

ISO/IEC 14776-481:2019-12 (E)

Information technology - Small computer system interface (SCSI) - Part 481: Security Features for SCSI Commands (SFSC)

Contents	Page
FOREWORD.....	9
INTRODUCTION.....	11
1 Scope.....	12
2 Normative references.....	12
3 Terms and definitions, symbols, abbreviations, and conventions.....	14
3.1 Terms and definitions.....	14
3.2 Abbreviations and symbols.....	24
3.2.1 Abbreviations.....	24
3.2.2 Symbols.....	25
3.2.3 Mathematical operators.....	25
3.3 Keywords.....	25
3.4 Editorial conventions.....	27
3.5 Numeric and character conventions.....	27
3.5.1 Numeric conventions.....	27
3.5.2 Units of measure.....	28
3.5.3 Byte encoded character strings conventions.....	29
3.6 Bit and byte ordering.....	29
4 Security features model common to all device types.....	31
4.1 Security features for SCSI devices.....	31
4.1.1 Security associations.....	31
4.1.1.1 Principles of SAs.....	31
4.1.1.2 SA parameters.....	32
4.1.1.3 Creating an SA.....	34
4.1.2 Key derivation functions.....	35
4.1.2.1 KDFs overview.....	35
4.1.2.2 IKEv2-based iterative KDF.....	36
4.1.2.3 HMAC-based KDFs.....	36
4.1.2.4 AES-XCBC-PRF-128 IKEv2-based iterative KDF.....	38
4.1.3 Using IKEv2-SCSI to create an SA.....	38
4.1.3.1 Overview.....	38
4.1.3.2 IKEv2-SCSI Protocol summary.....	42
4.1.3.3 IKEv2-SCSI Authentication.....	44
4.1.3.3.1 Overview.....	44
4.1.3.3.2 Pre-shared key authentication.....	45
4.1.3.3.3 Digital signature authentication.....	46
4.1.3.3.3.1 Overview.....	46
4.1.3.3.3.2 Certificates and digital signature authentication.....	46
4.1.3.3.3.3 Example of certificate use for digital signature authentication.....	47
4.1.3.3.3.4 Handling of the Certificate Request payload and the Certificate payload.....	47
4.1.3.3.3.4 Constraints on skipping the Authentication step.....	47
4.1.3.4 Summary of IKEv2-SCSI shared keys nomenclature and shared key sizes.....	49
4.1.3.5 Device Server Capabilities step.....	50
4.1.3.6 IKEv2-SCSI Key Exchange step.....	52
4.1.3.6.1 Overview.....	52

4.1.3.6.2	Key Exchange step SECURITY PROTOCOL OUT command	52
4.1.3.6.3	Key Exchange step SECURITY PROTOCOL IN command	53
4.1.3.6.4	Key Exchange step completion	54
4.1.3.6.5	After the Key Exchange step	54
4.1.3.7	IKEv2-SCSI Authentication step	54
4.1.3.7.1	Overview	54
4.1.3.7.2	Authentication step SECURITY PROTOCOL OUT command	55
4.1.3.7.3	Authentication step SECURITY PROTOCOL IN command	56
4.1.3.8	Generating shared keys	57
4.1.3.8.1	Overview	57
4.1.3.8.2	Generating shared keys when the Authentication step is skipped	58
4.1.3.8.3	Generating shared keys when the Authentication step is processed	58
4.1.3.8.4	Initializing shared key generation	58
4.1.3.8.4.1	Initializing for SA creation shared key generation	58
4.1.3.8.4.2	Initializing for generation of shared keys used by the created SA	59
4.1.3.8.5	Generating shared keys used for SA management	59
4.1.3.8.6	Generating shared keys for use by the created SA	60
4.1.3.9	IKEv2-SCSI SA generation	61
4.1.3.10	Abandoning an IKEv2-SCSI CCS	62
4.1.3.11	Deleting an IKEv2-SCSI SA	63
4.1.4	Security progress indication	63
4.1.5	ESP-SCSI encapsulations for parameter data	64
4.1.5.1	Overview	64
4.1.5.2	ESP-SCSI required inputs	64
4.1.5.3	ESP-SCSI data format before encryption and after decryption	65
4.1.5.4	ESP-SCSI outbound data descriptors	66
4.1.5.4.1	Overview	66
4.1.5.4.2	ESP-SCSI CDBs or Data-Out Buffer parameter lists including a descriptor length	67
4.1.5.4.2.1	Initialization vector absent	67
4.1.5.4.2.2	Initialization vector present	68
4.1.5.4.3	ESP-SCSI Data-Out Buffer parameter lists for externally specified descriptor length	70
4.1.5.4.3.1	Initialization vector absent	70
4.1.5.4.3.2	Initialization vector present	71
4.1.5.5	ESP-SCSI Data-In Buffer parameter data descriptors	71
4.1.5.5.1	Overview	71
4.1.5.5.2	ESP-SCSI Data-In Buffer parameter data including a descriptor length	72
4.1.5.5.2.1	Initialization vector absent	72
4.1.5.5.2.2	Initialization vector present	74
4.1.5.5.3	ESP-SCSI Data-In Buffer parameter data for externally specified descriptor length	75
4.1.5.5.3.1	Initialization vector absent	75
4.1.5.5.3.2	Initialization vector present	76
4.1.6	Security algorithm codes	77
4.2	Secure random numbers	79
5	Security protocol parameters for all device types	80
5.1	Security protocol information description	80
5.1.1	Overview	80
5.1.2	CDB description	80
5.1.3	Supported security protocols list description	81
5.1.4	Certificate data description	82
5.1.4.1	Certificate overview	82
5.1.4.2	Public Key certificate description	82
5.1.4.3	Attribute certificate description	82
5.1.5	Security compliance information description	83
5.1.5.1	Security compliance information overview	83
5.1.5.2	Compliance descriptor overview	84
5.1.5.3	FIPS 140 compliance descriptor	85
5.2	SA creation capabilities	86
5.2.1	Overview	86
5.2.2	SA creation capabilities CDB description	86

5.2.3 SA creation capabilities parameter data formats	87
5.2.3.1 Supported device server capabilities formats parameter data format	87
5.2.3.2 IKEv2-SCSI device server capabilities parameter data format.....	88
5.3 IKEv2-SCSI	88
5.3.1 Overview.....	88
5.3.2 IKEv2-SCSI SECURITY PROTOCOL IN CDB description	89
5.3.3 IKEv2-SCSI SECURITY PROTOCOL OUT CDB description	90
5.3.4 IKEv2-SCSI parameter data format.....	91
5.3.5 IKEv2-SCSI payloads.....	98
5.3.5.1 IKEv2-SCSI payload format.....	98
5.3.5.2 No Next payload	99
5.3.5.3 Key Exchange payload	100
5.3.5.4 Identification – Application Client payload and Identification – Device Server payload.....	101
5.3.5.5 Certificate payload.....	102
5.3.5.6 Certificate Request payload	103
5.3.5.7 Authentication payload	104
5.3.5.8 Nonce payload.....	106
5.3.5.9 Notify payload.....	107
5.3.5.10 Delete payload.....	108
5.3.5.11 Encrypted payload.....	109
5.3.5.11.1 Combined mode encryption.....	109
5.3.5.11.2 Encrypted payload introduction	110
5.3.5.11.3 IKEv2-SCSI AAD	112
5.3.5.11.4 Processing a received Encrypted payload	113
5.3.5.12 IKEv2-SCSI SA Creation Capabilities payload.....	115
5.3.5.13 IKEv2-SCSI SA Cryptographic Algorithms payload.....	116
5.3.5.14 IKEv2-SCSI SAUT Cryptographic Algorithms payload.....	118
5.3.5.15 IKEv2-SCSI Timeout Values payload.....	119
5.3.6 IKEv2-SCSI cryptographic algorithm descriptors	120
5.3.6.1 Overview.....	120
5.3.6.2 ENCR IKEv2-SCSI cryptographic algorithm descriptor	122
5.3.6.3 PRF IKEv2-SCSI cryptographic algorithm descriptor	124
5.3.6.4 INTEG IKEv2-SCSI cryptographic algorithm descriptor	126
5.3.6.5 D-H IKEv2-SCSI cryptographic algorithm descriptor.....	127
5.3.6.6 IKEv2-SCSI authentication algorithm IKEv2-SCSI cryptographic algorithm descriptor.....	129
5.3.7 Errors in IKEv2-SCSI security protocol commands	131
5.3.8 Errors in IKEv2-SCSI security protocol parameter data	133
5.3.8.1 Overview.....	133
5.3.8.2 Errors with high denial of service attack potential	133
5.3.8.3 Errors with low denial of service attack potential.....	134
5.3.9 Translating IKEv2 errors.....	134
Annex A (informative) Security goals and threat model.....	136
A.1 Overview	136
A.2 Security goals.....	136
A.3 Threat model	137
A.4 Types of attacks	137
A.5 SCSI security considerations	138
Annex B (informative) Variations between this document and equivalent security protocols	139
B.1 IKEv2 protocol details and variations for IKEv2-SCSI.....	139
B.2 ESP protocol details and variations for ESP-SCSI	142
BIBLIOGRAPHY	143

Figures

	Page
Figure 1 — SCSI document structure	11
Figure 2 — SA relationships	31
Figure 3 — IKEv2-SCSI Device Server Capabilities step	42
Figure 4 — IKEv2-SCSI Key Exchange step	42
Figure 5 — IKEv2-SCSI Authentication step	43
Figure 6 — IKEv2-SCSI Delete operation	44

Tables

	Page
Table 1 — Numbering conventions examples	28
Table 2 — Comparison of decimal prefixes and binary prefixes	29
Table 3 — Minimum SA parameters	32
Table 4 — USAGE_TYPE SA parameter	34
Table 5 — Security protocols that create SAs	35
Table 6 — KDFs summary	36
Table 7 — HMAC-based KDFs	37
Table 8 — Hash functions used by HMAC based on KDF_ID	37
Table 9 — RFC 3566 parameter translations for the KDF based on AES-XCBC-PRF-128	38
Table 10 — IKEv2-SCSI shared key names and SA shared key names	49
Table 11 — Shared key size determination	50
Table 12 — Device Server Capabilities step parameter data requirements	51
Table 13 — IKEv2-SCSI command terminations that do not abandon the CCS	62
Table 14 — ESP-SCSI data format before encryption and after decryption	65
Table 15 — ESP-SCSI outbound data descriptors	66
Table 16 — ESP-SCSI CDBs or Data-Out Buffer parameter list descriptor without initialization vector	67
Table 17 — ESP-SCSI CDBs or Data-Out Buffer full parameter list descriptor	69
Table 18 — ESP-SCSI Data-Out Buffer parameter list descriptor without length and initialization vector	70
Table 19 — ESP-SCSI Data-Out Buffer parameter list descriptor without length	71
Table 20 — ESP-SCSI Data-In Buffer parameter data descriptors	72
Table 21 — ESP-SCSI Data-In Buffer parameter data descriptor without initialization vector	72
Table 22 — ESP-SCSI Data-In Buffer full parameter data descriptor	74
Table 23 — ESP-SCSI Data-In Buffer parameter data descriptor without length and initialization vector	75
Table 24 — ESP-SCSI Data-In Buffer parameter data descriptor without length	76
Table 25 — Security algorithm codes	77
Table 26 — SECURITY PROTOCOL SPECIFIC field for SECURITY PROTOCOL IN protocol 00h	80
Table 27 — Supported security protocols SECURITY PROTOCOL IN parameter data	81
Table 28 — Certificate data SECURITY PROTOCOL IN parameter data	82
Table 29 — Security compliance information SECURITY PROTOCOL IN parameter data	83
Table 30 — Compliance descriptor format	84
Table 31 — COMPLIANCE DESCRIPTOR TYPE field	84
Table 32 — FIPS 140 compliance descriptor	85
Table 33 — RELATED STANDARD field	85
Table 34 — SECURITY PROTOCOL SPECIFIC field for the SA creation capabilities	87
Table 35 — Supported device server capabilities formats parameter data	87
Table 36 — IKEv2-SCSI device server capabilities parameter data	88
Table 37 — SECURITY PROTOCOL SPECIFIC field as defined by the IKEv2-SCSI SECURITY PROTOCOL IN command	89
Table 38 — SECURITY PROTOCOL SPECIFIC field as defined by the IKEv2-SCSI SECURITY PROTOCOL OUT command	90
Table 39 — IKEv2-SCSI SECURITY PROTOCOL OUT command and SECURITY PROTOCOL IN command parameter data	91

Table 40 — IKEv2-SCSI header checking of SAs	93
Table 41 — NEXT PAYLOAD field.....	94
Table 42 — MESSAGE ID field.....	95
Table 43 — Next payload values in SECURITY PROTOCOL OUT/IN parameter data	96
Table 44 — IKEv2-SCSI payload format.....	98
Table 45 — Key Exchange payload format.....	100
Table 46 — Identification payload format.....	101
Table 47 — ID TYPE field.....	101
Table 48 — Certificate payload format.....	102
Table 49 — CERTIFICATE ENCODING field.....	102
Table 50 — Certificate Request payload format	103
Table 51 — Authentication payload format	104
Table 52 — Nonce payload format	106
Table 53 — Notify payload format.....	107
Table 54 — Delete payload format	108
Table 55 — Encrypted payload format.....	110
Table 56 — Plaintext format for Encrypted payload CIPHERTEXT field.....	112
Table 57 — IKEv2-SCSI SA Creation Capabilities payload format.....	115
Table 58 — IKEv2-SCSI SA Cryptographic Algorithms payload format	116
Table 59 — IKEv2-SCSI SAUT Cryptographic Algorithms payload format.....	118
Table 60 — IKEv2-SCSI Timeout Values payload format.....	119
Table 61 — IKEv2-SCSI cryptographic algorithm descriptor format.....	120
Table 62 — ALGORITHM TYPE field	121
Table 63 — ENCR IKEv2-SCSI cryptographic algorithm descriptor format.....	122
Table 64 — ENCR ALGORITHM IDENTIFIER field.....	123
Table 65 — PRF IKEv2-SCSI cryptographic algorithm descriptor format.....	124
Table 66 — PRF ALGORITHM IDENTIFIER field.....	125
Table 67 — INTEG IKEv2-SCSI cryptographic algorithm descriptor format.....	126
Table 68 — INTEG ALGORITHM IDENTIFIER field.....	126
Table 69 — D-H IKEv2-SCSI cryptographic algorithm descriptor format.....	127
Table 70 — D-H ALGORITHM IDENTIFIER field	128
Table 71 — SA_AUTH_OUT and SA_AUTH_IN IKEv2-SCSI cryptographic algorithm descriptor format....	129
Table 72 — SA_AUTH_OUT and SA_AUTH_IN ALGORITHM IDENTIFIER field	130
Table 73 — IKEv2-SCSI command order processing requirements on a single I_T_L nexus.....	132
Table 74 — IKEv2-SCSI parameter error categories.....	133
Table 75 — IKEv2 Notify payload error translations for IKEv2-SCSI.....	135
Table B.1 — IKE payload names shorthand	141