INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

J.150

(03/98)

SERIES J: TRANSMISSION OF TELEVISION, SOUND PROGRAMME AND OTHER MULTIMEDIA SIGNALS

Digital television distribution through local subscriber networks

---

Operational functionalities for the delivery of digital multiprogramme television, sound and data services through multichannel, multipoint distribution systems (MMDS)

ITU-T Recommendation J.150

(Previously CCITT Recommendation)

ITU-T J-SERIES RECOMMENDATIONS

TRANSMISSION OF TELEVISION, SOUND PROGRAMME AND OTHER MULTIMEDIA SIGNALS

General Recommendations	J.1–J.9
General specifications for analogue sound-programme transmission	J.10–J.19
Performance characteristics of analogue sound-programme circuits	J.20–J.29
Equipment and lines used for analogue sound-programme circuits	J.30–J.39
Digital encoders for analogue sound-programme signals	J.40–J.49
Digital transmission of sound-programme signals	J.50–J.59
Circuits for analogue television transmission	J.60–J.69
Analogue television transmission over metallic lines and interconnection with radio-relay links	J.70–J.79
Digital transmission of television signals	J.80–J.89
Ancillary digital services for television transmission	J.90–J.99
Operational requirements and methods for television transmission	J.100–J.109
Interactive systems for digital television distribution	J.110–J.129
Transport of MPEG-2 signals on packetised networks	J.130–J.139
Measurement of the quality of service	J.140–J.149
Digital television distribution through local subscriber networks	**J.150–J.159**

For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION J.150

OPERATIONAL FUNCTIONALITIES FOR THE DELIVERY OF DIGITAL MULTIPROGRAMME TELEVISION, SOUND AND DATA SERVICES THROUGH MULTICHANNEL, MULTIPOINT DISTRIBUTION SYSTEMS (MMDS)

Source

ITU-T Recommendation J.150 was prepared by ITU-T Study Group 9 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 18th of March 1998.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Recommendation J.150

OPERATIONAL FUNCTIONALITIES FOR THE DELIVERY OF DIGITAL MULTIPROGRAMME TELEVISION, SOUND AND DATA SERVICES THROUGH MULTICHANNEL, MULTIPOINT DISTRIBUTION SYSTEMS (MMDS)

(Geneva, 1998)

1 Introduction

This Recommendation extends the cable television network architectural principles to Multichannel, Multipoint Distribution systems (MMDS) which use radio waves at microwave frequencies, of the order of a several GHz. Recommendation J.83 is incorporated by direct reference.

2 Scope

The scope of this Recommendation covers the operational functionalities for digital (multiprogramme) signals distributed by MMDS systems, used as extensions or alternatives to CATV networks, possibly in frequency division multiplex with existing analogue signals. Detailed specifications are contained in Annexes A, B, C and D.

Annex A is based on work done in Europe and should provide a suitable basis for future developments.

Annex B is still under study.

Annex C is based on work done in Japan and should provide a suitable basis for future developments.

Annex D is based on VSB modulation scheme and on work done in North America. It should provide a suitable basis for future developments.

It should be noted that this Recommendation deals with downstream signal delivery only; the needs for interactive services requiring both downstream and upstream (return) channels are beyond the scope of this Recommendation.

3 References

The following ITU-T Recommendations, and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] ITU-T Recommendation J.83 (1997), *Digital multi-programme systems for television, sound and data services for cable distribution*.

[2] Recommendation ITU-R F.755-1 (1993), *Point-to-multipoint systems used in the fixed service*.

[3] Recommendation ITU-R BO.1211 (1995), *Digital multi-programme emission systems for television, sound and data services for satellites operating in the 11/12 GHz frequency range*.

4 Definitions

This Recommendation defines the following term:

4.1 **byte**: A group of eight bits.

5 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

BB	Baseband
CATV	Cable Television
C/N	Carrier-to-Noise ratio
FEC	Forward Error Correction
I, Q	In-phase, Quadrature phase components of the modulated signal
MMDS	Multichannel, Multipoint Distribution System
MPEG	Moving Pictures Experts Group
MUX	Multiplex
QAM	Quadrature Amplitude Modulation
QPSK	Quaternary Phase Shift Keying
RF	Radio Frequency
VSB	Vestigial Sideband

Annex A

Digital multiprogramme MMDS System A

A.1 Introduction

This Annex describes a transmission system known as System A for digital multiprogramme television distribution by MMDS operating below 10 GHz. It is based on the System A of Recommendation J.83. It uses QAM modulation and allows for 16, 32 and 64 constellation points.

A.2 MMDS system concept

The MMDS system shall be defined as the functional block of equipment performing the adaptation of the baseband TV signals to the MMDS channel characteristics (see Figure A.1). At the transmitter site, the following TV baseband signal sources can be considered:

– satellite signal(s);

– cable signal(s);

– contribution link(s);

– local program source(s).

The following processes shall be applied as shown in Figure A.1:

– baseband interfacing and synchronization;

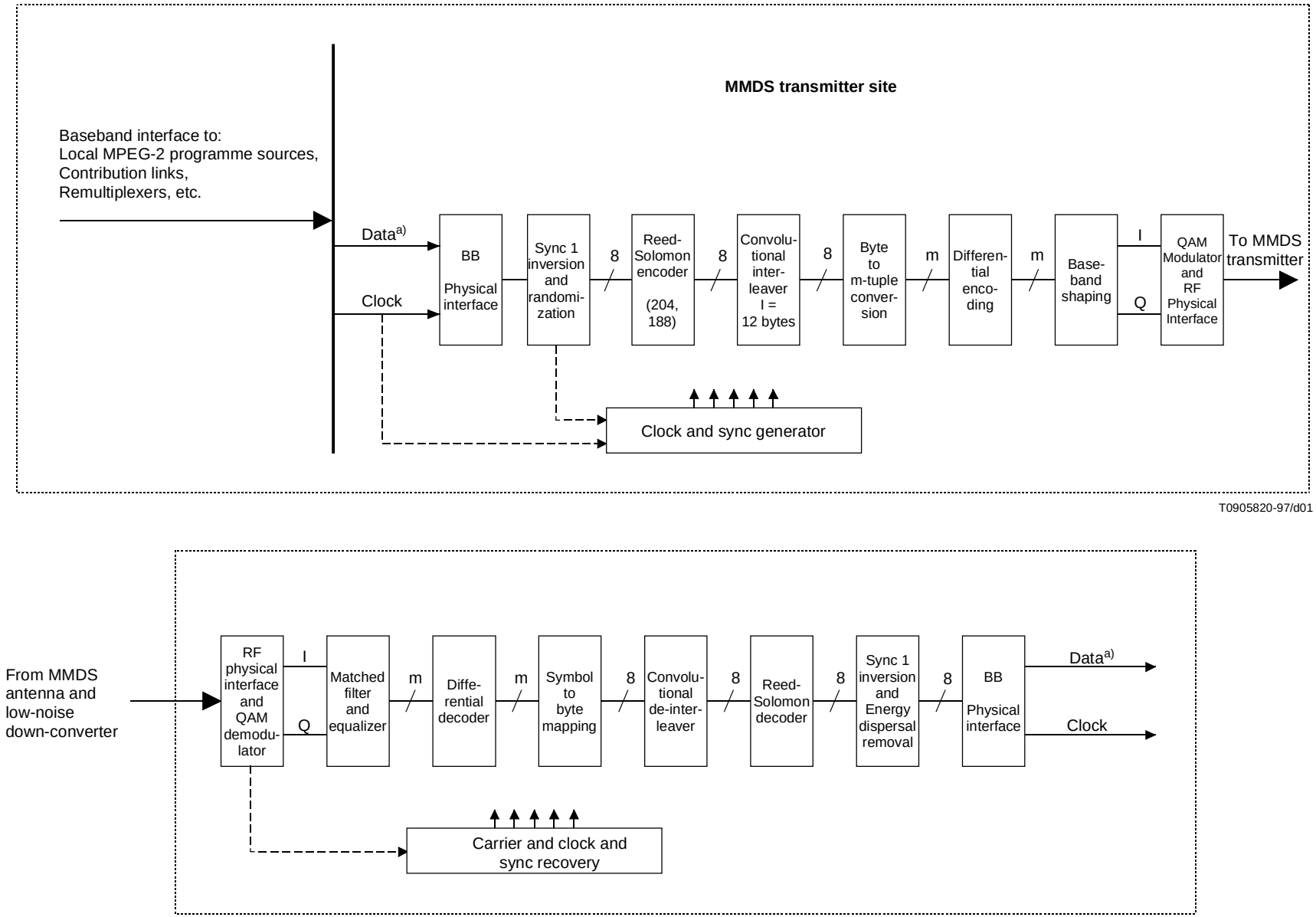
– synchronization 1 inversion and randomization;

– Reed-Solomon encoding;

– convolutional interleaving;

– byte to m-tuple conversion;

– differential encoding.



a) MPEG-2 transport MUX packets.

Figure A.1/J.150 – Conceptual block diagram of elements at the transmitting and receiving sites of MMDS systems below 10 GHz

All these functions are identical to those defined in Annex A/J.83.

– Baseband shaping

  Similar to the J.83 System A, this unit performs mapping from differentially encoded m-tuples to I and Q signals and a square-root raised cosine filtering of the I and Q signals prior to QAM modulation.

– QAM modulation and physical interface

  Similar to the J.83 System A, this unit performs QAM modulation. It is followed by interfacing the QAM modulated signal to the radio-frequency MMDS channel.

  The MMDS System A receiver shall perform the inverse signal processing, as described for the modulation process above, in order to recover the baseband signal.

A.3 MPEG-2 transport layer

The MPEG-2 transport layer shall be identical to the one defined in J.83 System A.

A.4 Framing structure

The framing structure shall be identical to the one defined in J.83 System A.

A.5 Channel coding

The channel coding shall be identical to the one defined in J.83 System A.

A.6 Byte-to-symbol mapping

The byte-to-symbol mapping shall be identical to the one defined in J.83 System A.

A.7 Modulation

J.83 System A defined modulations for cable networks. They are also valid for the MMDS channels. The modulations of System A shall be identical to the ones defined in J.83 System A.

A.8 Baseband filtering characteristics

The baseband filtering characteristics shall be identical to the ones defined in J.83 System A.

Annex B

Digital multiprogramme MMDS System B

System B of Recommendation J.83 has at the present time no companion MMDS system.

Annex C

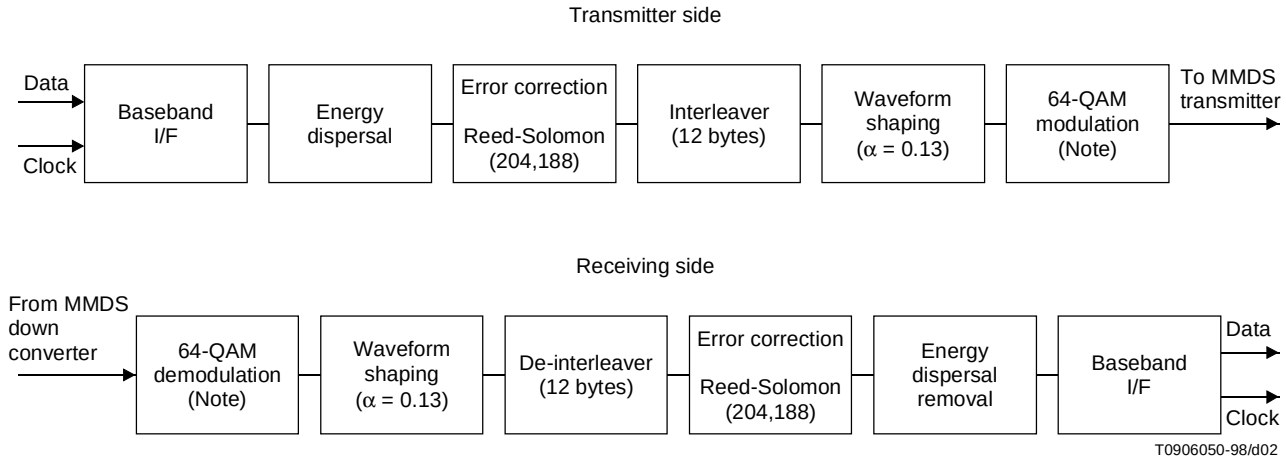
Digital multiprogramme MMDS System C

C.1 Introduction

This Annex describes a transmission system for digital multiprogramme television distribution known as MMDS. MMDS System C uses a frequency band up to several GHz. The system is based on Annex C/J.83, and this Recommendation depicts digital encoding and modulation before the MMDS transmitter and digital demodulation and decoding after the MMDS receiver that contains a down converter.

C.2 MMDS System C concept

A configuration of MMDS System C is shown in Figure C.1. Considering service data quality and service range, Forward Error Correction (FEC) and quadrature amplitude modulation (64-QAM) technologies are introduced. In a higher frequency usage, other modulation methods should be applied if the system could not meet the MMDS system requirement.



NOTE – In higher frequency ranges, other modulation methods should be applied to meet the MMDS system requirement.

Figure C.1/J.150 – MMDS System C configuration

C.2.1 Transmitter side

The baseband signal for MMDS transmission is a source of MPEG-2 188-byte packets. The MPEG-2 packets are processed by:

1) data randomizer;
2) Reed-Solomon encoder;
3) data interleaver;
4) differential encoder;
5) 64-QAM modulator.

C.2.2 Receiving side

After the low noise amplifier and down converter, the receiving side of MMDS System C is configured as the inverse function of the transmitter side: QAM demodulator, differential decoder, symbol-to-byte mapping, de-interleaver, Reed-Solomon decoder and data de-randomizer.

C.3 MPEG-2 transport layer

The MPEG-2 transport layer should be compliant with Annex C/J.83.

C.4 Framing structure

The framing structure should be compliant with Annex C/J.83.

C.5 Channel coding

The channel coding should be compliant with Annex C/J.83.

C.5.1 Randomization

The randomization should be compliant with Annex C/J.83.

C.5.2 Reed-Solomon coding

The Reed-Solomon coding should be compliant with Annex C/J.83.

C.5.3 Convolutional interleaving

The convolutional interleaving should be compliant with Annex C/J.83.

C.6 Modulation

C.6.1 Byte-to-symbol mapping

The byte-to-symbol mapping should be compliant with Annex C/J.83.

C.6.2 Differential encoding

The differential encoding should be compliant with Annex C/J.83.

C.6.3 64-QAM constellation

The 64-QAM constellation should be compliant with Annex C/J.83. Other modulation methods are under study for use at a frequency range higher than the one considered in this Recommendation.

C.6.4 Roll-off factor

The roll-off factor should be compliant with Annex C/J.83.

C.6.5 Baseband filter characteristics

The baseband filter characteristics should be compliant with Annex C/J.83.

Annex D

Digital multiprogramme MMDS architecture System D

D.1 Introduction

This Annex describes the head-end processing and equipment configuration suitable for digital MMDS based on MPEG-2 transport multiplexing by the use of a chosen mode of the Vestigial Sideband (VSB) digital transmission system as defined in Annex D/J.83.

D.2 MMDS VSB system concept

D.2.1 Head-end

A configuration of head-end equipment suitable for digital multiprogramme systems is shown in Figure D.1. As shown, television programming is supplied by satellite signals, terrestrial broadcast signals – local and distant, all of which may be analogue or digital. The satellite signal, when digital, with appropriate demodulator and interface circuitry, is a source of MPEG-2 188-byte packets.

The MPEG-2 188-byte packet source(s) are processed by:

1) data randomizer;

2) Reed-Solomon encoder;

3) Data interleaver;

4) mapper;

5) multiplexer – sync insertion;

6) pilot insertion;

7) VSB modulator;

8) RF up-converter.

The Mapper function, above, corresponds to the VSB mode chosen, as described in [1]. For example, if 8-VSB (non-trellis) is chosen (as has been used in field tests), the corresponding transport data rate is 29.09 Mbit/s in a 6 MHz channel bandwidth, and the carrier-to-noise (C/N) ratio threshold at the receiver is 22 dB.

D.2.2 MMDS receiver

The VSB receiver is shown in Figure D.2. The inverse functions of the transmitter are performed in the receiver: a low-noise block down-conversion, a down conversion (channel tuner), carrier detection, sync and timing recovery, de-interleaving, Reed-Solomon Forward Error Correction (FEC), and data de-randomization.

In addition, an equalizer, which follows detection, removes intersymbol interference making use of the data field sync as a training reference signal, and a phase tracker reduces the effect of phase-noise of the local oscillator of the tuner and the microwave downconverter. Following the phase tracker is the slicer which recovers the data from the multi-level symbols for the further processes of deinterleaving, Reed-Solomon FEC, and de-randomization.

The demodulating carrier is recovered from the pilot and the sync and clock are recovered from the segment sync.

The receiver channel tuner may also be fed with 8-VSB trellis-coded terrestrial broadcasts. In this case, the slicer function includes a trellis decoder.

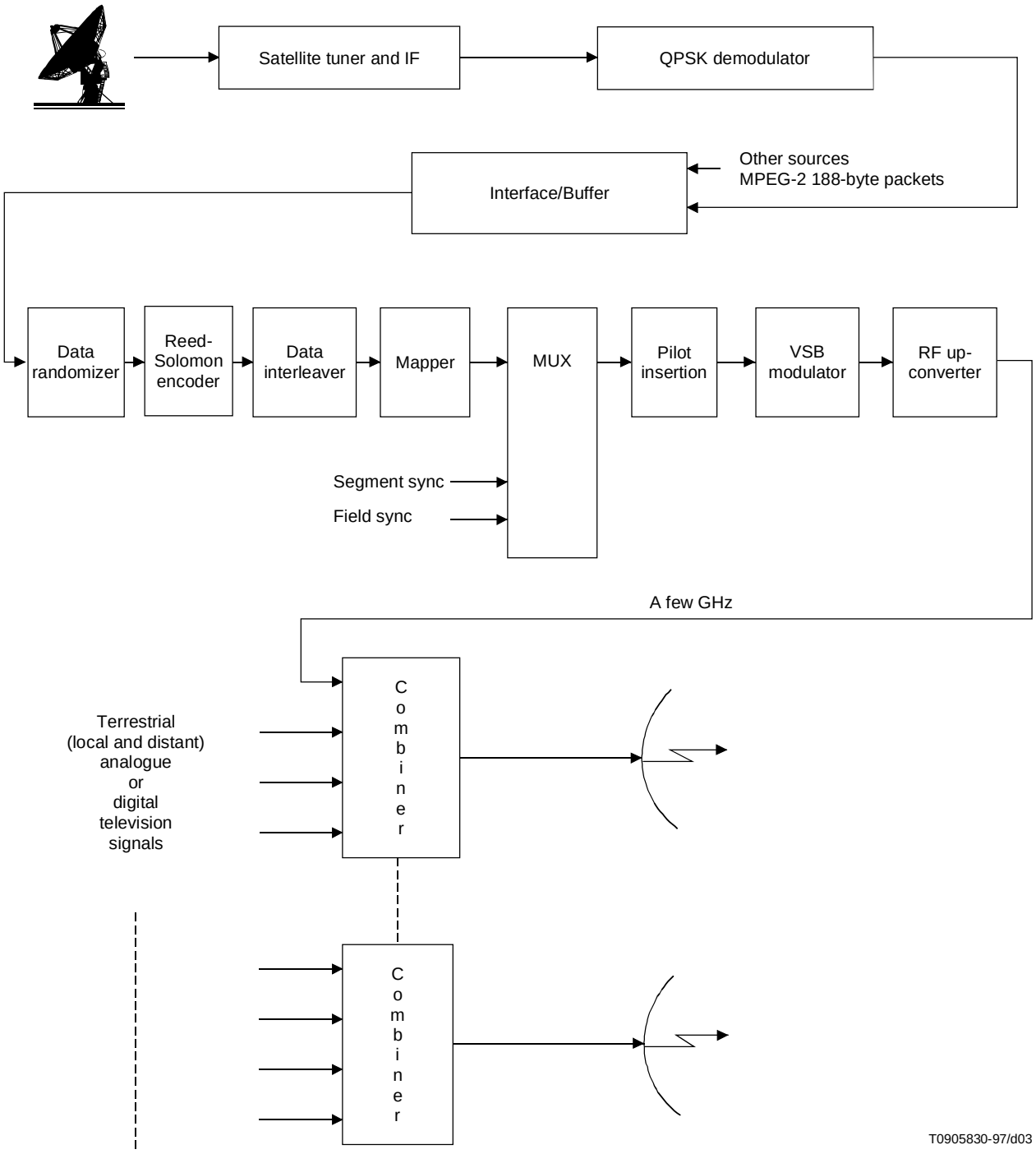
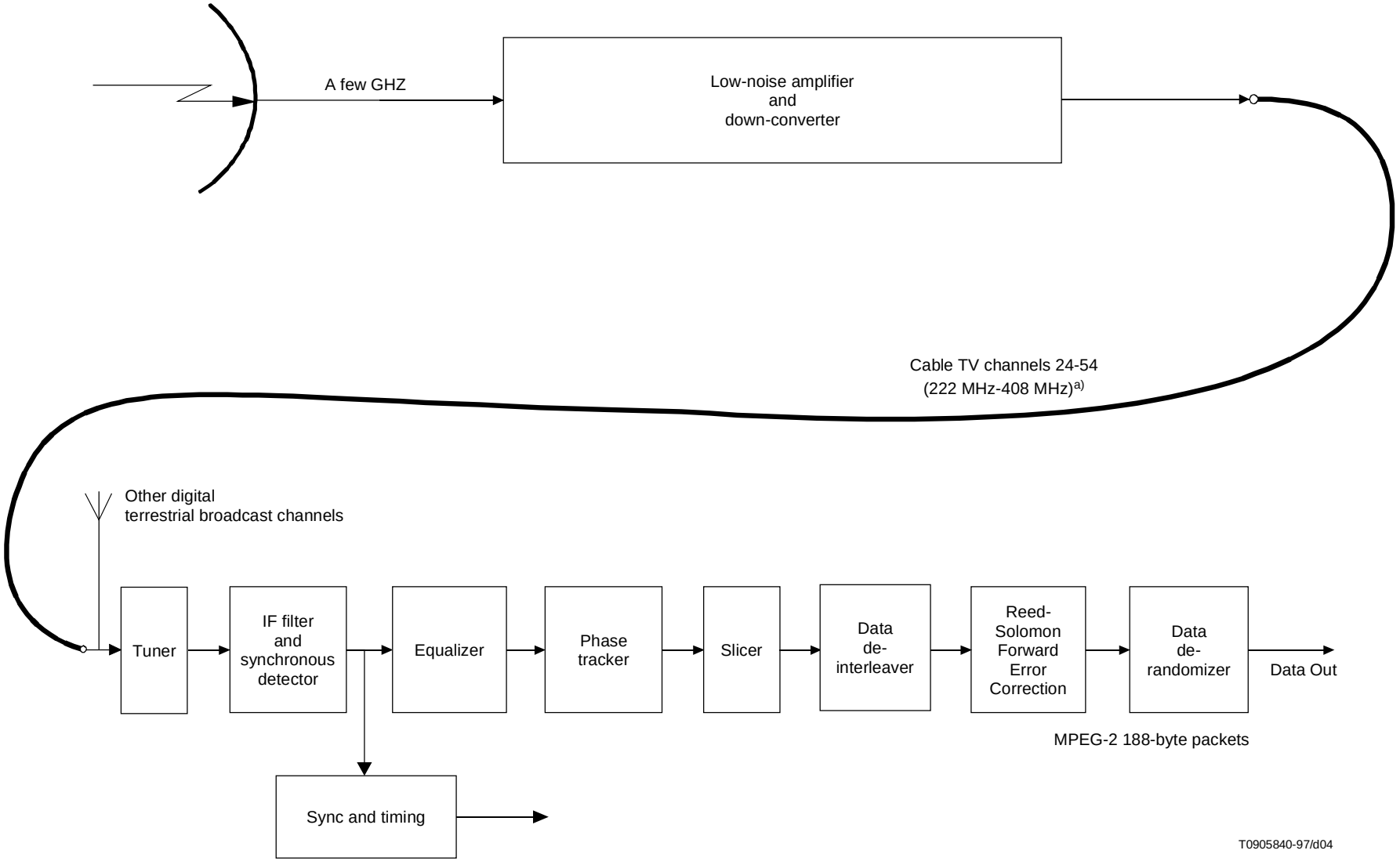


Figure D.1/J.150 – MMDS head-end equipment configuration



a) Example for 6 MHz channel bandwidth.

Figure D.2/J.150 – 2/4/8/16/8 (trellis-coded) VSB MMDS receiver

ITU-T RECOMMENDATIONS SERIES

Series A	Organization of the work of the ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	**Transmission of television, sound programme and other multimedia signals**
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	Global information infrastructure
Series Z	Programming languages