
```

```
       or

       proplist:(
         name:"SEQUENTIAL",
           proplist:(
             name:"SIMULTANEOUS",
               proplist:(
                 name:"VOICE", <voice structure>
                 name:"GRAPHICS", <graphics structure>
               )endlist,
             name:"SIMULTANEOUS",
               proplist:(
                 name:"VOICE", <voice structure>
                 name:"GRAPHICS", <graphics structure>
               )endlist,
           .
           .
           .
           )endlist
       )endlist
```

   Such a document structure suggests a slide presentation.

  Multiple Active Stream Example

   This example is exotic but illustrates what is possible. By making
   use of the structure and the simultaneous ordering it is possible
   to start in parallel two or more separate streams. Each stream
   will proceed at its own pace until all are concluded.

```
      <body> := <pd>

        <pd> := name:"SIMULTANEOUS", <pe>

          <pe> = <pd>

            <pd> := name:"SEQUENTIAL", <pe>

              <pe> = <pd>

                <pd> := name:"SIMULTANEOUS", <pe>

                  <pe> := name:"VOICE",
                                                <voice structure>
                          name:"GRAPHICS",
                                            <graphics structure>
```

```
        or

        proplist:(
         name:"SIMULTANEOUS",
            proplist:(
              name:"SEQUENTIAL",
                proplist:(
                  name:"SIMULTANEOUS",
                    proplist:(
                      name:"VOICE", <voice structure>
                      name:"GRAPHICS", <graphics structure>
                    )endlist,
                  name:"SIMULTANEOUS",
                     proplist:(
                       name:"VOICE", <voice structure>
                       name:"GRAPHICS", <graphics structure>
                     )endlist,
                  .
                  .
                  .
                )endlist
              name:"SEQUENTIAL",
                proplist:(
                  name:"SIMULTANEOUS",
                    proplist:(
                      name:"VOICE", <voice structure>
                      name:"GRAPHICS", <graphics structure>
                    )endlist,
                  .
                  .
                  .
                )endlist
            )endlist
        )endlist
```

2.3.5. The Media

   So far no explicit description has been given for the media classes
   which fit into a PE. It is not known what types of media will be
   supported in the various document stations in the future. Those for
   which support is in part already available are:

     TEXT
     VOICE
     FACSIMILE
     GRAPHICS

   Standard formats for data in each of these media must be defined.

   2.3.6. TEXT

   The text data may be structured according to a variety of protocols
   (yet to be defined). The top level of the data structure is a
   property list which identifies the protocol, and the version of that
   protocol.

      name:"TEXT", proplist:(
                     name:"PROTOCOL", <protocol>,
                     name:"VERSION", <version>,
                     name:"DATA", <data>
)endlist

   The first protocol is called PARAGRAPH, and the data is a list of
   paragraphs, where each paragraph is a text element.

      name:"DATA", list:(
                     text: <paragraph>
                     text: <paragraph>
                     .
                     .
                     .
)endlist

   2.3.7. VOICE

   Since a good deal of research has been done towards implementing the
   transmission of voice data on the ARPANET, the Network Voice
   Protocol (NVP) provides the basis for the standard for voice data
   [24].

   Voice data a property list which specifies the vocoder being used,
   the transmission protocol and the parcel data. The parcel data form
   is specific to the protocol used and is grouped in lists.

      name:"VOICE", proplist:(
                     name:"VOCODER", <vocoder>,
                     name:"PROTOCOL", <protocol>,
                     name:"VERSION", <version>,
                     name:"DATA", <data>
)endlist

   The NVP protocol has a number of parameters, the version number
   specifies a certain set of the parameters used by the vocoder
   hardware and software to set up timing and define the type of coding
   used. It is not expected that within a document the version number
   will change.

     NVP itself supports negotiation of these parameters to insure both
     ends of a network speech connection 'understand' one another. Since
     no such interactive negotiation is possible in a document system,
     negotiation capabilities have been excluded. As differing hardware
     becomes available new versions may be defined.

     For the NVP protocol the data list will take the following form:

        name:"DATA", list:(
                     bitstr: <parcel>
                     bitstr: <parcel>
                      .
                      .
                      .
)endlist

     The items in the list are parcels. The individual parcels are bit
     string data elements whose contents and length are predefined by the
     version number. The number of parcels in a parcel group is
     available from the item count in the enclosing list header.

   2.3.8. FACSIMILE

     There are a number of facsimile devices in use. While standards are
     being established by CCITT [25], of the devices available today many
     are incompatible due to proprietary compression algorithms. The
     description of fax data will allow for the possibility of several
     protocols.

        name:"FACSIMILE", proplist:(
                     name:"DEVICE", <device>,
                     name:"PROTOCOL", <protocol>,
                     name:"DATA", <data>
)endlist

     There are few facsimile devices interfaced to computers though, and
     the existing experiments in the ARPANET all use the RAPICOM 450. A
     first facsimile standard format will be based on the data structure
     used for this machine [26]. That is, for device RAPICOM450 and
     protocol BLOCK, the data will be:

        name:"DATA", list:(
                     bitstr:<r450-block>,
                     bitstr:<r450-block>,
                      .
                      .
                      .
)endlist

Where an r450-block is a 585 bit unit.

2.3.9. GRAPHICS

The situation for graphics bears much similarity to facsimile.
Devices on the market today have a variety of user interfaces and
options. A similar structure is defined.

```
name:"GRAPHICS", proplist:(
                  name:"DEVICE", <device>,
                  name:"PROTOCOL", <protocol>,
                  name:"DATA", <data>
                )endlist
```

There are several candidate protocols for use in describing graphics
data in documents. One is the Network Graphics Protocol [27],
another is the Graphics Language [28,29], and a third is the
SIGGRAPH Core System [30].

                    3.   EXAMPLES & SCENARIOS

Example 1: Text Example

  Suppose we want to send the following message:

     Date: 1979-03-29-11:46-08:00
     From: Jon Postel <Postel@ISIF>
     Subject: Meeting Thursday
     To: Danny Cohen <Cohen@ISIB>
     CC: Linda

     Danny:

     Please mark your calendar for our meeting Thursday at 3 pm.

     --jon.

  It will be encoded in the structured format. The following will
  present successive steps in the top down generation of this message.
  The identification and command portions of the messages will not be
  expanded here (see [1]).

  1. message

  2. (identification, command, document)

  3. (ID:<<identification>>,
       CMD:<<command>>,
       DOC:(date, from, subject, to, cc, body))

  4. (ID:<<identification>>,
       CMD:<<command>>,
       DOC:(DATE:date,
            FROM:from
            SUBJECT:subject,
            TO:to,
            CC:cc,
            BODY:body))

  5. (ID:<<identification>>,
       CMD:<<command>>,
       DOC:(DATE: 1979-03-29-11:46-08:00,
            FROM: (NET:ARPANET,HOST:ISIF,USER:Postel,PERSON:Jon Postel),
            SUBJECT: Meeting Thursday,
            TO: (NET:ARPANET,HOST:ISIB,USER:Cohen,PERSON:Danny Cohen),
            CC: (NET:ARPANET,HOST:ISIF,USER:Linda),
            BODY:
              Danny:

```
            Please mark your calendar for our meeting
            Thursday at 3 pm.

            --jon.))

  6.   PROPLIST:
       (ID:<<identification>>,
        CMD:<<command>>,
        DOC:
          PROPLIST:(
            DATE: 1979-03-29-11:46-08:00,
            FROM:
              LIST:(
                PROPLIST:(
                  NET:ARPANET,
                  HOST:ISIF,
                  USER:Postel,
                  PERSON:Jon Postel,
                )ENDLIST,
              )ENDLIST,
            SUBJECT: Meeting Thursday,
            TO:
              LIST:(
                PROPLIST:(
                  NET:ARPANET,
                  HOST:ISIB,
                  USER:Cohen,
                  PERSON:Danny Cohen,
                )ENDLIST,
              )ENDLIST,
            CC:
              LIST:(
                PROPLIST:(
                  NET:ARPANET,
                  HOST:ISIF,
                  USER:Linda,
                )ENDLIST,
              )ENDLIST,
            BODY:
              Danny:

              Please mark your calendar for our meeting
              Thursday at 3 pm.

              --jon.
          )ENDLIST
        )ENDLIST
```

```
7.  proplist:(
      name:"ID", <<identification>>,
      name:"CMD", <<command>>,
      name:"DOC",
        proplist:(
          name:"DATE", name:"1979-03-29-11:46-08:00",
          name:"FROM",
            list:(
              proplist:(
                name:"NET", name:"ARPANET",
                name:"HOST", name:"ISIF",
                name:"USER", name:"Postel",
                name:"PERSON", name:"Jon Postel",
              )endlist,
            )endlist,
          name:"SUBJECT", text:"Meeting Thursday",
          name:"TO",
            list:(
              proplist:(
                name:"NET", name:"ARPANET",
                name:"HOST", name:"ISIB",
                name:"USER", name:"Cohen",
                name:"PERSON", name:"Danny Cohen",
              )endlist,
            )endlist,
          name:"CC",
            list:(
              proplist:(
                name:"NET", name:"ARPANET",
                name:"HOST", name:"ISIF",
                name:"USER", name:"Linda",
              )endlist,
            )endlist,
          name:"BODY",
            text:"Danny:

                  Please mark your calendar for our
                  meeting Thursday at 3 pm.

                  --jon."
        )endlist
      )endlist
```

Example 2: Multimedia Example


```
proplist:(
  name:"ID", <<identification>>,
  name:"CMD", <<command>>,
  name:"DOC",
    proplist:(
      name:"DATE", name:"1980-08-06-11:46-08:00",
      name:"FROM",
        list:(
          proplist:(
            name:"NET", name:"ARPANET",
            name:"HOST", name:"ISIF",
            name:"USER", name:"Postel",
            name:"PERSON", name:"Jon Postel",
          )endlist,
        )endlist,
      name:"SUBJECT", text:"Multimedia Test Message",
      name:"TO",
        list:(
          proplist:(
            name:"GROUP", name:"Multimedia Experiment List",
          )endlist,
        )endlist,
      name:"CC",
        list:(
          proplist:(
            name:"NET", name:"ARPANET",
            name:"HOST", name:"ISIF",
            name:"USER", name:"Linda",
          )endlist,
        )endlist,
      name:"BODY",
        proplist:(
          name:"SEQUENTIAL",
            proplist:(
              name:"TEXT",
                proplist:(
                  name:"PROTOCOL", name:"PARAGRAPH",
                  name:"VERSION", index:"1",
                  name:"DATA",
                    list:(
                      text:"This is a test of multimedia mail."
                      text:"I hope you like it."
                    )endlist
                )endlist
```

```
                    name:"SIMULTANEOUS",
                      proplist:(
                        name:"VOICE",
                          proplist:(
                            name:"VOCODER", name:<vocoder>,
                            name:"PROTOCOL", name:"NVP",
                            name:"VERSION", index:"1",
                            name:"DATA",
                              list:(
                                bitstr:<parcel>
                                bitstr:<parcel>
                              )endlist
                          )endlist
                        name:"GRAPHICS",
                          proplist:(
                            name:"DEVICE", name:<device>,
                            name:"PROTOCOL", name:<protocol>,
                            name:"VERSION", index:<version>,
                            name:"DATA",<data>
                              )endlist
                          )endlist
                      )endlist
              name:"SEQUENTIAL",
                proplist:(
                  name:"TEXT,
                    proplist:(
                      name:"PROTOCOL", name:"PARAGRAPH",
                      name:"VERSION", index:"1",
                      name:"DATA",
                        list:(
                          text:"That was supposed to be some voice
                                and graphics in parallel."
                          text:"--jon."
                        )endlist
                    )endlist
                )endlist
            )endlist
        )endlist
    )endlist
```

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