
**Information technology — High
efficiency coding and media delivery
in heterogeneous environments —**

**Part 10:
MPEG Media Transport Forward Error
Correction (FEC) codes**

*Technologies de l'information — Codage à haute efficacité et livraison
des médias dans des environnements hétérogènes —*

*Partie 10: Codes de correction d'erreur anticipée pour le transport
des médias MPEG*

get full document from standards.iteh.ai

Sample Document

get full document from standards.iteh.ai



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2015

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions, symbols, and abbreviated terms	1
3.1 Terms and definitions	1
3.2 Symbols and abbreviated terms	2
3.3 Conventions	2
4 Overview	2
5 FEC Code Points	3
6 Specification for Reed-Solomon Codes	3
6.1 Introduction	3
6.2 Generator matrix	4
7 Specification for Structured Low-Density Parity-Check (S-LDPC) Codes	4
7.1 Introduction	4
7.2 Structured LDPC Codes	5
7.3 Creating Parity-Check Matrix	5
7.4 Encoding Algorithm	6
7.5 Decoding Algorithm	7
7.6 Base matrix	7
8 Specification 6330 code and RaptorQ LA code	11
8.1 Introduction	11
8.2 6330 code	12
8.3 RaptorQ LA	12
8.3.1 RaptorQ LA First Encoding Step	13
Intermediate symbol generation	13
8.3.2 Layer-Aware RaptorQ Second Encoding Step	15
8.3.3 Layer-Aware RaptorQ Decoding	15
9 Specification for FireFort Low Density Generate Matrix (FireFort-LDGM) codes	16
9.1 Introduction	16
9.2 FireFort Low Density Generator Matrix (FireFort-LDGM) Codes	16
9.2.1 Definition	16
9.2.2 FF-LDGM-Specific Elements	17
9.2.3 Parity Check Matrix of FF-LDGM Scheme	18
9.2.4 Creating a Sparse Matrix	18
9.2.5 Creating a Punctured Sparse Matrix	22
9.2.6 Source symbol division scheme	24
9.2.7 Structured interleaving and de-interleaving scheme	25
9.2.8 FF-LDGM code Encoding Algorithm	25
9.2.9 FF-LDGM code Decoding Algorithm	26
9.3 Layer-Aware FireFort-LDGM (LA FireFort-LDGM) Codes	26
9.3.1 Specification of the LA FF-LDGM Scheme	26
9.3.2 Encoding Algorithm	27
9.3.3 Decoding Algorithm	27
10 Specification for FEC code algorithms in SMPTE 2022-1	27
Bibliography	28

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/IEC JTC 1, *Information technology, SC 29, Coding of audio, picture, multimedia and hypermedia information*.

ISO/IEC 23008 consists of the following parts, under the general title *Information technology — High efficiency coding and media delivery in heterogeneous environments*:

- *Part 1: MPEG media transport (MMT)*
- *Part 2: High efficiency video coding (HEVC)*
- *Part 3: 3D Audio*
- *Part 10: MPEG Media Transport Forward Error Correction (FEC) codes*
- *Part 11: MPEG Media Transport Composition Information*

Introduction

This part of ISO/IEC 23008 specifies application level forward error correction (FEC) codes which can be used with application level-forward error correction (AL-FEC) framework of ISO/IEC 23008-1 MPEG Media Transport (MMT) to provide reliable delivery in IP network and non IP network environments that are prone to packet losses.

Sample Document

get full document from standards.iteh.ai

Sample Document

get full document from standards.iteh.ai

Information technology — High efficiency coding and media delivery in heterogeneous environments —

Part 10: MPEG Media Transport Forward Error Correction (FEC) codes

1 Scope

This part of ISO/IEC 23008 specifies application level forward error correction (FEC) codes which can be used with AL-FEC framework of ISO/IEC 23008-1 MPEG Media Transport to provide reliable delivery in IP network and non IP network environments that are prone to packet losses.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 23008-1, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 1: MPEG media transport (MMT)*

IETF RFC 5170, *Low Density Parity Check (LDPC) Staircase and Triangle Forward Error Correction (FEC) Schemes*, June 2008

IETF RFC 5510, *Reed-Solomon Forward Error Correction (FEC) Schemes*, April 2009

IETF RFC 6330, *RaptorQ Forward Error Correction Scheme for Object Delivery*, August 2011

SMPTE2022-1, *Forward Error Correction for Real-Time Video/Audio Transport Over IP Networks*

3 Terms, definitions, symbols, and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

3.1 Terms and definitions

3.1.1

code rate

ratio between the number of source symbols and the number of encoding symbols

3.1.2

encoding symbol

unit of data generated by the encoding process

3.1.3

encoding symbol block

set of encoding symbols from the encoding process of a source symbol block

3.1.4

3FEC code

algorithm for encoding data such that the encoded data flow is resilient to data loss

3.1.5

FEC payload ID

identifier that identifies the contents of a MMT packet with respect to the MMT FEC scheme

3.1.6

repair symbol

encoding symbol that is not a source symbol

3.1.7

repair symbol block

set of repair symbols which can be used to recover lost source symbols

3.1.8

source symbol

unit of data used during the encoding process

3.1.9

source symbol block

set of source symbols which is used to generate repair symbol block by FEC code

3.1.10

systematic code

any error correction code in which the source symbols are part of output encoded symbols

3.2 Symbols and abbreviated terms

For the purpose of this document, the symbols and abbreviated terms given below apply.

AL-FEC application layer (level) forward error correction

FEC forward error correction

LA layer aware

LA-FEC layer aware forward error correction

LDGM low density generator matrix

LDPC low density parity check

MMT MPEG media transport

RS Reed-Solomon

S-LDPC structured low density parity check

3.3 Conventions

The following conventions apply in this document:

— The Big Endian number representation scheme is used.

4 Overview

This part of ISO/IEC 23008 specifies application level forward error correction (FEC) codes. All codes specified in this part are systematic codes.

This specification defines six FEC code algorithms which each FEC code algorithm shall generate a repair symbol block from a source symbol block as shown in [Figure 1](#). The source symbol block consists

of K source symbols of size T (in bytes) and the repair symbol block consists of P repair symbols of size T (in bytes).

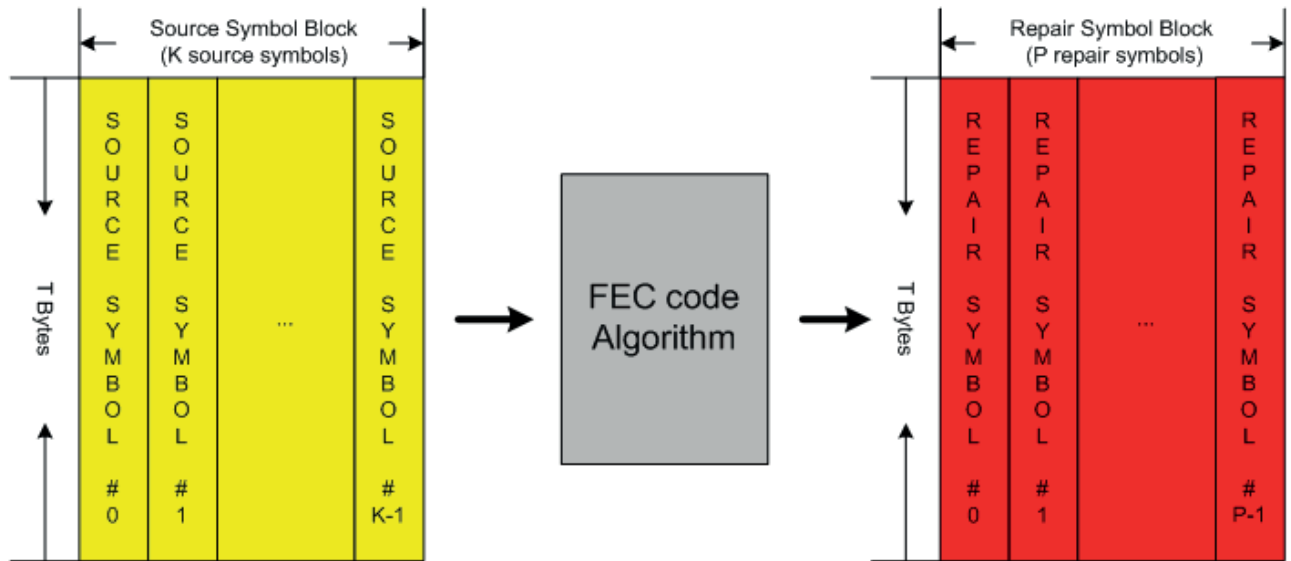


Figure 1 — Input and Output of FEC code

5 FEC Code Points

Table 1 specifies the code points for the FEC code algorithms specified in this part of ISO/IEC 23008. The FEC code algorithms themselves are specified in Clauses 6 to 10.

Table 1 — FEC Code Algorithms and Its Code Point

Code Point	FEC Code Algorithm
0	Reserved for ISO use
1	RS code (sub-Clause 6)
2	S_LDPC code (sub-Clause 7)
3	6330 code (sub-Clause 8.2)
4	RaptorQ LA code (sub-Clause 8.3)
5	FireFort-LDGM code (sub-Clause 9)
6	FEC code algorithm in SMPTE 2022-1 (sub-Clause 10)
7 ~ 255	Reserved for ISO use

NOTE When one of the FEC code algorithms specified in this specification is used for MMT AL-FEC framework, `fec_code_id_for_repair_flow` field as defined in ISO/IEC 23008-1:2014 Annex C.6 is set to its corresponding code point as specified in Table 1.

6 Specification for Reed-Solomon Codes

6.1 Introduction

In this clause, the following notations are used.

- K : number of source symbols in a source symbol block
- P : number of repair symbols in a repair symbol block