REPORT 1207

REFERENCE MODEL FOR DATA BROADCASTING

(1990)

1. Introduction

The study and development of systems and services of data broadcasting are active in various areas such as the television and sound channels in terrestrial and satellite broadcasting.

In order to ease standardization of data broadcasting systems and to facilitate smooth evolution of data broadcasting services in the future, the development of a common reference model for data broadcasting is necessary.

In particular, the use of such a reference model would facilitate the description and introduction of integrated services digital broadcasting (ISDB) which could include teletext, still pictures, audio signals, high fidelity audio, facsimile, data and other type of information.

In the CCIR Reccomendation 653 the teletext systems are described having an alignment with the ISO layer model for open systems architecture. This layered model could also be the basis for the development of a common reference model for data broadcasting whereby the four lower layers describe the data broadcasting system and the three upper layers generally characterize the service.

2. Definition

Data Broadcasting: the broadcasting of coded information intended to be received by means of appropriate data processing equipment.

3. A layered Model for Data Broadcasting

A hierarchical organization of communication functions for data broadcasting is presented in Fig.1 where the functional items, listed at each hierarchical level, do not refer to specific implementation solutions, but to the overall logical features that are considered sufficient to characterize the service and performance of any typical system.

According to this functional model, services may be delivered by arranging the information into logical groupings, delivering them to lower layers for proper form for use by the recipient.

In what follows, the names of the layers are those adopted by the ISO in ISO 7498 (1984) "Basic reference model for open systems interconnection".

LAYER 1: Physical

Within a given broadcast transmission system this layer relates to the electrical transmission of the data signal and includes such items as bit rate and pulse shaping.

LAYER 2: Data link

This layer includes logical functions related to the data transmission such as digital frame syncronization techniques and associated error control procedures, and data formatting.

LAYER 3: Network

This layer includes logical functions related to multiplexing, demultiplexing and error control of data packets belonging to different communication flows. Examples of such functions are data channel addressing and data packet sequencing.

LAYER 4: Transport

This layer provides the function of arranging the data in a way suitable for secure transfer from one point to another, by such means as scrambling where applicable and segmenting data into groups of information, delivering them to the lower layers for transmission to the distant point and there reconstituting the groups of information and arranging them in a proper sequence.

LAYER 5: Session

This layer includes data handling functions which are intended to assist the user to gain access to services.
Examples of such functions are access control and information selection.

LAYER 6: Presentation

This layer comprises the functions needed for the presentation of information relevant to each application which could include text, pictures, sound and other types of processable data.

LAYER 7: Application

This layer refers to practical use of the potential facilities provided by the lower layers for a given type of service.
Examples are captioning, telesoftware, cyclic teletext, stock market data, telemusic, etc..

ISO: Reference Model	Data broadcasting	
Layer	Principal function	Classification
7 Application	Use of information at application level	Service information protocol
6 Presentation	Conversion & presentation of information	
5 Session	Selection of and access to information	
4 Transport	Identification of group of data	Data broadcasting system
3 Network	Identification of logical channel	
2 Data Link	Linkage with logical transmission unit	
1 Physical	Physical transmission	

FIGURE 1 - Layer structure of data broadcasting

An example to illustrate the feasibility of the reference model in describing a broadcast software service using the FM radio channel, in operation in Italy, is given in the Annex.

ANNEX

RAI - Radiosoftware

outline of the communication protocol

A system for broadcasting software and data files in FM sound channels, called RAI - Radiosoftware, has been developed in Italy [Amato et al., 1987 and CCIR, 1986-90a, b]. Its communication protocol, structured in seven hierarchycal levels according to the ISO - OSI structure, is outlined in the following.

1. PHYSICAL LAYER

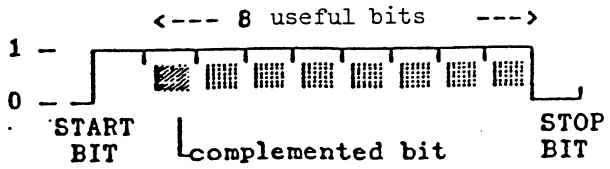
Information unit: bit
Physical and electrical characteristics of the signal:

- RS - 232 interface between the transmission computer and the base-band coder (CCITT V-21);
- base-band biphase differential coding (Manchester level code);
- bit rate: 4800 bit/s;
- FM modulation

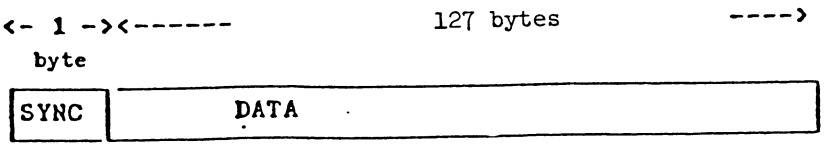
2. DATA LINK LAYER

Information units:

- RS - 232 character (10 bits, 1 START bit, 8 useful data bits, 1 STOP bit).



- The Data Unit of 128 bytes is made up of 1 framing code byte followed by 127 data bytes.



Transmission procedures:

The sync byte (01111110) is used to allow framing synchronization in the receiver.

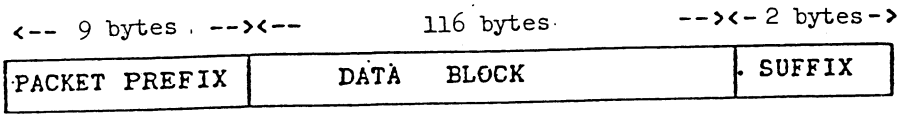
3. NETWORK LAYER

Information unit:

- Data Packet **(127 bytes), composed by:**

- Packet Prefix (Header)
- Data Block
- Packet Suffix **(CRC)**

The first byte of the prefix is the Packet Type (PT) which defines the packet structure according to 4 possible configuration For PT = 0 (default configuration) the Data Packet structure is the following:



- The Packet Prefix (9 bytes) is composed as follows:

a) Packet Type PT; 1 byte; four possible configurations (with Hamming distance 5) [hexadecimal notation]: 00, E3, 1F, FC.

b) Packet Address (PA): identifiyng the data packets belonging to the same data file. It is composed of 2 interleaved (8,4) Hamming codes. It provides the identification of up to 2 = 256 distinct data channels.

Two values of PA are reserved for particular files:

PA=0 for the Menu File (see level 5)
PA=1 for the Comment File (see level 5)

c) Continuity Index (I): allows the reconstruction of the logical sequence of the transmitted file (I=0 is the first packet of the file, I=N-1 the last). It is composed of 3 interleaved (8,4) Hamming code blocks; 12 useful bits (I1 is the most significant half byte).

d) Packets Number (N): is the total number of packets in the file. It is composed of 3 interleaved (8,4) Hamming code blocks; 12 useful bits (N1 is the most significant half byte).

- Data Block : 116 bytes of useful data.

- Data Suffix (CRC): it is composed of the 2 bytes redundancy of a cyclic error detection code, with the generator polynomial of CCITT Rec. V41.

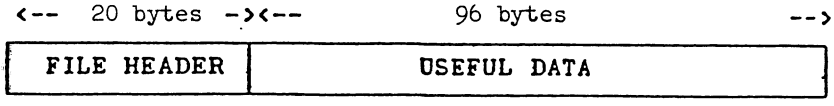
4. TRANSPORT LAYER

Information unit :

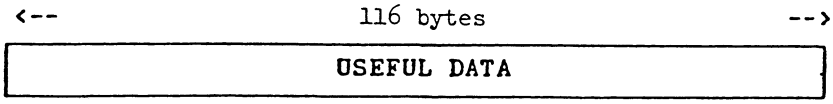
- Data File (116 bytes) transmitted in the Data Blocks of the packets.

The Data Blocks can assume two configurations:

- for I=0 (first packet of the data file) the Data Block is composed of the File Header (20 bytes) and of 96 Useful Data bytes:



- for I ≠ 0 the Data Block is filled by 116 bytes Useful Data:



A Data File is then transmitted in the Useful Data section of the packets.

The File Header (20 bytes) conveys information relevant to the data file, i.e:

- number of useful bytes in the last Data Block (I=N-1).
- type of coding of the Data File (see Lev.6).
- type of scrambling mask.
- encryption informations.
- number of future repetitions of the transmitted file.
- file name (8 ASCII characters (max) + . + 3 ASCII characters of extension, following the MS-DOS rules).

5. SESSION LAYER

The following data handling functions are provided:

- for cyclic transmission of several files:
  the Menu File giving the file names, as reported in the File Header of each data file and the computer family which can execute the transmitted programs and the Commentary File;
- for a single transmission of a file:
  construction of an Empty File (Data File composed of all 00) to ease synchronization recovery in the receiver.

The following procedures are carried out at the receiving end:

- information exchange with the user;
- Menu and Commentary Files acquisition;
- acquisition of the selected file;
- file storage on magnetic support.

6. PRESENTATION LAYER

Conversion and presentation of the processable data information.

7. APPLICATION LAYER

Practical use of the potential facilities provided by the lower layers for the RAI-Radiosoftware service.

REFERENCES

AMATO, P., COMINETTI, M., MORELLO, A. and TOSONI, N.S. [1987] RAI - Radiosoftware: nuovo sistema per impiego nei programmi radiofonici MF, RAI Centro Ricerche, Technical Report no. 87.

CCIR Documents

[1986-90]: a. JIWP 10-11/5 - 3 (Italy); b. JIWP 10-11/5 - 14 (Italy).