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Data Service Options for Wideband Spread Spectrum Systems

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Data Service Options for Spread Spectrum Systems

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Data Service Options for Spread Spectrum Systems: High Speed Packet Data Services

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1 INTRODUCTION

1.1 General Description

This chapter defines requirements for support of high speed packet data transmission capability on TIA/EIA-95-B spread spectrum systems. Packet data transmission is supported on TIA/EIA-95-B Traffic Channels using primary or secondary traffic. For packet data transmission using TIA/EIA-95-B Traffic Channels, the Radio Link Protocol Type 2 specified in IS-707-A.8 is used.

This standard specifies a packet data bearer service for communication between terminal equipment and a packet interworking function (IWF) via a base station/mobile switching center (BS/MSC). It provides procedures that can apply to multiple packet data services, e.g., CDPD and Mobile-IP.

Packet data service options provide a means of establishing and maintaining Traffic Channels for packet data service. Service Options 22, 23, 24, and 25 are used to request packet data service through an IWF supporting an Internet standard Point-to-Point Protocol (PPP) interface to network layer protocols (see 4.1 and 4.2). Service Options 26, 27, 28, and 29 are used to request packet data service through an IWF supporting CDPD data services over a PPP interface (see 4.3). Additional packet data service options may be defined in future revisions to select other types of IWF resources or services.

1.2 Terms

Base Station (BS). A fixed station used for communicating with mobile stations. Depending upon the context, the term base station may refer to a cell, a sector within a cell, or other part of the cellular system.

BS. See base station.

BS/MSC. The base station and mobile switching center considered as a single functional entity.

CDPD. Cellular Digital Packet Data.

CLNP. Connectionless Network Protocol (See ISO 8473-1988).

Data Circuit-Terminating Equipment (DCE). A DCE connects a DTE to the PSTN. A typical DCE would be a V-series modem.

DTE. Data Terminal Equipment.

Forward Supplemental Code Channel. A Supplemental Code Channel operating in the forward direction.

Fundamental Code Channel. A portion of a Traffic Channel (Forward or Reverse) that is always present, and carries primary traffic, secondary traffic, signaling, and power control information.

GHDM. *General Handoff Direction Message* (see 7.7.3.3.2.31 of TIA/EIA-95-B).

IWF. Interworking Function (see 1.4.2).

IP. Internet Protocol.

IPCP. Internet Protocol Control Protocol (see RFC 1332).

LCP. PPP Link Control Protocol (see RFC 1661).

Mobile IP. Mobile Internet Protocol (see RFC 2002).

Mobile Station. A station in the Public Cellular Radio Telecommunications Service intended to be used while in motion or during halts at unspecified points. Mobile stations include portable units (e.g., hand-held personal units) and units installed in vehicles.

MSC. Mobile Switching Center.

MT0. Mobile Termination 0 (see 1.4.2).

MT2. Mobile Termination 2 (see 1.4.2).

OSINLCP. OSI Network Layer Control Protocol (see RFC 1377).

PPDN. Public Packet Data Network.

PPP. Point-to-Point Protocol (see RFC 1661).

PSTN. Public Switched Telephone Network.

Reverse Supplemental Code Channel. A Supplemental Code Channel operating in the reverse direction.

RFC. Request for Comments. The generic name of a specification developed by the Internet Engineering Task Force (IETF).

RLP. Radio Link Protocol.

SCAM. *Supplemental Channel Assignment Message* (see 7.7.3.3.2.24 of TIA/EIA-95-B).

SCRM. *Supplemental Channel Request Message* (see 6.7.2.3.2.18 of TIA/EIA-95-B).

SLIP. Serial Line IP.

Supplemental Code Channel. A portion of a Traffic Channel (Forward or Reverse) that is optionally present, and carries either primary or secondary traffic.

TCP. Transmission Control Protocol.

TE2. Terminal Equipment 2 (see 1.4.2).

Traffic Channel. A Fundamental Code Channel (Forward or Reverse) and optionally up to seven Supplemental Code Channels used to transport user data and signaling traffic between the base station and the mobile station.

1.3 References

ANSI/TIA/EIA-617 *Inband DCE Control for Asynchronous DTE-DCE Interfaces.*

Common Cryptographic Algorithms Revision A.1. An ITAR controlled document subject to restricted distribution. Contact the Telecommunications Industry Association, Washington, D.C., April 25, 1995.

4 RLP FRAME FORMATS

For RLP control frames, RLP shall use the formats defined in 4.1.

For Fundamental RLP data frames whose rate is less than Rate 1, RLP shall use the formats in 4.2.1 or 4.2.2. For Rate 1 Fundamental or Supplemental RLP data frames, RLP shall use the formats in 4.2.3.

For idle frames, RLP shall use the format in 4.3.

4.1 Control Frames

Control frames are distinguished by the CTL field.

Control frames shall contain the least significant 8 bits of L_V(S), in order that missing data frames may be quickly detected. RLP shall not increment L_V(S) after generating a control frame.

4.1.1 SYNC, SYNC/ACK, and ACK Control Frames

SYNC, SYNC/ACK, and ACK control frames are used during RLP initialization.

Field	Length (bits)
SEQ	8
CTL	6
ENCRYPTION_MODE	2
EM	0 or 2
EXT_SEQ_M	0 or 18
Padding_1	Variable
FCS	16
Padding_2	Variable

SEQ - Data frame sequence number.

CTL - RLP frame type. For SYNC, SYNC/ACK, and ACK control frames, the CTL field is defined as follows:

'1101 10' - SYNC. Requests return of a control frame with the ACK bit set.

'1110 10' - ACK. Acknowledges receipt of a control frame with the SYNC bit set.

'1111 10' - SYNC/ACK. Indicates both SYNC and ACK.

ENCRYPTION_MODE - Encryption Mode.

This field indicates the supported or desired user data encryption mode(s), set according to Table 11.

EM - Encryption Request Indicator.

'00' (Default) Requests or Acknowledges no RLP data frame encryption (not supported or inactive).

'01' Requests or Acknowledges RLP data frame encryption capability.

EXT_SEQ_M - This field shall be included when the EM field is included.

When the EM field is set to '01', this field shall be set to the 18 most significant bits of EXT_V(S) (see 3.1.1.2.1). Otherwise, this field shall be set to all zeros.

Padding_1 - Padding bits. As required to octet align the FCS field. These bits shall be set to '0'.

FCS - Frame Check Sequence. The contents shall be as generated by the 16-bit FCS polynomial specified in 3.1 of RFC 1662. The FCS shall cover all fields before the FCS field.

Padding_2 - Padding bits. As required to fill the remainder of the frame. These bits shall be set to '0'.

Table 11 User Data Encryption Modes

Encryption Mode (binary)	Meaning
00	Encryption not supported (default).
01	Enhanced encryption mode
10	Both basic and enhanced encryption modes. This value shall not be used in ACK control frames.
11	Basic encryption mode.

4.1.2 NAK Control Frame

A NAK control frame requests the retransmission of one or more data frames.

Field	Length (bits)
SEQ	8
CTL	6
NAK_TYPE	2
L_SEQ_HI	4

If NAK_TYPE = '00', the following fields shall be:

FIRST	12
LAST	12

If NAK_TYPE = '01', the following fields shall be:

NAK_Map_Count	2

NAK_Map_Count + 1 occurrences of the following record:

NAK_Map_SEQ	12
NAK_Map	8

For any NAK_TYPE value, the following fields shall be:

Padding_1	Variable
FCS	16
Padding_2	variable

SEQ - Data frame sequence number.

CTL - '1100 00' - NAK. Requests retransmission of data frames.

NAK_TYPE - NAK type, as defined below:

'00' - Requests retransmission of data frames numbered FIRST through LAST, inclusive.
'01' - Requests retransmission of data frames as specified by the NAK Map(s).

L_SEQ_HI - The most significant 4 bits of L_V(S).

FIRST - The 12-bit sequence number of the first data frame for which retransmission is requested.

LAST - The 12-bit sequence number of the last data frame for which retransmission is requested.

Padding_1 - Padding bits. As required to octet align the FCS field. These bits shall be set to '0'.

FCS - Frame Check Sequence. The contents shall be as generated by the 16-bit FCS polynomial specified in 3.1 of RFC 1662. The FCS shall cover all fields before the FCS field.

Padding_2 - Padding bits. As required to fill the remainder of the frame. These bits shall be set to '0'.

NAK_Map_Count - One less than the number of NAK Maps in this NAK control frame.

NAK_Map_SEQ - The 12-bit sequence number of the first data frame for which retransmission is requested.

NAK_Map - A bitmap identifying additional missing data frames for which retransmission is requested. The most significant bit corresponds to the data frame identified by (NAK_Map_SEQ +1) modulo 4096. Each less significant bit corresponds to the next sequential data frame. A bit set to '1' indicates that the corresponding data frame is missing.

4.2 Data Frames

4.2.1 Unsegmented Data Frames

Unsegmented data frames carry a variable number of data octets, using a length field to indicate the number of octets.

Field	Length (bits)
SEQ	8
CTL	1
REXMIT	1
LEN	6
Data	8xLEN
Padding	Variable

SEQ - Data frame sequence number. See 3.1.2.

CTL - For a frame carrying unsegmented data the CTL field shall be set to '0'.[18]

REXMIT - Retransmitted frame indicator. This bit is set to '1' when the frame is a retransmitted data frame. Otherwise, it is set to '0'.

LEN - Data length. May be any value in the range from 0 to the maximum allowable for the data frame. Maximum values of LEN (MAX_LEN) are given in Table 12.

When LEN is zero, the frame is treated as an idle frame.

Data - Data octets.

[18]Note that the most significant bit of the CTL field of a control frame and a segmented data frame is always set to '1'.

Padding - Padding bits. As required to fill the remainder of the frame. These bits shall be set to '0'.

Table 12 Values of the Maximum Allowable Data Length (MAX_LEN

RLP Frame Type	MAX_LEN Multiplex Options 1, 3, 5, 7, 9, 11, 13, and 15	MAX_LEN Multiplex Options 2, 4, 6, 8, 10, 12, 14, and 16
Primary Traffic		
Rate 1 (Format A, see 4.2.3.1.1)	19	31
Rate 1/2	8	13
Rate 1/4	Not Used	4
Secondary Traffic		
Rate 1 (Format A, see 4.2.3.1.2)	19	30
Rate 7/8	17	28
Rate 3/4	14	24
Rate 1/2	9	15
Rate 7/16	N/A	13
Rate 3/8	N/A	10
Rate 1/4	Not Used	6
Rate 3/16	N/A	4

4.2.2 Segmented Data Frames

Segmented data frames carry a variable number of data octets, using a length field to indicate the number of octets. This type of data frame shall only be used to carry retransmitted data frames (see 3.1.4).

Field	Length (bits)
SEQ	8
CTL	4
LEN	0 or 4
Data	0 or 8xLEN
Padding	Variable

SEQ - Data frame sequence number. See 3.1.4.

CTL - For segmented data frames, the CTL field is defined as follows:

'1000' - First Segment. Contains the first LEN octets of the segmented data frame.

'1001' - Second Segment. Contains the next LEN octets of the segmented data frame.

'1010' - Last Segment. Contains the last LEN octets of the segmented data frame.

'1011' - Intersegment Fill Frame. When Multiplex Option 2, 4, 6, 8, 10, 12, 14, or 16 is used, intersegment fill frames can be sent before or between segmented data frames (see 3.1.4). Intersegment fill frames are not used with Multiplex Option 1, 3, 5, 7, 9, 11, 13, or 15.

LEN - Data length. When CTL is set to "1000', '1001', or '1010', the LEN field may be any value in the range from 1 to the maximum allowable for the data frame, or 15, whichever is less. Values of the maximum allowable data length (MAX_LEN) are given in Table 12. When CTL is set to '1011' the LEN field shall not be included.

Data - Data octets. When CTL is set to '1000', '1001', or '1010', this field shall carry LEN Data octets. When CTL is set to '1011' the Data field shall not be included.

Padding - Padding bits. As required to fill the remainder of the frame. These bits shall be set to '0'.

4.2.2.1 Rate 1/8 and Rate 1/16 Intersegment Fill Frames

For Multiplex Option 2, 4, 6, 8, 10, 12, 14, or 16, Rate 1/8 primary traffic RLP frames and Rate 1/16 secondary traffic RLP frames may be intersegment fill frames.

Field	**Length (bits)**
SEQ	8
FCS	8
ISF	4

SEQ - Data frame sequence number. See 3.1.4.

FCS - Frame Check Sequence. This field is identical to the FCS field of an idle frame with matching SEQ field. See 4.3.

ISF - Intersegment Fill frame indicator. The value '1111' indicates an intersegment fill frame.

4.2.3 Rate 1 RLP Frames

For Rate 1 RLP data frames, two special frame formats are used. Format A RLP data frames are described in 4.2.3.1. Format B RLP data frames are described in 4.2.3.2.

4.2.3.1 Rate 1 RLP Frame Format A

4.2.3.1.1 Format A for Primary Traffic

When RLP frames are carried as primary traffic by Multiplex Option 1, 3, 5, 7, 9, 11, 13, and 15, a format A frame is defined as follows:

Field	Length (bits)
Information	168
TYPE	3

Information - Control or data frame. Formatted according to the control and data frame formats described in 4.1, 4.2.1 and 4.2.2.

TYPE - Frame type. The TYPE field shall be set to '001'.

When RLP frames are carried as primary traffic by Multiplex Option 2, 4, 6, 8, 10, 12, 14, and 16, a format A frame is defined as follows:

Field	Length (bits)
Information	264
TYPE	2

Information - Control or data frame. Formatted according to the control and data frame formats described in 4.1, 4.2.1 and 4.2.2.

TYPE - Frame type. The TYPE field shall be set to '01'.

4.2.3.1.2 Format A for Secondary Traffic

When RLP frames are carried as secondary traffic by Multiplex Option 1, 3, 5, 7, 9, 11, 13, and 15, a format A frame is defined as follows:

Field	Length (bits)
Information	165
TYPE	3

Information - Control or data frame. Formatted according to the control and data frame formats described in 4.1, 4.2.1 and 4.2.2.

TYPE - Frame type. The TYPE field shall be set to '001'.

When RLP frames are carried as secondary traffic by Multiplex Option 2, 4, 6, 8, 10, 12, 14, and 16, a format A frame is defined as follows:

Field	Length (bits)
Information	260
TYPE	2

Information - Control or data frame. Formatted according to the control and data frame formats described in 4.1, 4.2.1 and 4.2.2.

TYPE - Frame type. The TYPE field shall be set to '01'.

4.2.3.2 Rate 1 RLP Data Frame Format B

4.2.3.2.1 Format B for Primary Traffic

When RLP frames are carried as primary traffic by Multiplex Option 1, 3, 5, 7, 9, 11, 13, and 15, a format B frame is defined as follows:

Field	Length (bits)
SEQ	8
Data	160
TYPE	3

SEQ - Data frame sequence number. See 3.1.2 and 3.1.4.

Data - Data octets. This field shall contain 20 octets of data.

TYPE - Frame type. The TYPE field is set to '010' for a new data frame and set to '011' for a retransmitted data frame.

When RLP frames are carried as primary traffic by Multiplex Option 2, 4, 6, 8, 10, 12, 14, and 16, a format B frame is defined as follows:

Field	Length (bits)
SEQ	8
Data	256
TYPE	2

SEQ - Data frame sequence number. See 3.1.2 and 3.1.4.

Data - Data octets. This field shall contain 32 octets of data.

TYPE - Frame type. The TYPE field is set to '10' for a new data frame and set to '11' for a retransmitted data frame.

4.2.3.2.2 Format B for Secondary Traffic

When RLP frames are carried as secondary traffic by Multiplex Option 1, 3, 5, 7, 9, 11, 13, and 15, a format B frame is defined as follows:

Field	Length (bits)
SEQ	8
Data	152
TYPE	8

SEQ - Data frame sequence number. See 3.1.2 and 3.1.4.

Data - Data octets. This field shall contain 19 octets of data.

TYPE - Frame type. The TYPE field is set to '00000010' for a new data frame and set to '00000011' for a retransmitted data frame.

When RLP frames are carried as primary traffic by Multiplex Option 2, 4, 6, 8, 10, 12, 14, and 16, a format B frame is defined as follows:

Field	Length (bits)
SEQ	8
Data	248
TYPE	6

SEQ - Data frame sequence number. See 3.1.2 and 3.1.4.

Data - Data octets. This field shall contain 31 octets of data.

TYPE - Frame type. The TYPE field is set to '000010' for a new data frame and set to '000011' for a retransmitted data frame.

4.3 Idle Frames

For Multiplex Option 1, 3, 5, 7, 9, 11, 13, and 15, Rate 1/8 RLP frames are idle frames. For Multiplex Option 2, 4, 6, 8, 10, 12, 14, and 16, Rate 1/8 primary traffic RLP frames and Rate 1/16 secondary traffic RLP frames may be idle frames. Higher rate RLP data frames with zero length (LEN = 0) (see 4.2.1) are also idle frames.

Field	Length (bits)
SEQ	8
FCS	8
Padding	0 or 4

SEQ - Data frame sequence number. See 3.1.2.

FCS - Frame Check Sequence based on a modified Nordstrom-Robinson code.

Let the sequence number to be coded be denoted as $(X_7X_6X_5X_4X_3X_2X_1X_0)$

Let the FCS be denoted as $(Y_7Y_6Y_5Y_4Y_3Y_2Y_1Y_0)$

The FCS is generated as follows:

$$Y_0 = X_7 \oplus X_6 \oplus X_0 \oplus X_1 \oplus X_3 \oplus (X_0 \oplus X_4)\cdot(X_1 \oplus X_2 \oplus X_3 \oplus X_5)\oplus (X_1 \oplus X_2)\cdot(X_3 \oplus X_5)$$

Where $\oplus$ denotes modulo-2 addition. Code bits Y_1 through Y_6 are found by cyclically shifting X_0 through X_6. In other words, $X_{(i+j) \bmod 7}$ is substituted for X_i in the generating equation for Y_j. Y_7 is a parity bit over the previous 15 bits. The final step in generating the FCS is to complement the last three bits. A table specifying the code is provided in Table 13.

Pad - Padding bits. As required to fill the remainder of the frame. These bits shall be set to '0'.

Table 13 presents the modified Nordstrom–Robinson code used to protect Rate 1/8 and Rate 1/16 idle frames. In Table 13, the most significant byte in a word is the SEQ value to be protected and the least significant byte is the FCS. All numbers are hexadecimal.

Table 13 Modified Nordstrom–Robinson Code

0007	20f3	40ee	6034	8078	a08c	c091	e04b
01d4	2119	4161	6182	81ab	a166	c11e	e1fd
02a0	226d	423b	62d8	82df	a212	c244	e2a7
034a	23be	438d	6357	8335	a3c1	c3f2	e328
04c9	242a	4452	649f	84b6	a455	c42d	e4e0
057f	25a5	45b8	654c	8500	a5da	c5c7	e533
061c	26c6	46f5	6601	8663	a6b9	c68a	e67e
0793	2770	4726	67eb	87ec	a70f	c759	e794
089a	2840	485d	68a9	88e5	a83f	c822	e8d6
092c	29cf	49b7	697a	8953	a9b0	c9c8	e905
0a76	2a95	4ac3	6a0e	8a09	aaea	cabc	ea71
0bf9	2b23	4b10	6be4	8b86	ab5c	cb6f	eb9b
0c31	2cfc	4c84	6c67	8c4e	ac83	ccfb	ec18
0de2	2d16	4d0b	6dd1	8d9d	ad69	cd74	edae
0eaf	2e5b	4e68	6eb2	8ed0	ae24	ce17	eecd
0f45	2f88	4fde	6f3d	8f3a	aff7	cfa1	ef42
10bd	305e	5008	70c5	90c2	b021	d077	f0ba
1132	31e8	51db	712f	914d	b197	d1a4	f150
1251	328b	5296	7262	922e	b2f4	d2e9	f21d
13e7	3304	537c	73b1	9398	b37b	d303	f3ce
1464	3490	54a3	7479	941b	b4ef	d4dc	f406
158e	3543	5515	75f6	95f1	b53c	d56a	f589
16fa	3637	564f	76ac	9685	b648	d630	f6d3
1729	37dd	57c0	771a	9756	b7a2	d7bf	f765
186b	38a6	58f0	7813	9814	b8d9	d88f	f86c
1981	3975	5946	799c	99fe	b90a	d939	f9e3
1acc	3a38	5a25	7aff	9ab3	ba47	da5a	fa80
1b1f	3bd2	5baa	7b49	9b60	bbad	dbd5	fb36
1cd7	3c0d	5c3e	7cca	9ca8	bc72	dc41	fcb5
1d58	3dbb	5ded	7d20	9d27	bdc4	dd92	fd5f
1e02	3ee1	5e99	7e54	9e7d	be9e	dee6	fe2b
1fb4	3f6e	5f73	7f87	9fcb	bf11	df0c	fff8