

Figure 6.1 AES Encryption Process

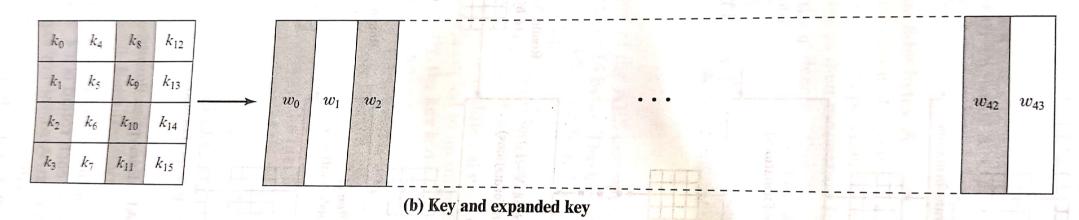


Figure 6.2 AES Data Structures

Table 6.1 AES Parameters

Key Size (words/bytes/bits)	4/16/128	6/24/192	8/32/256
Plaintext Block Size (words/bytes/bits)	4/16/128	4/16/128	4/16/128
Number of Rounds	10	12	14
Round Key Size (words/bytes/bits)	4/16/128	4/16/128	4/16/128
Expanded Key Size (words/bytes)	44/176	52/208	60/240

Table 6.2 AES S-Boxes and a restriction of the land

					Circle seprimelates			Total Control Control	-								
		and the same of		The Laboratory	-	-			7 1	y				Photo (Personal Property of		alerto agai essento	
		0	1	2	3	4	-5	6	7	8	9	Λ	В	C	D	E	F
	0	6.3	7C	77	7B	F2	6B	6F	C5	30	01	67	2B	FE.	D7	AB	76
	1	CA	82	C9	7D	FA	59	47	F0	AD	D4	A2	AF	9C	A4	72	CO
	2	B7	FD	93	26	36	3F	F7	CC	34	A5	11.5	FI	71	D8	31	15
	3	04	C7	23	C3	18	96	05	9A	07	12	80	1:2	EB	27	B2	75
	4	09	83	2C	1A	1B	6E	5A	A0	52	3B	D6	B3	29	E3	2F	84
	5	53	D1	00	ED	20	FC	B1	5B	6A	СВ	BE	39	4A	4C	58	CF
	-6	D0	EF	AA	FB	43	4D	33	85	45	F9	02	7F	50	3C	9F	A8
	7	51	A3	40	8F	92	9D	38	F5	BC	B6	DA	21	10	FF	F3	D2
7.	-8	CD	0C	_13	EC	5F	97	44	17	C4	Λ7	7E	3D	64	5D	19	73
	9	60	81	4F	DC	22	2A)	90	88	46	EE	B8	14	DE	5E	ов	DB
	A	E0	32	3A	0A	49	06	24	5C	C2	D3	AC	62	91	95	E4	79
	В	E7	C8	37	6D	8D	D5	4E	A9	6C	56	F4	EA	65	7A	AE	08
	Ç	BA	78	25	2E	1C	A6	B4	C6	E8	DD	74	1F	4B	BD	8B	8A
	D	70	3E	B5	66	48	03	F6	0E	61	35	57	В9	86	CI	1D	9E
	E	El	F8	98	11	69	D9	8E	94	9B	1E	87	E9	CE	55	28	DF
	F	8C	A1	89	0D	BF	E6	42	68	41	99	2D	OF	B0	54	ВВ	16

(a) S-bo

			-		-		-	-	-	-	mily distribution (decrease	-	-			
	0	1	2	3	4	- 5	6	7	8	-9	A	В	C	D	E	F
0	52	09	6A	D5	- 30	36	A5.	38	BF	40	A3	9E	81	F3	D 7	FB
1	7C	E3	39	82	9B	2F	FF	87	34	8E	43	44	C4	DE	E9	CB
2	54	7B	94	32	A6	C2	23	3D	EE	4C	95 ,	0B	42	FA	C3	4E
3	08	2E	Al	66	28	D9	24	B2	76	5B	A2)	49	6D	8B	D1	25
4	72	F8	F6	64	86	- 68	98	16	D4	A4	5Ć	CC	5D	65	B6	92
5	6C	70	-48	-50	FD	ED	B9	DA	5E	15	46	57	A7	8D	9D	84
-6	90	D8	AB	00	8C	BC	D3	0A	F7	E4	58	05	B8	В3	45	06
7	DO	2C	1E	8F	CA	3F	0F	02	CI	AF	BD	03	01	13	8A	6B
8	Contract of the	of the last of the		41	4F	67-	DC	EA	97	F2	CF	CE	FO	B4	E6	73
-	CONTRACTOR SECTION		-	Color Color	E7	AD	35	85	E2	F9	37	E8	1C	75	DF	6E
-	-				THE PERSON NAMED IN	29	C5	89	6F	B7	62	0E	AA	18	BE	1B
	-	-		the second second second	and the second second second	D2	79	20	9A	DB	CO	FE	78	CD	5A	F4
-	-	-		Name and Address			C7	31	B1	12	10	59	27	80	EC	5F
-					-			OD	2D	E5	7A	9F	93	C9	9C	EF
-		- Million accordance - million (gro		Account the Control	-			В0	C8	EB	BB	3C	83	53	99	-61
-	-	Selection of the Selection			A CONTRACTOR OF LANSING		The state of the s	and the second second	A STATE OF THE PARTY.	69	14	63	55	21	0C	7D
	0 1 2 3 4 5 6 7	0 52 1 7C 2 54 3 08 4 72 5 6C 6 90 7 D0 8 3A 9 96 A 47 B FC C 1F D 60 E A0	0 1 0 52 09 1 7C E3 2 54 7B 3 08 2E 4 72 F8 5 6C 70 6 90 D8 7 D0 2C 8 3A 91 9 96 AC A 47 F1 B FC 56 C 1F DD D 60 51 E A0 E0	0 1 2 0 52 09 6A 1 7C E3 39 2 54 7B 94 3 08 2E A1 4 72 F8 F6 5 6C 70 48 6 90 D8 AB 7 D0 2C 1E 8 3A 91 11 9 96 AC 74 A 47 F1 1A B FC 56 3E C 1F DD A8 D 60 51 7F E A0 E0 3B	0 1 2 3 0 52 09 6A D5 1 7C E3 39 82 2 54 7B 94 32 3 08 2E A1 66 4 72 F8 F6 64 5 6C 70 48 50 6 90 D8 AB 00 7 D0 2C 1E 8F 8 3A 91 11 41 9 96 AC 74 22 A 47 F1 1A 71 B FC 56 3E 4B C 1F DD A8 33 D 60 51 7F A9 E A0 E0 3B 4D	0 1 2 3 4 0 52 09 6A D5 30 1 7C E3 39 82 9B 2 54 7B 94 32 A6 3 08 2E A1 66 28 4 72 F8 F6 64 86 5 6C 70 48 50 FD 6 90 D8 AB 00 8C 7 D0 2C 1E 8F CA 8 3A 91 11 41 4E 9 96 AC 74 22 E7 A 47 F1 1A 71 1D B FC 56 3E 4B C6 C 1F DD A8 33 88 D 60 51 7F A9 19 <td>0 1 2 3 4 5 0 52 09 6A D5 30 36 1 7C E3 39 82 9B 2F 2 54 7B 94 32 A6 C2 3 08 2E A1 66 28 D9 4 72 F8 F6 64 86 68 5 6C 70 48 50 FD ED 6 90 D8 AB 00 8C BC 7 D0 2C 1E 8F CA 3F 8 3A 91 11 41 4F 67 9 96 AC 74 22 E7 AD A 47 F1 1A 71 1D 29 B FC 56 3E 4B C6 D2</td> <td>0 1 2 3 4 5 6 0 52 09 6A D5 30 36 A5 1 7C E3 39 82 9B 2F FF 2 54 7B 94 32 A6 C2 23 3 08 2E A1 66 28 D9 24 4 72 F8 F6 64 86 68 98 5 6C 70 48 50 FD ED B9 6 90 D8 AB 00 8C BC D3 7 D0 2C 1E 8F CA 3F 0F 8 3A 91 11 41 4F 67 DC 9 96 AC 74 22 E7 AD 35 A 47 F1 1A 71</td> <td>0 1 2 3 4 5 6 7 0 52 09 6A D5 30 36 A5 38 1 7C E3 39 82 9B 2F FF 87 2 54 7B 94 32 A6 C2 23 3D 3 08 2E A1 66 28 D9 24 B2 4 72 F8 F6 64 86 68 98 16 5 6C 70 48 50 FD ED B9 DA 6 90 D8 AB 00 8C BC D3 0A 7 D0 2C 1E 8F CA 3F 0F 02 8 3A 91 11 41 4F 67 DC EA 9 96 AC 74</td> <td> 0</td> <td>0 1 2 3 4 5 6 7 8 9 0 52 09 6A D5 30 36 A5 38 BF 40 1 7C E3 39 82 9B 2F FF 87 34 8E 2 54 7B 94 32 A6 C2 23 3D EE 4C 3 08 2E A1 66 28 D9 24 B2 76 5B 4 72 F8 F6 64 86 68 98 16 D4 A4 5 6C 70 48 50 FD ED B9 DA 5E 15 6 90 D8 AB 00 8C BC D3 0A F7 E4 7 D0 2C 1E 8F CA 3F 0F</td> <td>0 1 2 3 4 5 6 7 8 9 A 0 52 09 6A D5 30 36 A5 38 BF 40 A3 1 7C E3 39 82 9B 2F FF 87 34 8E 43 2 54 7B 94 32 A6 C2 23 3D EE 4C 95 3 08 2E A1 66 28 D9 24 B2 76 5B A2 4 72 F8 F6 64 86 68 98 16 D4 A4 5C 5 6C 70 48 50 FD ED B9 DA 5E 15 46 6 90 D8 AB 00 8C BC D3 0A F7 E4 58</td> <td>0 1 2 3 4 5 6 7 8 9 A B 0 52 09 6A D5 30 36 A5 38 BF 40 A3 9E 1 7C E3 39 82 9B 2F FF 87 34 8E 43 44 2 54 7B 94 32 A6 C2 23 3D EE 4C 95 0B 3 08 2E A1 66 28 D9 24 B2 76 5B A22 49 4 72 F8 F6 64 86 68 98 16 D4 A4 5C CC 5 6C 70 48 50 FD ED B9 DA 5E 15 46 57 6 90 D8 AB 00 8C</td> <td> 0</td> <td>0 1 2 3 4 5 6 7 8 9 A B C D 0 52 09 6A D5 30 36 A5 38 BF 40 A3 9E 81 F3 1 7C E3 39 82 9B 2F FF 87 34 8E 43 44 C4 DE 2 54 7B 94 32 A6 C2 23 3D EE 4C 95 0B 42 FA 3 08 2E A1 66 28 D9 24 B2 76 5B A2 49 6D 8B 4 72 F8 F6 64 86 68 98/16 D4 A4 5C CC 5D 65 5 6C 70 48 50 FD BD B9/10 DA<</td> <td> 0</td>	0 1 2 3 4 5 0 52 09 6A D5 30 36 1 7C E3 39 82 9B 2F 2 54 7B 94 32 A6 C2 3 08 2E A1 66 28 D9 4 72 F8 F6 64 86 68 5 6C 70 48 50 FD ED 6 90 D8 AB 00 8C BC 7 D0 2C 1E 8F CA 3F 8 3A 91 11 41 4F 67 9 96 AC 74 22 E7 AD A 47 F1 1A 71 1D 29 B FC 56 3E 4B C6 D2	0 1 2 3 4 5 6 0 52 09 6A D5 30 36 A5 1 7C E3 39 82 9B 2F FF 2 54 7B 94 32 A6 C2 23 3 08 2E A1 66 28 D9 24 4 72 F8 F6 64 86 68 98 5 6C 70 48 50 FD ED B9 6 90 D8 AB 00 8C BC D3 7 D0 2C 1E 8F CA 3F 0F 8 3A 91 11 41 4F 67 DC 9 96 AC 74 22 E7 AD 35 A 47 F1 1A 71	0 1 2 3 4 5 6 7 0 52 09 6A D5 30 36 A5 38 1 7C E3 39 82 9B 2F FF 87 2 54 7B 94 32 A6 C2 23 3D 3 08 2E A1 66 28 D9 24 B2 4 72 F8 F6 64 86 68 98 16 5 6C 70 48 50 FD ED B9 DA 6 90 D8 AB 00 8C BC D3 0A 7 D0 2C 1E 8F CA 3F 0F 02 8 3A 91 11 41 4F 67 DC EA 9 96 AC 74	0	0 1 2 3 4 5 6 7 8 9 0 52 09 6A D5 30 36 A5 38 BF 40 1 7C E3 39 82 9B 2F FF 87 34 8E 2 54 7B 94 32 A6 C2 23 3D EE 4C 3 08 2E A1 66 28 D9 24 B2 76 5B 4 72 F8 F6 64 86 68 98 16 D4 A4 5 6C 70 48 50 FD ED B9 DA 5E 15 6 90 D8 AB 00 8C BC D3 0A F7 E4 7 D0 2C 1E 8F CA 3F 0F	0 1 2 3 4 5 6 7 8 9 A 0 52 09 6A D5 30 36 A5 38 BF 40 A3 1 7C E3 39 82 9B 2F FF 87 34 8E 43 2 54 7B 94 32 A6 C2 23 3D EE 4C 95 3 08 2E A1 66 28 D9 24 B2 76 5B A2 4 72 F8 F6 64 86 68 98 16 D4 A4 5C 5 6C 70 48 50 FD ED B9 DA 5E 15 46 6 90 D8 AB 00 8C BC D3 0A F7 E4 58	0 1 2 3 4 5 6 7 8 9 A B 0 52 09 6A D5 30 36 A5 38 BF 40 A3 9E 1 7C E3 39 82 9B 2F FF 87 34 8E 43 44 2 54 7B 94 32 A6 C2 23 3D EE 4C 95 0B 3 08 2E A1 66 28 D9 24 B2 76 5B A22 49 4 72 F8 F6 64 86 68 98 16 D4 A4 5C CC 5 6C 70 48 50 FD ED B9 DA 5E 15 46 57 6 90 D8 AB 00 8C	0	0 1 2 3 4 5 6 7 8 9 A B C D 0 52 09 6A D5 30 36 A5 38 BF 40 A3 9E 81 F3 1 7C E3 39 82 9B 2F FF 87 34 8E 43 44 C4 DE 2 54 7B 94 32 A6 C2 23 3D EE 4C 95 0B 42 FA 3 08 2E A1 66 28 D9 24 B2 76 5B A2 49 6D 8B 4 72 F8 F6 64 86 68 98/16 D4 A4 5C CC 5D 65 5 6C 70 48 50 FD BD B9/10 DA<	0

(b) Inverse S-box

Here is an example of the SubBytes transformation:

EA	04	65	85		87	F2	4D	97
83	45	5D	96		EC	6E	4C	90
5C	33	98	В0		4A	C3	46	E7
F0	2D	AD	C5	6,15	8C	D8	95	A6

The S-box is constructed in the following fashion (Figure 6.6a).

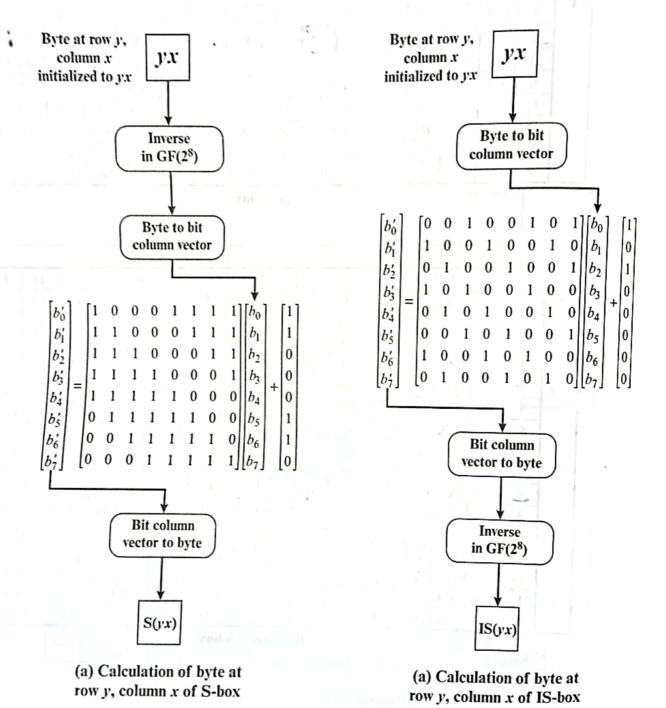


Figure 6.6 Constuction of S-Box and IS-Box

- 1. Initialize the S-box with the byte values in ascending sequence row by row. The first row contains [00], {01}, {02}, ..., {0F}; the second row contains [10], [11], etc.; and so on. Thus, the value of the byte at row y, column x is $\{yx\}$.
- 2. Map each byte in the S-box to its multiplicative inverse in the finite field GF(28); the value {00} is mapped to itself.
- 3. Consider that each byte in the S-box consists of 8 bits labeled $(b_7, b_6, b_5, b_4, b_3, b_2, b_1, b_0)$. Apply the following transformation to each bit of each byte in the S-box:

$$b'_{i} = b_{i} \oplus b_{(i+4) \mod 8} \oplus b_{(i+5) \mod 8} \oplus b_{(i+6) \mod 8} \oplus b_{(i+7) \mod 8} \oplus c_{i}$$
 (6.1)

where c_i is the *i*th bit of byte c with the value [63]; that is, $(c_7c_6c_5c_4c_3c_2c_1c_0) = (01100011)$. The prime (') indicates that the variable is to be updated by the value on the right. The AES standard depicts this transformation in matrix form as follows.

$$\begin{bmatrix} b'_0 \\ b'_1 \\ b'_2 \\ b'_3 \\ b'_4 \\ b'_5 \\ b'_6 \\ b'_7 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} b_0 \\ b_1 \\ b_2 \\ b_3 \\ b_4 \\ b_5 \\ b_6 \\ b_7 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}$$

$$(6.2)$$

Equation (6.2) has to be interpreted carefully. In ordinary matrix multiplication,4 each element in the product matrix is the sum of products of the elements of one row and one column. In this case, each element in the product matrix is the bitwise XOR of products of elements of one row and one column. Furthermore, the final addition shown in Equation (6.2) is a bitwise XOR. Recall from Section 5.6 that the bitwise XOR is addition in GF(28).

As an example, consider the input value {95}. The multiplicative inverse in $GF(2^8)$ is $\{95\}^{-1} = \{8A\}$, which is 10001010 in binary. Using Equation (6.2),

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \end{bmatrix} \oplus \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{bmatrix} \oplus \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}$$

⁴For a brief review of the rules of matrix and vector multiplication, refer to Appendix E.

CHAPTER 6 / ADVANCED ENCRYPTION STANDARD

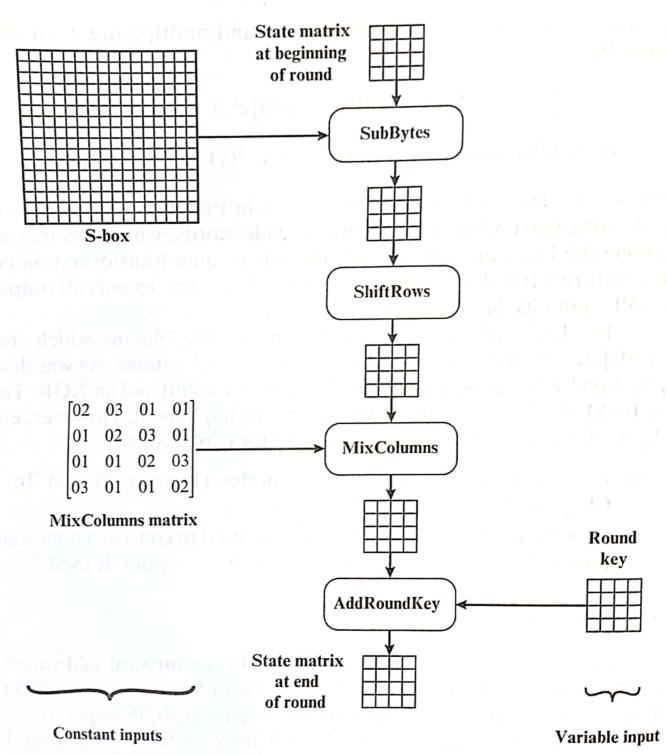
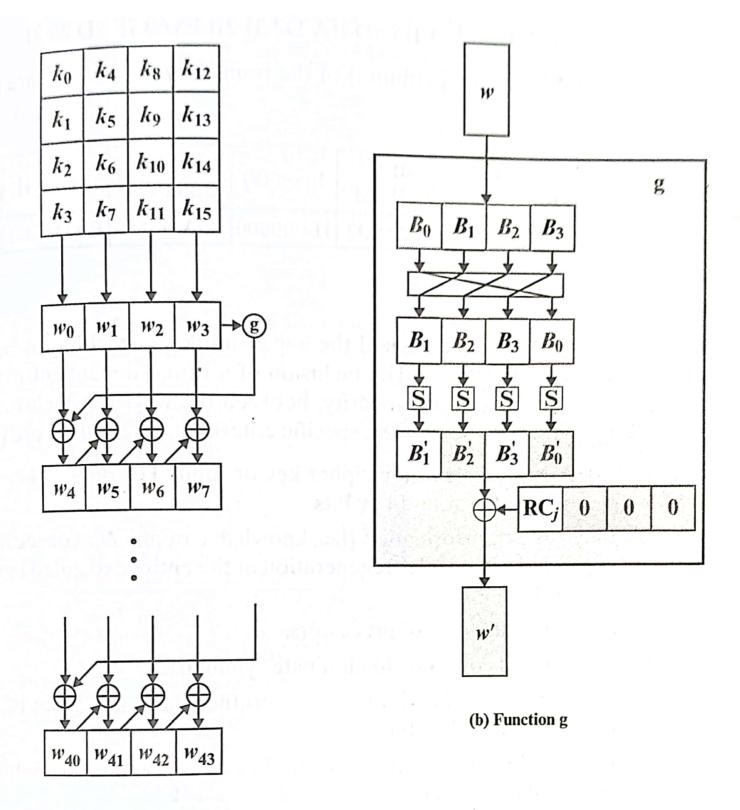


Figure 6.8 Inputs for Single AES Round



(a) Overall algorithm

Figure 6.9 AES Key Expansion

Table 6.3 Key Expansion for AES Example

Key Words	Auxiliary Function
w0 = 0f 15 71 c9	RotWord (w3) = 7f 67 98 af = x1
w1 = 47 d9 e8 59	SubWord (x1) = d2 85 46 79 = y1
w2 = 0c b7 ad d6	Rcon (1) = 01 00 00 00
w3 = af 7f 67 98	y1 \oplus Rcon (1) = d3 85 46 79 = z1
$w4 = w0 \oplus z1 = dc \ 90 \ 37 \ b0$	RotWord (w7) = 81 15 a7 38 = x2
$w5 = w4 \oplus w1 = 9b \ 49 \ df \ e9$	SubWord (x2) = 0c 59 5c 07 = y2
$w6 = w5 \oplus w2 = 97 \ fe \ 72 \ 3f$	Rcon (2) = 02 00 00 00
$w7 = w6 \oplus w3 = 38 \ 81 \ 15 \ a7$	y2 \oplus Rcon (2) = 0e 59 5c 07 = z2
$w8 = w4 \oplus z2 = d2 c9 6b b7$	RotWord (w11) = ff d3 c6 e6 = x3
$w9 = w8 \oplus w5 = 49 80 b4 5e$	SubWord (x3) = 16 66 b4 83 = y3
$w10 = w9 \oplus w6 = de 7e c6 61$	Rcon (3) = 04 00 00 00
$w11 = w10 \oplus w7 = e6 ff d3 c6$	y3 Rcon (3) = 12 66 b4 8e = z3
$w12 = w8 \oplus z3 = c0$ af df 39	RotWord (w15) = ae 7e c0 b1 = x4
$w13 = w12 \oplus w9 = 89$ 2f 6b 67	SubWord (x4) = e4 f3 ba c8 = y4
$w14 = w13 \oplus w10 = 57$ 51 ad 06	Rcon (4) = 08 00 00 00
$w15 = w14 \oplus w11 = b1$ ae 7e c0	y4 \oplus Rcon (4) = ec f3 ba c8 = 4

(Continued)

Table 6.3 Continued

Table 6.5 Commune	
Key Words	Auxiliary Function
$w16 = w12 \oplus z4 = 2c \ 5c \ 65 \ f1$ $w17 = w16 \oplus w13 = a5 \ 73 \ 0e \ 96$ $w18 = w17 \oplus w14 = f2 \ 22 \ a3 \ 90$ $w19 = w18 \oplus w15 = 43 \ 8c \ dd \ 50$	RotWord (w19) = 8c dd 50 43 = x5 SubWord (x5) = 64 c1 53 1a = y5 Rcon(5) = 10 00 00 00 y5 ⊕ Rcon (5) = 74 c1 53 1a = z5 RotWord (w23) = 40 46 bd 4c = x6
$w20 = w16 \oplus z5 = 58 \text{ 9d } 36 \text{ eb}$ $w21 = w20 \oplus w17 = \text{fd ee } 38 \text{ 7d}$ $w22 = w21 \oplus w18 = 0 \text{f cc 9b ed}$ $w23 = w22 \oplus w19 = 4 \text{c } 40 \text{ 46 bd}$	SubWord (x6) = 09 5a 7a 29 = y6 Rcon(6) = 20 00 00 00 v6 \oplus Rcon(6) = 29 5a 7a 29 = z6
$w24 = w20 \oplus z6 = 71 \text{ c7 4c c2}$ $w25 = w24 \oplus w21 = 8c 29 74 \text{ bf}$ $w26 = w25 \oplus w22 = 83 \text{ e5 ef 52}$ $w27 = w26 \oplus w23 = \text{cf a5 a9 ef}$	RotWord (w27) = a5 a9 ef cf = x7 SubWord (x7) = 06 d3 bf 8a = y7 Rcon (7) = 40 00 00 00 y7 ⊕ Rcon(7) = 46 d3 df 8a = z7
$w28 = w24 \oplus z7 = 37 \ 14 \ 93 \ 48$ $w29 = w28 \oplus w25 = bb \ 3d \ e7 \ f7$ $w30 = w29 \oplus w26 = 38 \ d8 \ 08 \ a5$ $w31 = w30 \oplus w27 = f7 \ 7d \ a1 \ 4a$	RotWord (w31) = 7d al 4a f7 = x8 SubWord (x8) = ff 32 d6 68 = y8 Rcon (8) = 80 00 00 00 y8 \oplus Rcon(8) = 7f 32 d6 68 = z8
	RotWord (w35) = be 0b 38 3c = x9 SubWord (x9) = ae 2b 07 eb = y9 Rcon (9) = 1B 00 00 00 y9 Rcon (9) = b5 2b 07 eb = z9
$w37 = w36 \oplus w33 = 0e 16 e0 1c$ $w38 = w37 \oplus w34 = c5 d5 4a 6e$ $w39 = w38 \oplus w35 = f9 6b 41 56$	RotWord (w39) = 6b 41 56 f9 = x10 SubWord (x10) = 7f 83 b1 99 = y10 Rcon (10) = 36 00 00 00 y10 \oplus Rcon (10) = 49 83 b1 99 = z10
$w40 = w36 \oplus z10 = b4 \text{ 8e f3 52}$ $w41 = w40 \oplus w37 = ba 98 13 4e$ $w42 = w41 \oplus w38 = 7f 4d 59 20$ $w43 = w42 \oplus w39 = 86 26 18 76$	

Start of Round	After SubBytes	After ShiftRows	After MixColumns	Round Key
01 89 fe 76				0f 47 0c af
23 ab dc 54		6.		15 d9 b7 7f
45 cd ba 32		_		71 e8 ad 67
67 62	ab 0b 00 ar			c9 59 d6 98
0e ce f2 d9	ab 8b 89 35 05 40 7f f1	ab 8b 89 35	b9 94 57 75	dc 9b 97 38
36 72 6b 2b	18 3f f0 fc	40 7f f1 05	e4 8e 16 51	90 49 fe 81
34 25 -	e4 4e 2f c4	f0 fc 18 3f	47 20 9a 3f	37 df 72 15
ae b6 4e 88	4d 76 ba e3	c4 e4 4e 2f	c5 d6 f5 3b	b0 e9 3f a7
65 Of c0 4d	92 c6 9b 70	4d 76 ba e3	8e 22 db 12	d2 49 de e6
74 c7 e8 d0 70 ff e8 2a	51 16 9b e5	c6 9b 70 92	b2 f2 dc 92	c9 80 7e ff
70 11 e8 2d 75 3f ca 9c	9d 75 74 de	9b e5 51 16	df 80 f7 c1	6b b4 c6 d3
	4a 7f 6b bf	de 9d 75 74	2d c5 1e 52	b7 5e 61 c6
5c 6b 05 f4	21 40 3a 3c	4a 7f 6b bf	b1 c1 0b cc	c0 89 57 b1
7b 72 a2 6d b4 34 31 12	8d 18 c7 c9	40 3a 3c 21	ba f3 8b 07	af 2f 51 ae
9a 9b 7f 94	b8 14 d2 22	c7 c9 8d 18	f9 1f 6a c3	df 6b ad 7e
		22 b8 14 d2	1d 19 24 5c	39 67 06 c0
71 48 5c 7d 15 dc da a9	a3 52 4a ff	a3 52 4a ff	d4 11 fe 0f	2c a5 f2 43
26 74 c7 bd	59 86 57 d3 f7 92 c6 7a	86 57 d3 59	3b 44 06 73	5c 73 22 8c
24 7e 22 9c	36 f3 93 de	c6 7a f7 92	cb ab 62 37	65 0e a3 dd
		de 36 f3 93	19 b7 07 ec	f1 96 90 50
f8 b4 0c 4c 67 37 24 ff	41 8d fe 29 85 9a 36 16	41 8d fe 29	2a 47 c4 48	58 fd 0f 4c
ae a5 c1 ea		9a 36 16 85	83 e8 18 ba	9d ee cc 40
e8 21 97 bc	e4 06 78 87 9b fd 88 65	78 87 e4 06	84 18 27 23	36 38 9b 46
		65 9b fd 88	eb 10 0a f3	eb 7d ed bd
72 ba cb 04 1e 06 d4 fa	40 f4 1f f2	40 f4 1f f2	7b 05 42 4a	71 8c 83 cf
b2 20 bc 65	72 6f 48 2d	6f 48 2d 72	1e d0 20 40	c7 29 e5 a5
00 6d e7 4e	37 b7 65 4d 63 3c 94 2f	65 4d 37 b7 2f 63 3c 94	94 83 18 52	4c 74 ef a9
0a 89 c1 85			94 c4 43 fb	c2 bf 52 ef
d9 f9 c5 e5	67 a7 78 97	67 a7 78 97	ec 1a c0 80	37 bb 38 f7
d8 f7 f7 fb	35 99 a6 d9	99 a6 d9 35 68 Of 61 68	0c 50 53 c7	14 3d d8 7d
56 7b 11 14	61 68 68 0f b1 21 82 fa	fa b1 21 82	3b d7 00 ef b7 22 72 e0	93 e7 08 a1
db a1 f8 77		b9 32 41 f5		48 f7 a5 4a
18 6d 8b ba	b9 32 41 f5	3c 3d f4 ad	bl 1a 44 17 3d 2f ec b6	48 f3 cb 3c
a8 30 08 4e	ad 3c 3d f4 c2 04 30 2f	30 2f c2 04	0a 6b 2f 42	26 1b c3 be
ff d5 d7 aa	16 03 0e ac	ac 16 03 0e	9f 68 f3 b1	45 a2 aa 0b
f9 e9 8f 2b		99 1e 73 f1	31 30 3a c2	20 d7 72 38
1b 34 2f 08	99 1e 73 f1	18 15 30 af	ac 71 8c c4	fd 0e c5 f9 0d 16 d5 6b
4f c9 85 49	af 18 15 30	97 3b 84 dd	46 65 48 eb	42 e0 4a 41
Dr bf 81 89	84 dd 97 3b 08 08 0c a7	a7 08 08 0c	6a 1c 31 62	cb 1c 6e 56
cc 3e ff 3h		4b b2 16 e2		b4 ba 7f 86
al 67 50 -5	4b b2 16 e2	85 cb 79 32	1	8e 98 4d 26
04 85 02	32 85 cb 79 f2 97 77 ac	77 ac f2 97	, ,	f3 13 59 18
00 5f 34	32 63 cf 18	18 32 63 cf		52 4e 20 76
II 08 60 C4	52 55 62 25			
00 53 34 7 a	get sent part		* 1	: 1
Df ah os		1		
4a 7c 43 b9	and a think of the	1	Soonnad with C	ComCoonnor
			Scanned with C	aniscannei