

# ISO/IEC 15444-8:2023-10 (E)

## Information technology - JPEG 2000 image coding system - Part 8: Secure JPEG 2000

---

Contents		Page
1	Scope.....	1
2	Normative references .....	1
3	Definitions.....	1
4	Symbols and abbreviations.....	4
5	JPSEC syntax .....	5
5.1	JPSEC framework overview .....	5
5.2	JPSEC security services .....	6
5.3	Comments on design and implementation of secure JPSEC systems .....	7
5.4	Byte aligned segment (BAS).....	8
5.5	Main security marker (SEC) .....	9
5.6	JPSEC tools.....	13
5.7	Zone of Influence (ZOI) syntax .....	16
5.8	Protection method template syntax (T).....	25
5.9	Processing domain syntax (PD) .....	34
5.10	Granularity syntax (G) .....	35
5.11	Value list syntax (V) .....	36
5.12	Relationships among ZOI, Granularity (G) and Value List (VL) .....	37
5.13	In-codestream security marker (INSEC).....	38
6	Normative-syntax usage examples (informative).....	39
6.1	ZOI examples.....	39
6.2	Key information template examples .....	43
6.3	JPSEC normative tool examples .....	44
6.4	Distortion field examples .....	50
Annex A	Guidelines and use cases .....	52
A.1	A class of JPSEC applications .....	52
Annex B	Interoperability .....	58
B.1	Rec. ITU-T T.800   ISO/IEC 15444-1 – Core coding system .....	58
B.2	Rec. ITU-T T.808   ISO/IEC 15444-9 – JPIP .....	58
B.3	Rec. ITU-T T.810   ISO/IEC 15444-11 – JPWL.....	59
Annex C	File format security .....	62
C.1	Scope.....	62
C.2	Introduction.....	62
C.3	Extension to ISO base media file format.....	64
C.4	Elementary stream and sample definitions.....	72
C.5	Protection at file format level.....	74
C.6	Examples (Informative) .....	75
C.7	Boxes defined in ISO/IEC 14496-12 (informative) .....	85
Annex D	Technology examples.....	90
D.1	Introduction.....	90
D.2	A flexible access control scheme for JPEG 2000 codestreams .....	90
D.3	A unified authentication framework for JPEG 2000 images.....	92
D.4	A simple packet-based encryption method for JPEG 2000 codestreams .....	94
D.5	Encryption tool for JPEG 2000 access control.....	97
D.6	Key generation tool for JPEG 2000 access control .....	99
D.7	Wavelet and bitstream domain scrambling for conditional access control .....	102

D.8	Progressive access for JPEG 2000 codestream .....	104
D.9	Scalable authenticity of JPEG 2000 codestreams .....	106
D.10	JPEG 2000 data confidentiality and access control system based on data splitting and luring .....	108
D.11	Secure scalable streaming and secure transcoding .....	111
	Bibliography .....	115

## FIGURES

	<i>Page</i>
Figure 1 – Overview of the conceptual steps in JPSEC framework .....	5
Figure 2 – Byte aligned segment (BAS) structure .....	8
Figure 3 – Main security marker segment syntax .....	9
Figure 4 – Main security marker syntax when multiple marker segments are used .....	10
Figure 5 – Codestream security parameters (P <sub>SEC</sub> ) syntax .....	10
Figure 6 – TRLC <sub>P</sub> tag descriptor (P <sub>TRLC<sub>P</sub></sub> ) syntax .....	11
Figure 7 – Use of multiple JPSEC tools .....	12
Figure 8 – JPSEC tool syntax (Tool <sup>(i)</sup> ) .....	13
Figure 9 – Parameters (P <sub>ID</sub> ) syntax for JPSEC normative tools (t = 0) .....	14
Figure 10 – ID <sub>RA</sub> syntax .....	15
Figure 11 – Zone of Influence conceptual structure .....	17
Figure 12 – ZOI syntax .....	17
Figure 13 – Zone description class structure (DCzoi) .....	18
Figure 14 – Zone syntax consists of a description class and one or more parameter sets .....	18
Figure 15 – Distortion field syntax .....	20
Figure 16 – Distortion field syntax .....	21
Figure 17 – Relative importance field syntax .....	21
Figure 18 – Bit-rate field syntax .....	22
Figure 19 – ZOI example using image related descriptions .....	23
Figure 20 – ZOI example using image related and non-image related descriptions .....	23
Figure 21 – A second ZOI example using image related and non-image related descriptions .....	24
Figure 22 – ZOI description parameter syntax .....	24
Figure 23 – Decryption template syntax .....	26
Figure 24 – Block cipher template syntax .....	27
Figure 25 – Stream cipher template syntax .....	28
Figure 26 – Asymmetric cipher template syntax .....	29
Figure 27 – Authentication template syntax .....	29
Figure 28 – Hash-based authentication template .....	30
Figure 29 – Cipher-based authentication template syntax .....	31
Figure 30 – Digital signature template syntax .....	32
Figure 31 – Hash template syntax .....	33
Figure 32 – Key information template syntax .....	33
Figure 33 – ITU-T X.509 certificate syntax .....	34
Figure 34 – Processing domain syntax .....	34
Figure 35 – Granularity syntax .....	35
Figure 36 – Value list field syntax .....	37
Figure 37 – Granularity Level (GL) is resolution .....	37

Figure 38 – Granularity Level (GL) is layer .....	38
Figure 39 – In-codestream security marker syntax .....	38
Figure A.1 – Overview of a secure JPEG 2000 image distribution application .....	52
Figure A.2 – Legend description .....	53
Figure A.3 – Encryption procedure .....	54
Figure A.4 – Decryption procedure .....	54
Figure A.5 – Signature generation procedure .....	55
Figure A.6 – Authentication procedure .....	56
Figure A.7 – ICV generation procedure .....	56
Figure A.8 – Integrity check procedure .....	57
Figure B.1 – Typical JPWL and JPSEC combination .....	60
Figure C.1 – System diagram for time-sequenced scalable media .....	63
Figure C.2 – Self-contained ES and scalable composed ES .....	73
Figure C.3 – Self-contained ES and decodable composed ES .....	73
Figure C.4 – Relationship between iloc, iinf and ipro .....	74
Figure C.5 – An example sample description entry protected by authentication scheme followed by description scheme .....	75
Figure C.6 – Example 1: Item-based protection of JP2 file (authentication) .....	76
Figure C.7 – Example 2: Item-based protection of a JPEG 2000 images (encryption) .....	77
Figure C.8 – Example 2: Secure transcoding to lower resolution (discarding resolution 2) .....	77
Figure C.9 – Example 3: Item-based protection of a JPEG 2000 image (Authentication) .....	78
Figure C.10 – Example 3: Transcoding to resolution 1 .....	79
Figure C.11 – Example 4: Sample-based protection of a time-sequenced JPEG 2000 pictures .....	80
Figure C.12 – Example 4: Secure transcoding to lower SNR quality (layer 1) .....	81
Figure C.13 – Example 5: Sample-based protection for video browsing or video summarization .....	82
Figure C.14 – Example 5: Transcoding to shorter time length (discarding the last 5000 pictures) .....	82
Figure C.15 – Example 6: Authentication transcoding, discarding received but unverifiable packets .....	83
Figure C.16 – Motion JPEG 2000 file with detailed box structure .....	83
Figure C.17 – Simplified Motion JPEG 2000 box structure showing references .....	84
Figure C.18 – Simplified Motion JPEG 2000 box structure showing references after length changing protection operations .....	84
Figure C.19 – JPM file with detailed box structure .....	85
Figure C.20 – Simplified JPM box structure showing references .....	85
Figure C.21 – JPM box structure showing references after length changing protection operations .....	85
Figure D.1 – SEC segment syntax .....	91
Figure D.2 – P <sub>ID</sub> field syntax .....	91
Figure D.3 – TP <sub>ID</sub> field syntax .....	91
Figure D.4 – AK <sub>info</sub> field syntax .....	92
Figure D.5 – Image protection using unified authentication framework for JPEG 2000 .....	93

Figure D.6 – Packet-based encryption principle.....	95
Figure D.7 – Overview of this technology .....	100
Figure D.8 – Block diagram for wavelet domain scrambling .....	102
Figure D.9 – Block diagram for bitstream domain scrambling .....	103
Figure D.10 – Non-normative protection tool syntax in the case of multiple keys .....	103
Figure D.11 – Syntax for AP: Wavelet domain scrambling (left), Bitstream domain scrambling (right) .....	104
Figure D.12 – Technical overview of this technology.....	105
Figure D.13 – Non-normative tool syntax .....	107
Figure D.14 – Security parameters TP <sub>ID</sub> syntax .....	108
Figure D.15 – System overview .....	110
Figure D.16 – JPSEC enables end-to-end security and mid-network secure transcoding .....	112
Figure D.17 – An example of forming a JPSEC codestream.....	113

## TABLES

	<i>Page</i>
Table 1 – Main security parameter values .....	10
Table 2 – Codestream security parameters (P <sub>SEC</sub> ) in first SEC marker segment .....	11
Table 3 – Semantics for F <sub>PSEC</sub> values (FBAS).....	11
Table 4 – Parameter field for TRLC <sub>P</sub> tag descriptor (P <sub>TRLC<sub>P</sub></sub> ) .....	12
Table 5 – JPSEC tool parameter values.....	13
Table 6 – JPSEC normative tool Template ID values (ID <sub>T</sub> ).....	14
Table 7 – JPSEC normative tool parameter values.....	15
Table 8 – Parameters values in ID <sub>RA</sub> syntax .....	15
Table 9 – ID values for JPSEC non-normative tools (ID <sub>RA, id</sub> ).....	16
Table 10 – Zone of influence field (ZOI) parameter values .....	17
Table 11 – Zone parameter values.....	18
Table 12 – Description class indicator value .....	18
Table 13 – Image related description class .....	18
Table 14 – Non-image related description class .....	19
Table 15 – Distortion field parameter values.....	20
Table 16 – Distortion field parameter values.....	21
Table 17 – Relative importance field parameter values.....	21
Table 18 – Bit-rate field parameter values.....	22
Table 19 – Pzoi <sup>i</sup> parameter values .....	24
Table 20 – Mzoi parameter values.....	25
Table 21 – Template ID values (ID <sub>T</sub> ) .....	25
Table 22 – Decryption template parameter values .....	26
Table 23 – Marker emulation flag values (ME <sub>decry</sub> ).....	26

Table 24 – Cipher identifier values ( $CT_{\text{decry}}$ ) .....	26
Table 25 – Block cipher identifier values ( $CT_{\text{decry}}$ ) .....	26
Table 26 – Stream cipher identifier values ( $CT_{\text{decry}}$ ).....	27
Table 27 – Asymmetric cipher identifier values ( $CT_{\text{decry}}$ ) .....	27
Table 28 – Block cipher template values .....	27
Table 29 – Block cipher mode values ( $M_{\text{bc}}$ ) .....	28
Table 30 – Padding mode for block cipher ( $P_{\text{bc}}$ ).....	28
Table 31 – Stream cipher template values .....	28
Table 32 – Asymmetric cipher template values.....	29
Table 33 – Authentication template parameter values.....	29
Table 34 – Authentication methods ( $M_{\text{auth}}$ ) .....	29
Table 35 – Hash-based authentication template parameter values .....	30
Table 36 – Hash-based authentication method identifier ( $M_{\text{HMAC}}$ ).....	30
Table 37 – Hash function identifier ( $H_{\text{HMAC}}$ ).....	31
Table 38 – MAC template values .....	31
Table 39 – Cipher-based authentication method ( $C_{\text{CMAC}}$ ).....	32
Table 40 – Digital signature template values.....	32
Table 41 – Digital signature methods ( $M_{\text{DS}}$ ).....	32
Table 42 – Hash template parameter values .....	33
Table 43 – Key template values.....	33
Table 44 – Key information identifier values ( $KID_{\text{KT}}$ ).....	34
Table 45 – ITU-T X.509 certificate values ( $KI_{\text{KT}}$ if $KID_{\text{KT}} = 2$ ).....	34
Table 46 – Encoding rule values ( $ER_{\text{KT}}$ ) .....	34
Table 47 – Processing domain parameters.....	35
Table 48 – Processing Domain (PD) parameter values .....	35
Table 49 – Processing domain field ( $F_{\text{PD}}$ ) parameter values in wavelet coefficient domain and quantized wavelet coefficient domain .....	35
Table 50 – Processing domain field ( $F_{\text{PD}}$ ) parameter values in codestream domain .....	35
Table 51 – Granularity parameter values (G) .....	36
Table 52 – Processing order values (PO).....	36
Table 53 – Granularity level values (GL) .....	36
Table 54 – Value list field (V) parameter values.....	37
Table 55 – In-codestream security parameter values (INSEC).....	39
Table 56 – Relevance zone values (R).....	39
Table 57 – ZOI in example 1 .....	39
Table 58 – ZOI in example 2 .....	40
Table 59 – ZOI in example 3 .....	41
Table 60 – ZOI in example 4 .....	41
Table 61 – ZOI in example 5 .....	42

Table 62 – ZOI in example 6.....	43
Table 63 – Key information in example 1 .....	43
Table 64 – Key information in example 2 .....	43
Table 65 – Key information in example 3 .....	44
Table 66 – Key information in example 4 .....	44
Table 67 – SEC marker segment for example 1 .....	45
Table 68 – ZOI example.....	45
Table 69 – P <sub>ID</sub> example.....	46
Table 70 – Decryption template example .....	47
Table 71 – Key template example .....	47
Table 72 – The SEC marker segment .....	48
Table 73 – ZOI signalling.....	48
Table 74 – P <sub>ID</sub> signalling parameters .....	49
Table 75 – Associating distortion field to two data segments (extension of ZOI example 3 in 6.1.3) .....	50
Table 76 – Signalling a range of packets and associating distortions for each packet.....	51
Table C.1 – List of existing and new boxes.....	64
Table D.1 – Example parameters for this scheme .....	91
Table D.2 – P <sub>ID</sub> parameters.....	91
Table D.3 – TP <sub>ID</sub> parameters .....	92
Table D.4 – AK <sub>info</sub> parameters.....	92
Table D.5 – Syntax for semi-fragile authentication.....	93
Table D.6 – Example of Zone of Influence, with spatial coordinates, resolutions and layers .....	95
Table D.7 – Decryption template description, in the case of AES-192/CBC .....	96
Table D.8 – Processing domain syntax.....	96
Table D.9 – Granularity and value list syntax .....	97
Table D.10 – Example parameters for this technology.....	98
Table D.11 – Example ZOI of this key generation tool.....	98
Table D.12 – P <sub>ID</sub> for this technology .....	99
Table D.13 – Example of decryption template of this technology .....	99
Table D.14 – Recommended parameter in this technology .....	100
Table D.15 – Example ZOI of this key generation tool.....	101
Table D.16 – P <sub>ID</sub> for this technology .....	101
Table D.17 – Example of decryption template of this technology .....	102
Table D.18 – Syntax and semantic for P <sub>ID</sub> .....	103
Table D.19 – Syntax and semantic for AP.....	104
Table D.20 – Example parameters for this tool .....	105
Table D.21 – Example ZOI of this technology.....	106
Table D.22 – P <sub>ID</sub> for this technology .....	106

Table D.23 – Example of decryption template of this technology .....	106
Table D.24 – Non-normative tool parameters .....	108
Table D.25 – Security parameters.....	108
Table D.26 – Parameter values for this tool .....	111
Table D.27 – Parameter values for template protection tool, processing domain and granularity .....	114
Table D.28 – Parameter values for authentication template protection tool .....	114