TIA
STANDARD

PROJECT 25
LINK CONTROL WORD FORMATS
AND MESSAGES
NEW TECHNOLOGY STANDARDS
PROJECT - DIGITAL RADIO
TECHNICAL STANDARDS

TIA-102.AABF-A
(Merger of TSB-102.AABF and AABF-1)

TELECOMMUNICATIONS INDUSTRY ASSOCIATION

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(From Standards Proposal No. 3-3603-UGRV1, formulated under the cognizance of the TIA TR-8.10 Subcommittee on Trunking and Conventional Control.)

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Foreword

(This foreword is not part of this bulletin.)

This document has been submitted to APCO/NASTD/FED by the Telecommunications Industry Association (TIA), as provided for in a Memorandum of Understanding (MOU) dated December 1993. That MOU provides that the APCO/NASTD/FED will devise a Common System Standard for digital public safety communications (the Standard), and that TIA shall provide technical assistance in the development of documentation for the Standard.

This document has been developed with inputs from the APCO/TIA Project 25 Interface Committee (APIC), the APIC Trunking Task Group, the APIC Format Task Group, and the TIA Industry members.

This document is being published because it is felt that there is an urgent need for technical information on the emerging digital techniques for Land Mobile Radio Service.

This document describes the link control formats and messages for conventional and trunked systems utilizing the Common Air Interface meeting the Project 25 requirements. These definitions are necessary to insure interoperability of radio units.

As other documents describing the conventional and trunking protocols are developed, this document will be subject to change. All reasonable efforts have been made to ensure accuracy, but it should be understood that conformance test remain to be developed and proven.

Table of Contents

Patent Identification

The reader's attention is called to the possibility that compliance with this document may require the use of one or more inventions covered by patent rights.

By publication of this document no position is taken with respect to the validity of those claims or any patent rights in connection therewith. The patent holders so far identified have, we believe, filed with APCO/NASTD/FED statements of willingness to grant licenses under those rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such licenses. Details may be obtained from APCO/NASTD/FED.

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Ericsson Inc.--Patent Nos. US 4,939,746

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1   Introduction

This document shall provide information that is necessary to define the formats and messages for the Link Control Words for both conventional and trunking operation. Link Control Words are code words that encode 9 octets of information. They may be embedded within voice messages or separated into voice terminators, as defined in the Project 25 FDMA *Common Air Interface*, reference 1.

This document also incorporates information originally published as an addendum (TSB-102.AABF-1) to TSB-102.AABF. This addendum was published to optimize the capabilities of a Project 25 digital trunked radio system. The addendum provided information integral to the Link Control Word message formats for trunking operation only.

2   Scope

The CAI Link Control Word Formats and messages document is part of an intended suite of standards necessary for interoperability of Project 25 systems. A general overview of the Project 25 standard is in the *Project 25 System and Standard Definition* given as reference 7. The reader should have familiarity with this document. Included in this reference are the Project 25 General System Model, Standards Organization, Glossary, and the Statement of Requirements.

This specification is to define the formats and messages of the Link Control Words that are to be used in the APCO Project 25 systems, both conventional and trunked. Not all of the Link Control words would apply to conventional systems. Not all of them apply to trunked systems. Some Link Control words apply to both. Collectively the definitions cover the needs for both trunked and conventional systems. The Link Control words carry identification information and/or control information necessary and useful for notifying listeners on a voice call of system events and status.

Information being incorporated from TSB-102AABF-1 introduces VHF/UHF Multi Band Operations support for each of the following messages:

- Secondary Control Channel Broadcast
- Adjacent Site Status Broadcast
- RFSS Status Broadcast
- Network Status Broadcast
- Channel Identifier Update.

The incorporated material defines the format for an "Explicit" version of each broadcast message and a VHF/UHF specific version of the Channel Identifier Update message.

This document does not define the error correction for the Link Control words, nor the details of the modulation on the radio channel. This is covered in the APCO 25 Common Air Interface, reference 1.

This document makes use of the fields defined in other documents, such as the APCO 25 Common Air Interface, reference 1, APCO 25 Common Air Interface Reserved Values, reference 2, and Project 25 - Trunking Control Channel Messages, reference 5. Among these definitions are the MFID, individual and group addresses, channel numbers, reserved bits, etc.

3   Document Revision History

Table 1: Revision History

Version	Date	Description
ISSUE A	1-OCT-2003	Initial Draft. Merger of TSB-102.BAAF and Multi-Band Addendum, TSB-102-AABF-1.
ISSUE B	7-JAN-2004	Updated based on comments received to Issue A
ISSUE C	25-Mar-2004	Updated based on comments received to Issue B. Update for non-zero standard MFID,

4   Symbols, Abbreviations, Terms, Definitions, Mnemonics

The following sections provide a listing of phrases used throughout the rest of the document for which the reader may appreciate a little extra interpretive assistance.

4.1.1 Symbols

For the purposes of this Standard, the following symbols apply:

The following numbering conventions will be used in this document.

Decimal	Hexadecimal	Binary
13	$D	%1101

The $ represents a number that is hexadecimal. The % represents a number that is binary.

4.1.2 Abbreviations

For the purposes of this document, the following abbreviations apply:

kb/s   kilo bits per second
Mb/s   Million bits per second
mV   millivolts
V   volts

4.1.3 Terms

For the purposes of this Standard, the following terms apply:

4.1.4 Definitions

For the purposes of this Standard, the following Project 25 General System Model reference point definitions (found in TSB-102-A) apply:

A	Subscriber Unit data communications reference point
E_d	Wireline End system data reference point
U_m	Common Air Interface reference point
SU	Subscriber Unit is used to refer to radio units (fixed, mobile or portable) or wireline unit (PSTN or dispatcher)
System	A System is composed of at least one RFSS supporting a set of communication services across a defined coverage area.
Source SU	The SU originally requesting a call service from the RFSS.
Destination SU	The SU participating in a call service as the called party.

4.1.5 Mnemonics

For the purposes of this Standard, the following mnemonics apply:

ANSI	American National Standards Institute
(bx – by)	Bit x to Bit y in the octet
CAI	Common Air Interface
CRC	Cyclical Redundancy Check
ETDU	Expanded Terminator Data Unit
EIA	Electronic Industries Alliance
FNE	Fixed Network Equipment
ID	Identifier
IETF	Internet Engineering Task Force
ISP	Inbound Signaling Packet
LC	Link Control Word
LCF	Link Control Format
LCO	Link Control Opcode
LDU1	Logical Link Data Unit 1
LRA	Location Registration Area
MFID	Manufacturers Identity
MI	Message Indicator
OSP	Outbound Signaling Packet
P	Protected Flag
PSTN	Public Switched Telephone Network
RFSS	RF Sub System
SCCB	Secondary Control Channel Broadcast
SF	Implicit/Explicit MFID Format
TIA	Telecommunications Industry Association
TSB	Technical Service Bulletin
WACN	Wide Area Communication Network

5   <u>References</u>

The following documents contain provisions that, through reference in this text, constitute provisions of this document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. ANSI, TIA, and IETF maintain registers of currently valid national and international standards published by them.

5.1   Normative References

1. TIA-102.BAAA-A, "Project 25 FDMA Common Air Interface - New Technology Standards Project - Digital Radio Technical Standards", Telecommunications Industry Association (TIA), TR-8.15, 2003 September.

2. TIA-102.BAAC-A, "Project 25 - Common Air Interface Reserved Values", Telecommunications Industry Association (TIA), TR-8.15, 2003 December.

3. TIA-102.BAAD, "Project 25 - Common Air Interface Operational Description for Conventional Channels", Telecommunications Industry Association (TIA), TR-8.15, 2003 December.

4. TIA/EIA-102.AABB, "Project 25 - Trunking Control Channel Formats", Telecommunications Industry Association (TIA), TR-8.10, May 1, 2000.

5. TIA-102.AABC-A, "Project 25 - Trunking Control Channel Messages", Telecommunications Industry Association (TIA), TR-8.10, 2004 April.

6. TIA/EIA-102.AAAA-A, "Project 25 DES Encryption Protocol", Telecommunications Industry Association (TIA), TR-8, February 1, 2001.

5.2   Informative References

7. TSB-102-A, "APCO Project 25, Systems and Standards Definition", Telecommunications Industry Association (TIA), TR-8, November 1, 1995.

8. TSB-102.AABD, "APCO Project 25 Trunking Procedures - New Technology Standards Project - Digital Radio Technical Standards", Telecommunications Industry Association (TIA), TR-8.10, October 1, 1997.

6   Link Control Word Overview

The Link Control Word is a portion of the voice message as defined in the Common Air Interface specifications, References 1, 2, 3, 4, 5, 6, 7, 8. The Link Control Word resides in the Logical Link Data Unit 1 (LDU1) and the Expanded Terminator Data Unit (ETDU).

7   Link Control Word Formats

The Link Control Word (LC) is 72 bits of information that is error coded with a concatenated code of Reed-Solomon and either a shortened Hamming code or extended Golay Code. The formats that are shown show only the information bits. The error coding that is performed on the LC is shown in the *Project 25 Common Air Interface, reference 1.*

7.1   Implicit [MFID] LC Message Basic Format

There is a basic format that is only used when the Standard Manufacturers ID is used. The LC basic format that implicitly assumes the standard MFID is shown as the following:
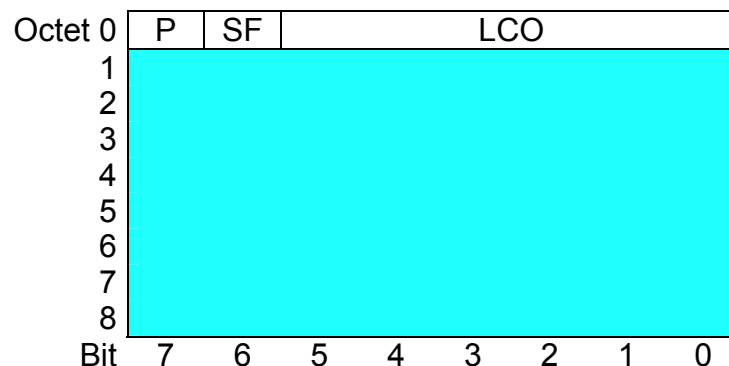
Octet 0	P	SF	LCO				
1							
2							
3							
4							
5							
6							
7							
8							
Bit	7	6	5	4	3	2	1	0

LCF - Link Control Format
This is the content of octet 0. It contains the P, SF, and LCO sub-fields.

P - Protected flag
This indicates whether the information is protected or not.
A "1" shall indicate the message is protected and Octets 1 through 8 are encrypted, shown as shaded area.
A "0" shall indicate the LC is not encrypted.

SF - Implicit / Explicit MFID Format
This indicates whether the format employs an implicit standard MFID or not. This is equal to "1" for Implicit [MFID] Formats, in this case the standard Manufacturers ID (0) is implied.

This is equal to "0" for Explicit [MFID] Format.

LCO - Link Control Opcode
This indicates the Link Control Format opcode.
This has values of 0 through 63 and is set appropriately for the different commands.

Octets 1 through 8 shall be defined for each specific LCO.

7.2   Explicit [MFID] LC Message Basic Format

There is a basic format that is used when the Manufacturers ID is specified explicitly. The explicit [MFID] LC basic format is shown as the following:
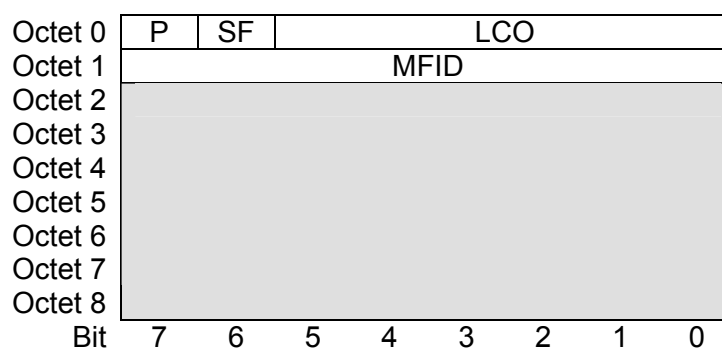
Octet 0	P	SF	LCO
Octet 1		MFID	
Octet 2			
Octet 3			
Octet 4			
Octet 5			
Octet 6			
Octet 7			
Octet 8			
Bit	7 6 5 4 3 2 1 0		

LCF - Link Control Format
This is the content of octet 0. It contains the P, SF, and LCO sub-fields.

P - Protected flag
This indicates that the information is protected or not.
A "1" shall indicate the message is protected and Octets 2 through 8 are encrypted, shown as shaded area.
A "0" shall indicate the LC is not encrypted.

SF - Implicit / Explicit MFID Format
This indicates whether the format employs an implicit standard MFID or not.
This is equal to "1" for Implicit [MFID] Formats, in this case the standard Manufacturers ID (0) is implied.
This is equal to "0" for Explicit [MFID] Format.

LCO - Link Control Opcode
This indicates the Link Control Format opcode.
This has values of 0 through 63 and is set appropriately for the different commands or information and shall be determined by the manufacturer since this is a non-standard format.

MFID - Manufacturers ID
This is the Manufacturers ID, see Project 25 – Common Air Interface Reserved Values, reference 2.

NOTE - The MFID identifies the manufacturer for non-standard link control words. The Standard Project 25 Manufacturer's ID is defined as either all zeros ($00) or one ($01). Throughout this document, the Manufacturer's ID field is to assume the Standard Project 25 Manufacturer's ID value of $00 unless explicitly stated otherwise for each of the cited message definitions.

Octets 2 through 8 shall be defined by the manufacturer since this is an explicit [MFID] format.

7.3   LC Messages

The following are the defined LC Messages, both explicit and implicit MFID format.

7.3.1   Group Voice Channel User

This indicates the user of this channel for group voice traffic. This is used on both inbound and outbound messages.

Octet 0	P	SF	LCO						**LCO** = 0 (%00,0000)
1	MFID								**SF** = 0
2	Service Options								
3	Reserved								
4	Group								
5	Address								
6	Source								
7	Address								
8									
Bit	7	6	5	4	3	2	1	0	

7.3.2 Group Voice Channel Update

This indicates the updates of other group voice traffic on a trunked system and which channels the other traffic is using. This is used on outbound messages only and on trunked system only.

Octet 0	P	SF	LCO						**LCO** = 2 (%00,0010)
1	Channel - A								**SF** = 1
2									
3	Group -A								
4	Address								
5	Channel - B								
6									
7	Group - B								
8	Address								
Bit	7	6	5	4	3	2	1	0	
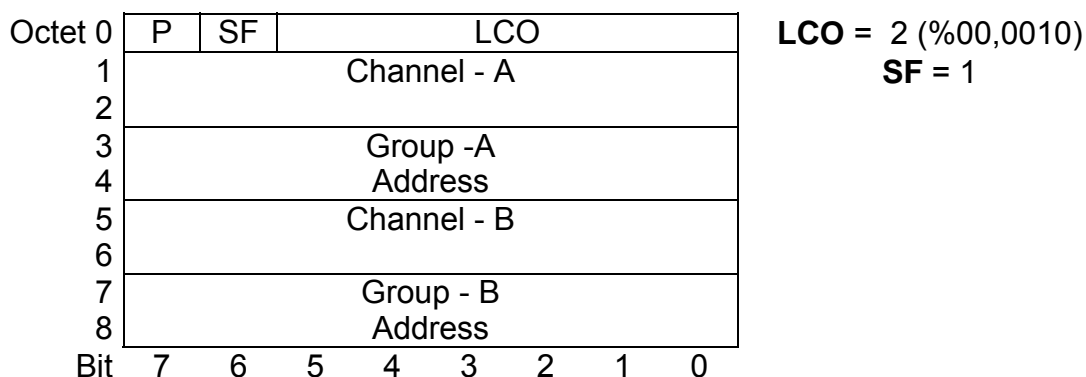
7.3.3 Unit to Unit Voice Channel User

This indicates the users of this channel for unit to unit voice traffic. This is used on both inbound and outbound messages and on conventional and trunked systems.

Octet 0	P	SF	LCO						**LCO** = 3 (%00,0011)
1	MFID								**SF** = 0
2	Service Options								
3	Target								
4	Address								
5									
6	Source								
7	Address								
8									
Bit	7	6	5	4	3	2	1	0	
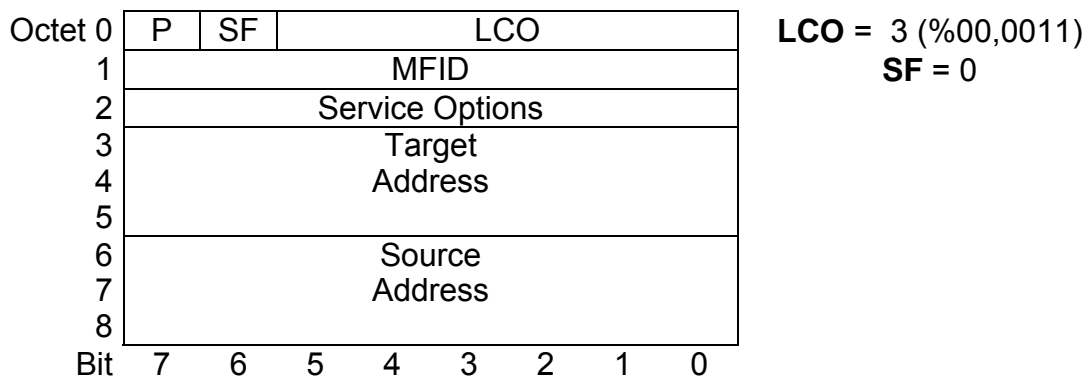
7.3.4 Group Voice Channel Update - Explicit

This indicates the updates of other group voice traffic on a trunked system and which channels the other traffic is using. This is used on outbound messages only and on trunked system only for working channels that require explicit receive and transmit frequency designations.

Octet 0	P	SF	LCO						**LCO** = 4 (%00,0100)
1	Reserved								**SF** = 1
2	Service Options								
3	Group								
4	Address								
5	Channel (T)								
6									
7	Channel (R)								
8									
Bit	7	6	5	4	3	2	1	0	
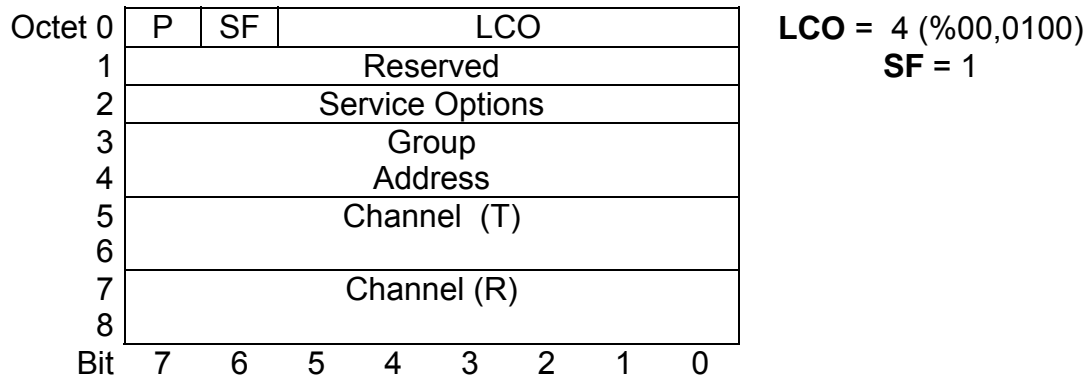
7.3.5 Unit to Unit Answer Request

This indicates requests for unit to unit voice traffic on a trunked system looking for the target address unit. This is used on outbound messages only and on trunked systems only.

Octet 0	P	SF	LCO						**LCO** = 5 (%00,0101)
1	Service Options								**SF** = 1
2	Reserved								
3	Target								
4	Address								
5									
6	Source								
7	ID								
8									
Bit	7	6	5	4	3	2	1	0	
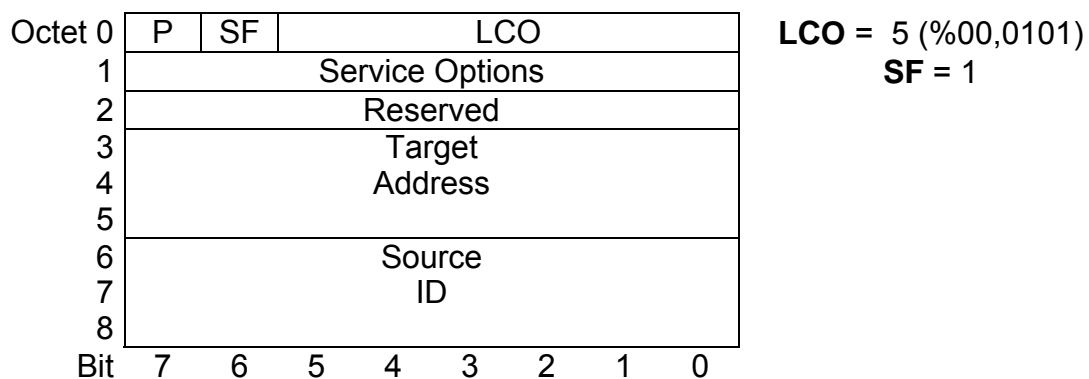
7.3.6 Telephone Interconnect Voice Channel User

This indicates the user of this channel for telephone interconnect voice traffic. This is used on both inbound and outbound messages and on conventional and trunked systems.

```
Octet 0 | P | SF |        LCO        |   LCO = 6 (%00,0110)
       1 |      Reserved             |       SF = 1
       2 |    Service Options        |
       3 |      Reserved             |
       4 |      Call Timer           |
       5 |                           |
       6 |    Source/Target          |
       7 |      Address              |
       8 |                           |
     Bit   7   6   5   4   3   2   1   0
```

7.3.7 Telephone Interconnect Answer Request

This is a request for a target address unit for telephone interconnect voice traffic on a trunked system. This is used on outbound messages only and on trunked systems only.

```
Octet 0 | P | SF |        LCO        |   LCO = 7 (%00,0111)
       1 |   Digit 1   |   Digit 2   |       SF = 1
       2 |   Digit 3   |   Digit 4   |
       3 |   Digit 5   |   Digit 6   |
       4 |   Digit 7   |   Digit 8   |
       5 |   Digit 8   |   Digit 10  |
       6 |      Target               |
       7 |      Address              |
       8 |                           |
     Bit   7   6   5   4   3   2   1   0
```

7.3.8 Call Termination/Cancellation

This indicates the termination of a call that is used in an Expanded Terminator Data Unit, ETDU. This terminates a call and releases this channel for another call. It is distinguishable from the termination of a transmission, which does not release the channel. This is used on both inbound and outbound messages and on conventional and trunked systems.

```
Octet 0 | P | SF |          LCO          |     LCO = 15 (%00,1111)
       1 |                               |     SF = 1
       2 |                               |
       3 |           Reserved            |
       4 |                               |
       5 |                               |
       6 |        Source Address /       |
       7 |         Target Address        |
       8 |                               |
     Bit   7   6   5   4   3   2   1   0
```
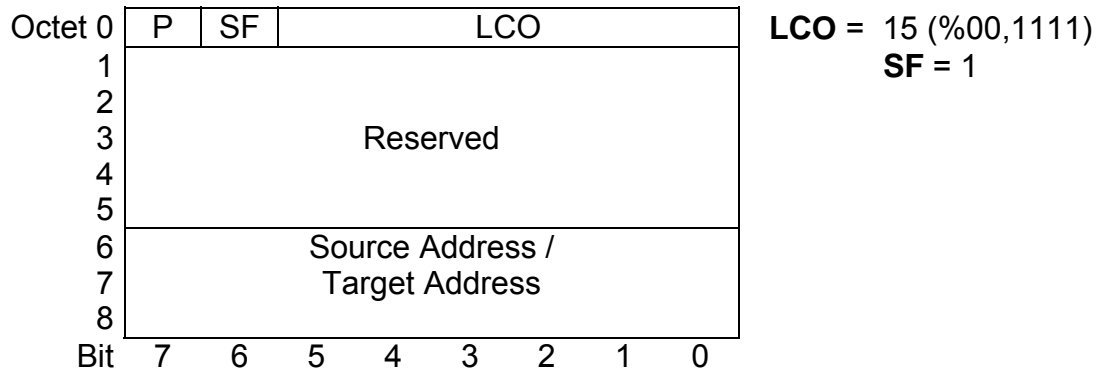
7.3.9 Group Affiliation Query

This is a query for a subscriber unit to respond with its group affiliation information. This is used on outbound messages only and on trunked systems only.

```
Octet 0 | P | SF |          LCO          |     LCO = 16 (%01,0000)
       1 |           Reserved            |     SF = 1
       2 |                               |
       3 |            Target             |
       4 |            Address            |
       5 |                               |
       6 |            Source             |
       7 |            Address            |
       8 |                               |
     Bit   7   6   5   4   3   2   1   0
```
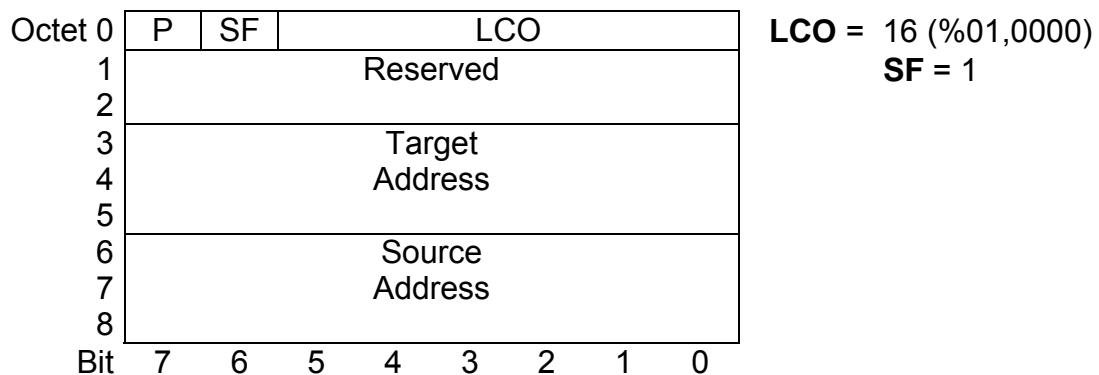
7.3.10 Unit Registration Command

This is a command for a subscriber unit to respond with a unit registration. This is used on outbound messages only and on trunked systems only.

```
Octet 0 | P | SF |        LCO          |     LCO =  17 (%01,0001)
      1 |      Network ID               |        SF = 1
      2 |                               |
      3 |   (b3 - b0)   |   (b11- b8)   |
      4 |     System ID (b7 - b0)       |
      5 |         Target ID             |
      6 |                               |
      7 |                               |
      8 |         Reserved              |
      Bit  7   6   5   4   3   2   1   0
```
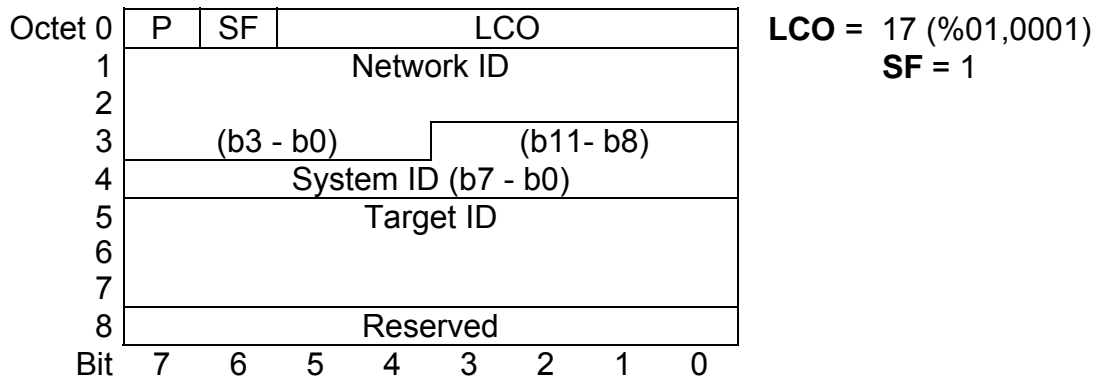
7.3.11 Unit Authentication Command

This is a command for a subscriber unit to respond with a unit authentication. This is used on outbound messages only and on trunked systems only.

```
Octet 0 | P | SF |        LCO          |     LCO =  18 (%01,0010)
      1 |                               |        SF = 1
      2 |                               |
      3 |   (b3 - b0)   |   (b11- b8)   |
      4 |     System ID (b7 - b0)       |
      5 |         Target ID             |
      6 |                               |
      7 |                               |
      8 |         Reserved              |
      Bit  7   6   5   4   3   2   1   0
```
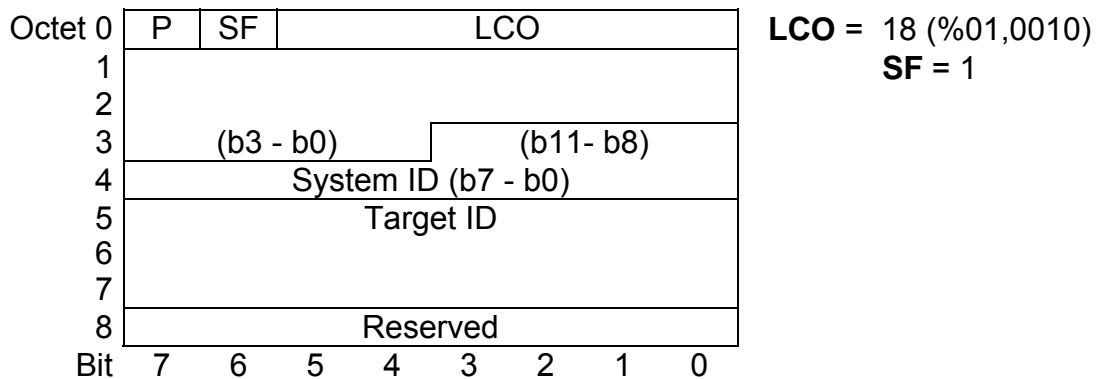
7.3.12 Status Query

This is a query for a subscriber unit to respond with its user and unit status information. This is used on outbound messages only and on trunked systems only.

```
Octet 0 | P  | SF  |          LCO          |    LCO = 19 (%01,0011)
      1 |         Reserved               |        SF = 1
      2 |
      3 |          Target                |
      4 |          Address               |
      5 |
      6 |          Source                |
      7 |          Address               |
      8 |
   Bit    7    6    5    4    3    2    1    0
```
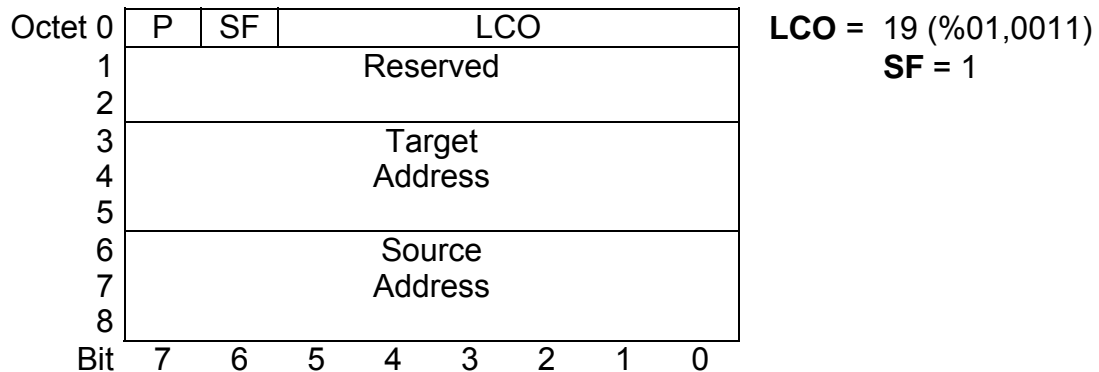
7.3.13 System Service Broadcast

This broadcast will inform the subscriber units of the current system services supported and currently offered on the Primary control channel of this site. It will also indicate the current priority level threshold for service request activity on the SITE. This is used on outbound messages only but on both conventional and trunked systems.

```
Octet 0 | P  | SF  |          LCO          |    LCO = 32 (%10,0000)
      1 |          Reserved              |        SF = 1
      2 |   Reserved   | Request Priority Level |
      3 |
      4 |     System Services Available          |
      5 |
      6 |
      7 |     System Services Supported          |
      8 |
   Bit    7    6    5    4    3    2    1    0
```
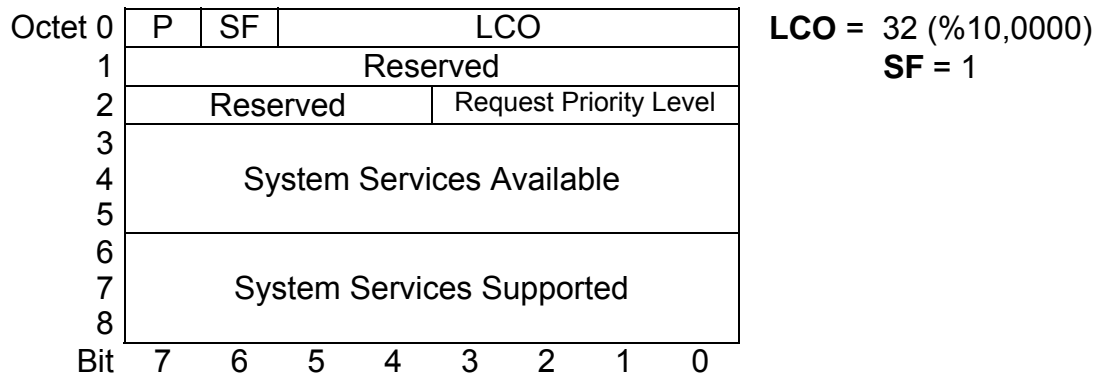
7.3.14 Secondary Control Channel Broadcast

This addresses the current secondary control channel assignments for this SITE. This will identify the designated secondary control channels along with what services are supported by each control channel.

This supports two (2) secondary control channel updates per packet. If there is an odd number of secondary control channels on the site, then either one of the channels may be repeated to fill the space, or the System Service Class field may be set to $00 to indicate this set of channel parameters are not to be considered a valid secondary control channel.

This is used on outbound messages only and on trunked systems only.

```
Octet 0 | P | SF |          LCO          |        LCO = 33 (%10,0001)
       1 |    RF Sub-System ID           |             SF = 1
       2 |          Site ID              |
       3 |        Channel - A            |
       4 |                               |
       5 |   System Service Class - A    |
       6 |        Channel - B            |
       7 |                               |
       8 |   System Service Class - B    |
    Bit    7   6   5   4   3   2   1   0
```
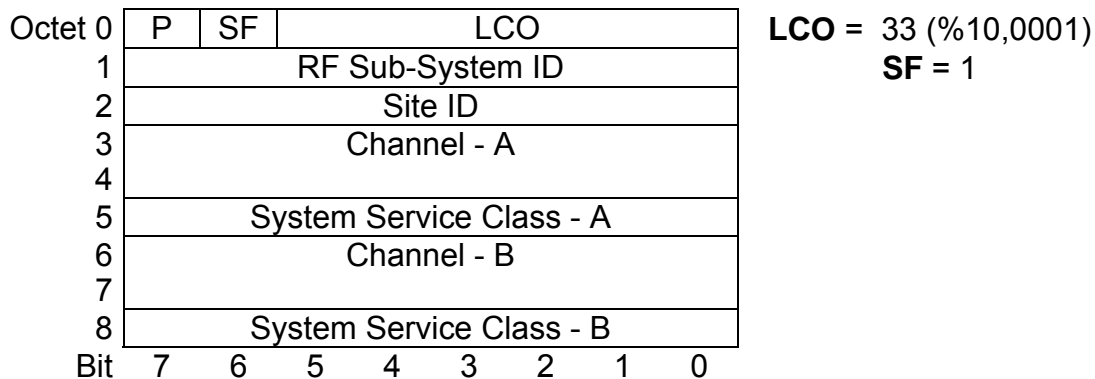
7.3.15 Adjacent Site Status Broadcast

This update addresses the presence and status of sites adjacent to this particular site. At present this addresses only adjacent sites of the same NETWORK ID as this particular site. This is used on outbound messages only and is for both conventional and on trunked systems.

```
Octet 0 | P | SF |          LCO          |        LCO = 34 (%10,0010)
       1 |   Location Registration Area  |             SF = 1
       2 |   Reserved    |   (b11 - b8)   |
       3 |     System ID (b7 - b0)        |
       4 |     RF Sub-System ID           |
       5 |          Site ID              |
       6 |          Channel              |
       7 |                               |
       8 |   System Service Class        |
    Bit    7   6   5   4   3   2   1   0
```

7.3.16 RFSS Status Broadcast

This provides the current RF Sub-system and Site identity information to the subscriber units. This is used on outbound messages only and is for both conventional and on trunked systems.

The Channel field identifies the primary control channel of this site.

Octet 0	P	SF	LCO						**LCO** = 35 (%10,0011)
1	Location Registration Area								**SF** = 1
2	Reserved			(b11 - b8)					
3	System ID (b7 - b0)								
4	RF Sub-System ID								
5	Site ID								
6	Channel								
7									
8	System Service Class								
Bit	7	6	5	4	3	2	1	0	
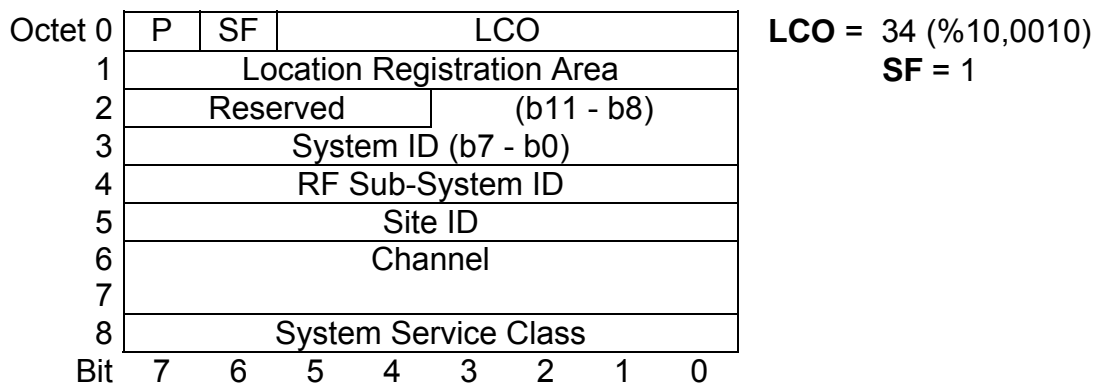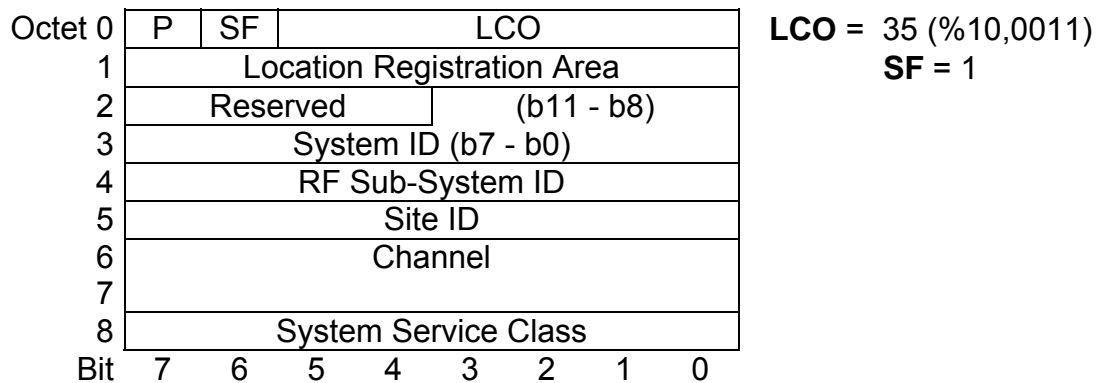
7.3.17 Network Status Broadcast

This provides the current NETWORK ID and SYSTEM identity information to the subscriber units. This is used on outbound messages only and is for both conventional and on trunked systems.

The Channel field identifies the primary control channel of this site.

Octet 0	P	SF	LCO						**LCO** = 36 (%10,0100)
1	Reserved								**SF** = 1
2	NETWORK ID								
3									
4				(b11-b8)					
5	System ID (b7-b0)								
6	Channel								
7									
8	System Service Class								
Bit	7	6	5	4	3	2	1	0	
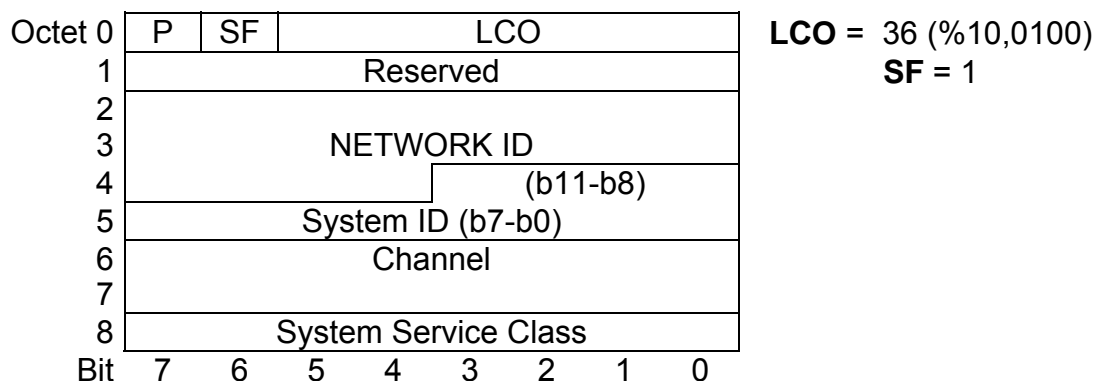
7.3.18 Status Update

This is the echo of the status update request from a subscriber unit when the destination of the update is another subscriber unit via traffic channel signaling. This is used on outbound messages only and on trunked systems only.

Octet 0	P	SF	LCO						**LCO** = 20 (%01,0100)
1			Status						**SF** = 1
2									
3			Target						
4			Address						
5									
6			Source						
7			Address						
8									
Bit	7	6	5	4	3	2	1	0	
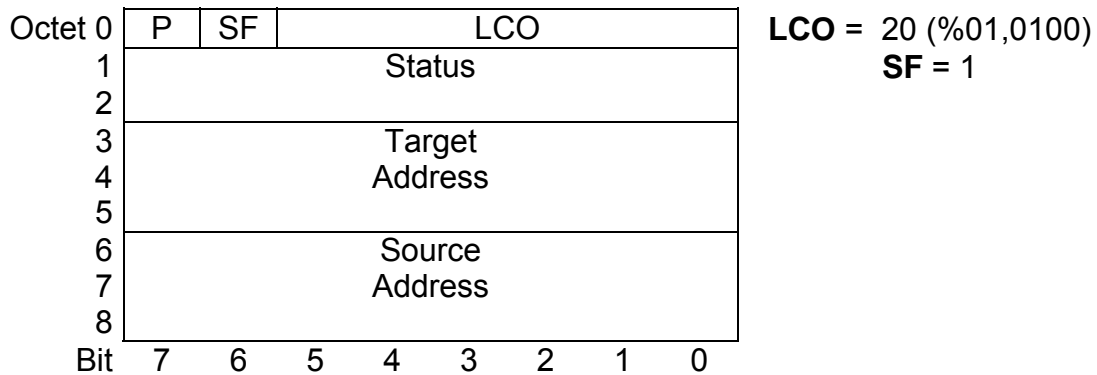
7.3.19 Message Update

This is the echo of the short data message request from a subscriber unit when the destination of the update is another subscriber unit via traffic channel signaling. This is used on outbound messages only and on trunked systems only.

Octet 0	P	SF	LCO						**LCO** = 21 (%01,0101)
1			Message						**SF** = 1
2									
3			Target						
4			Address						
5									
6			Source						
7			Address						
8									
Bit	7	6	5	4	3	2	1	0	
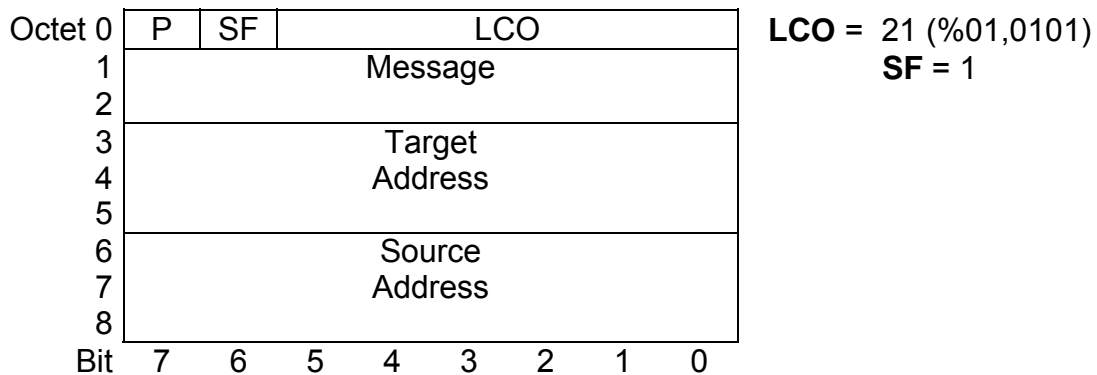
7.3.20 Call Alert

This is the request for a target subscriber unit to call a source subscriber unit. This is used on outbound messages only and on trunked systems only.

Octet 0	P	SF	LCO						**LCO** = 22 (%01,0110)
1	Reserved								**SF** = 1
2									
3	Target								
4	Address								
5									
6	Source								
7	Address								
8									
Bit	7	6	5	4	3	2	1	0	
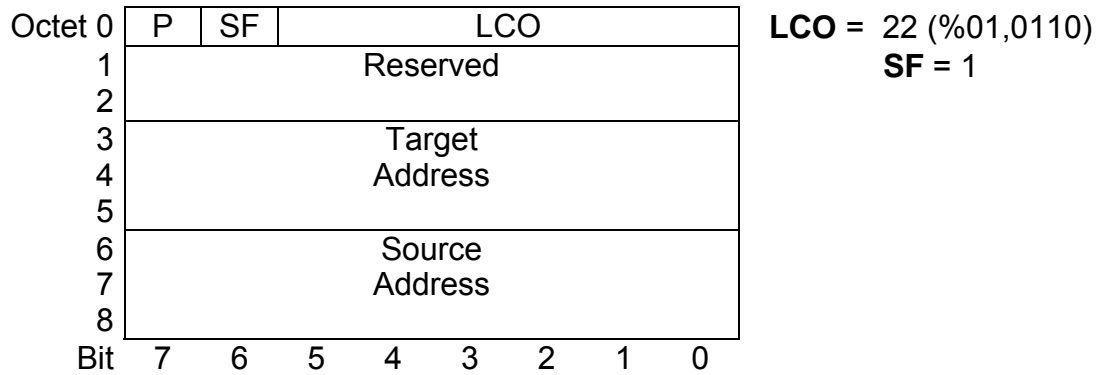
7.3.21 Extended Function Command

This is a transaction addressed to a subscriber unit for an extended function. This message is used on outbound messages only and on trunked systems only.

Octet 0	P	SF	LCO						**LCO** = 23 (%01,0111)
1									**SF** = 1
2									
3	Extended Function								
4									
5									
6	Target								
7	Address								
8									
Bit	7	6	5	4	3	2	1	0	
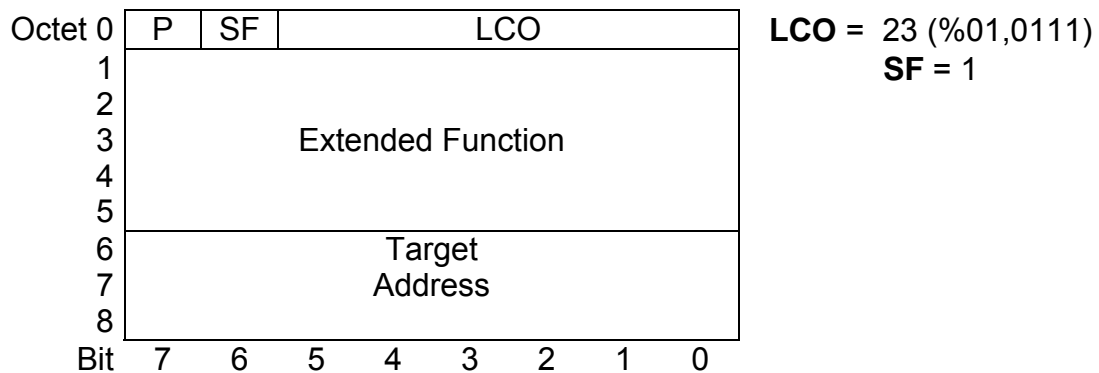
7.3.22 Channel Identifier Update

This message provides information concerning a specific identifier to subscriber units. This message is used on outbound messages only and for both conventional and trunked systems.

```
Octet 0 | P | SF |           LCO              |      LCO = 24 (%01,1000)
      1 |  Channel Identifier   |      BW      |       SF = 1
      2 |                       |
      3 |      Transmit Offset        |
      4 |        Channel Spacing      |
      5 |
      6 |        Base Frequency
      7 |
      8 |
    Bit   7    6   5   4   3   2   1   0
```
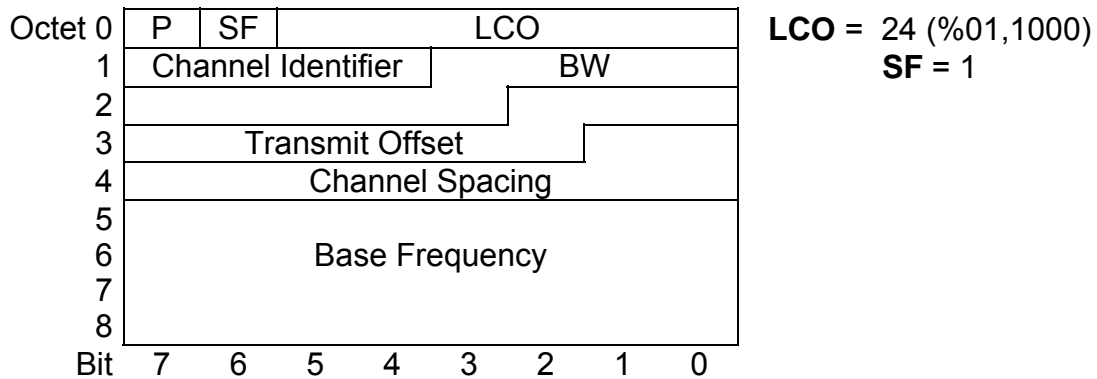
7.3.23 Protection Parameter Broadcast

This message provides protection parameters for the control channel to the subscriber unit. This message is used on outbound messages only and on trunked systems only.

```
Octet 0 | P | SF |           LCO              |      LCO = 37 (%10,0101)
      1 |          Reserved                    |       SF = 1
      2 |
      3 |         Algorithm ID                 |
      4 |           Key ID                     |
      5 |
      6 |           Target                     |
      7 |          Address                     |
      8 |
    Bit   7    6   5   4   3   2   1   0
```
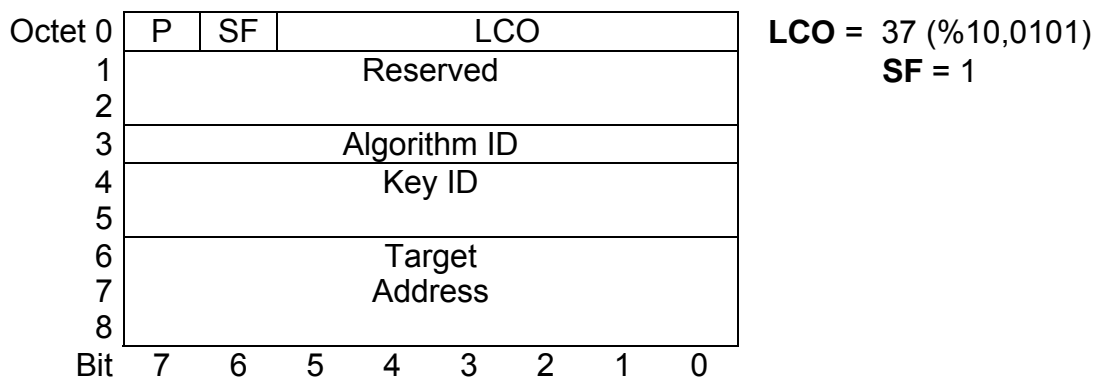
7.3.24 Secondary Control Channel Broadcast - Explicit (LCSCBX)

The Secondary Control Channel Broadcast - Explicit (LCSCBX) message addresses the current secondary control channel assignments for this site. The message will identify the designated secondary control channels along with what services are supported by each control channel.

The Secondary Control Channel Broadcast - Explicit (LCSCBX) message supports one (1) secondary control channel update per packet.

The Secondary Control Channel Broadcast - Explicit (LCSCBX) message is used on outbound messages only and on trunked systems only for secondary control channels that require explicit receive and transmit frequency designations.

Bit/Octet	7	6	5	4	3	2	1	0	Notes
0	P	SF	LCO						**P**=0, **SF**=1, **LCO**=%100110
1	RF Sub-system ID								
2	Site ID								
3	Channel (T)								
4									
5	Channel (R)								
6									
7	System Service Class								
8	Reserved								

Figure 1: Secondary Control Channel Broadcast - Explicit (LCSCBX)

7.3.25 Adjacent Site Status Broadcast – Explicit (LCASBX)

The Adjacent Site Status Broadcast – Explicit (LCASBX) message addresses the presence and status of sites adjacent to this particular site. This message includes control channel information for the adjacent site. At present, the Adjacent Site Status Broadcast – Explicit (LCASBX) message addresses only adjacent sites of the same Network ID as this particular site.

The Adjacent Site Status Broadcast – Explicit (LCASBX) message is used on outbound messages only and on trunked systems only for control channels that require explicit receive and transmit frequency designations.

Bit/Octet	7	6	5	4	3	2	1	0	Notes
0	P	SF	LCO						**P**=0, **SF**=1, **LCO**=%100111
1	LRA								
2	Channel (T)								
3									
4	RF Sub-system ID								
5	Site ID								
6	Channel (R)								
7									
8	C	F	V	A	Reserved				

Figure 2: Adjacent Site Status Broadcast - Explicit (LCASBX)

7.3.26 Channel Identifier Update – Explicit (LCCIUX)

The Channel Identifier Update - Explicit (LCCIUX) message provides information concerning a specific channel identifier to subscriber units.

The Channel Identifier Update - Explicit (LCCIUX) message is used on outbound messages only and on trunked systems only.

Bit/Octet	7	6	5	4	3	2	1	0	Notes
0	P	SF	LCO						**P**=0, **SF**=1, **LCO**=%011001
1	Identifier				BW_VU				
2									
3	Transmit Offset VU								
4	Channel Spacing								
5	Base Frequency								
6									
7									
8									

Figure 3: Channel Identifier Update - Explicit (LCCIUX)

7.3.27 RFSS Status Broadcast – Explicit (LCRSBX)

The RFSS Status Broadcast - Explicit message provides the current RF Sub-system and Site identity information to the subscriber units. Channel(R) and Channel(T) refer to the primary control channel.

The RFSS Status Broadcast - Explicit is used on outbound messages only and on trunked system only for control channels that require explicit receive and transmit frequency designations.

Bit/ Octet	7	6	5	4	3	2	1	0	Notes
0	P	SF	LCO						**P**=0, **SF**=1, **LCO**=%101000
1	LRA								
2	Channel (R)								
3									
4	RF Sub-system ID								
5	Site ID								
6	Channel (T)								
7									
8	System Service Class								

Figure 4: RFSS Status Broadcast - Explicit (LCRSBX)

7.3.28 Network Status Broadcast – Explicit (LCNSBX)

The Network Status Broadcast - Explicit message provides the current NETWORK ID, SYSTEM ID and primary control channel information to the subscriber units.

The Network Status Broadcast - Explicit message is used on outbound messages only and on trunked systems only for control channels that require explicit receive and transmit frequency designations.

Bit/ Octet	7	6	5	4	3	2	1	0	Notes
0	P	SF	LCO						**P**=0, **SF**=1, **LCO**=%101001
1	Network ID								
2									
3					(b11-b8)				
4	System ID (b7-b0)								
5	Channel (T)								
6									
7	Channel (R)								
8									

Figure 5: Network Status Broadcast - Explicit (LCNSBX)

7.4   Standard LC Field Definitions

The following are the Standard LC field definitions.

Algorithm ID
The Algorithm ID field identifies the specific encryption algorithm used to encrypt the message. The standard value for unencrypted messages and the default for equipment which is not equipped with encryption is $80. For standard values used for encryption refer to *Project 25 – Common Air Interface Reserved Values*, reference 2. For operation of the Algorithm ID refer to *Project 25 DES Encryption Protocol*, reference 6.

Base Frequency
The Base Frequency field defines the absolute frequency that is to be used to determine the actual frequency value for a channel assignment. For field values refer to "Base Frequency field" in Project 25 - *Trunking Control Channel Messages,* reference 5.

BW or BW VU
The BW or Bandwidth field specifies the channel bandwidth for the set of channels. For field values refer to "BW or BW VU" in Project 25 - *Trunking Control Channel Messages,* reference 5.

Call Timer
This field provides an indication of the allowed period of time that the call resource(s) are assigned to this call. This is measured in 100 millisecond increments. The values range from $0000 to $FFFF, with $0000 denoting that there is no call time limit for this call, i.e., unlimited time. The values $0001 to $FFFF provide a range of 0.1 seconds to 6,553.6 seconds (109.23 minutes).

Channel - Channel information
This field is used to identify the channel resource assigned for a specific service or information. This field is composed of two sub-fields, 1) Channel Identifier, and 2) Channel Number.

Bit →	7	6	5	4	3	2	1	0
Octet 0	Channel Identifier				(b11-b8)			
1	Channel Number (b7-b0)							
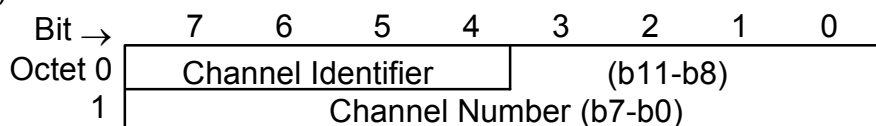
Channel Field

Channel Identifier
The Channel Identifier field will determine the band of frequencies to associate with a Channel Number value. Each channel identifier shall be associated with a set of channel characteristics. Refer to "Channel

Identifier field" in *Project 25 - Trunking Control Channel Messages,* reference 5.

Channel Number

The Channel Number field will contain the actual value to be translated to a frequency based upon the Channel Identifier field information. For field values refer to "Channel Number field" in *Project 25 - Trunking Control Channel Messages,* reference 5.

Channel Spacing

The Channel Spacing field defines channel spacing. Specifically, it defines what should be used as the frequency multiplier for the channel number specified in the channel field of the message formats.   For field values refer to "Channel field" in *Project 25 - Trunking Control Channel Messages,* reference 5.

Digit

The Digit field represents a telephone dialed digit or special dialing command. For field values refer to "Digit field" in *Project 25 - Trunking Control Channel Messages*, reference 5.

Extended Function

The Extended Function field provides a number of special radio operations. The field is subdivided into Class (the basic function category), Operand (the specific function within a class), and Arguments (additional information).   For field values refer to "Extended Function field" in *Project 25 - Trunking Control Channel Messages,* reference 5.

Group Address

This field defines the 16-bit group identifier that uniquely defines a group within a System. For field values refer to "Group Address field" in *Project 25 - Trunking Control Channel Messages*, reference 5.

Key ID

The Key ID field provides the label of the key used for encryption of the message. The KID has only one standard value, $0000, which is used for either unencrypted messages or as a default value for encrypted messages. For operation of the KID, refer to *APCO Project 25 DES Encryption Protocol,* reference 6.

Location Registration Area

The Location Registration Area field indicates a region in which a Subscriber Unit registers for service, and over which region a registered Subscriber Unit may roam without subsequent registration. Refer to *APCO Project 25 Trunking Procedures,* reference 8.

LCO - Link Control Opcode

This indicates the Link Control Format opcode. This has values of 0 through 63 and is set appropriately for the different commands.

Table 2: LCO - Link Control Opcode

LCO Value	Alias Name	Full Name Mnemonic
0 (%00,0000)	LC_GRP_V_CH_USR	Group Voice Channel User LCGVR
1 (%00,0001)	Reserved	
2 (%00,0010)	LC_GRP_V_CH_UPDT	Group Voice Channel Update LCGVU
3 (%00,0011)	LC_UU_V_CH_USR	Unit to Unit Voice Channel User LCUVR
4 (%00,0100)	LC_GRP_CH_UPDT_EXP	Group Voice Channel Update - Explicit LCGVUX
5 (%00,0101)	LC_UU_ANS_REQ	Unit to Unit Answer Request LCUAQ
6 (%00,0110)	LC_TELE_INT_V_CH_USR	Telephone Interconnect Voice Channel User LCTVR
7 (%00,0111)	LC_TELE_INT_ANS_REQ	Telephone Interconnect Answer Request LCTAQ
8 (%00,1000)	Reserved	
9 (%00,1001)	Reserved	
10 (%00,1010)	Reserved	
11 (%00,1011)	Reserved	
12 (%00,1100)	Reserved	
13 (%00,1101)	Reserved	
14 (%00,1110)	Reserved	
15 (%00,1111)	LC_CALL_TRM_CAN	Call Termination/Cancellation LCCT
16 (%01,0000)	LC_GRP_AFF_Q	Group Affiliation Query LCGAQ
17 (%01,0001)	LC_U_REG_CMD	Unit Registration Command LCRC
18 (%01,0010)	LC_AUTH_CMD	Unit Authentication Command LCAC
19 (%01,0011)	LC_STS_Q	Status Query LCSQ
20 (%01,0100)	LC_STA_UPDT	Status Update LCSU
21 (%01,0101)	LC_MSG_UPDT	Message Update LCMU
22 (%01,0110)	LC_CALL_ALRT	Call Alert LCCA
23 (%01,0111)	LC_EXT_FNCT_CMD	Extended Function Command LCEFC
24 (%01,1000)	LC_CH_ID_UPDT	Channel Identifier Update LCCIU
25 (%01,1001)	LC_CH_ID_UPDT_EXP	Channel Identifier Update - Explicit LCCIUX
26 (%01,1010)	Reserved	
27 (%01,1011)	Reserved	
28 (%01,1100)	Reserved	
29 (%01,1101)	Reserved	
30 (%01,1110)	Reserved	
31 (%01,1111)	Reserved	
32 (%10,0000)	LC_SYS_SRV_BCST	System Service Broadcast LCSSB
33 (%10,0001)	LC_SCCB	Secondary Control Channel Broadcast LCSCB
34 (%10,0010)	LC_ADJ_STS_BCST	Adjacent Site Status Broadcast LCASB
35 (%10,0011)	LC_RFSS_STS_BCST	RFSS Status Broadcast LCRSB
36 (%10,0100)	LC_NET_STS_BCST	Network Status Broadcast LCNSB
37 (%10,0101)	LC_P_PARM_BCST	Protection Parameter Broadcast LCPPB
38 (%10,0110)	LC_SCCB_EXP	Secondary Control Channel Broadcast – Explicit LCSCBX
39 (%10,0111)	LC_ADJ_STS_BCST_EXP	Adjacent Site Status Broadcast - Explicit LCASBX
40 (%10,1000)	LC_RFSS_STS_BCST_EXP	RFSS Status Broadcast - Explicit LCRSBX
41 (%10,1001)	LC_NET_STS_BCST_EXP	Network Status Broadcast – Explicit LCNSBX
42 – 63	Reserved	

MFID - Manufacturers ID
This indicates the identity of the Manufacturer of the information. The values for the Manufacturer ID's are given in Ref. 2 - TIA-102.BAAC-A "Project 25 - Common Air Interface - Reserved Values". As of the date of this document, an MFID of $00 or $01 (the standard values) indicates a Standard Project 25 message. As of the date of this document, no opcodes have been defined with MFID=$01.

Throughout this document the Manufacturer's ID field is to assume the Standard Project 25 MFID value of $00 unless explicitly stated otherwise for each of the cited message definitions. Note that a non-zero MFID must be explicitly provided, even if it is a standard value, e.g., $01. Also see the definition of "SF" later in this section.

If a non-standard MFID is used, the information fields will not meet the standard formats.

Network ID
This is a 20 bit field that identifies the network portion of the total identity. The Network ID is unique within the entire communications network.

P - Protected flag
This indicates whether the information is protected or not.
A "1" shall indicate the message is protected by encryption – Sections 7.1 and 7.2 show the areas to be protected.   The MFID may be required for proprietary encryption schemes.
A "0" shall indicate the LC is not protected.

R - Reserved bit
This indicates the bit is reserved. The bit is set to "0" for transmit. The bit is not used or is ignored when received.

Request Priority Lvl
This 3-bit field indicates the lowest service request priority which will be processed by the site at the given time until the next update. The value that is given is the level of service or greater that will be serviced. For field values refer to "Priority Level field" in Project 25 - Trunking Control Channel Messages, reference 5.

Reserved
These bits are reserved for future use if necessary. This bit(s) are set to zero (0) by the send and ignored by the receiver.

RF Sub-System ID

This is an 8-bit field that indicates the identity of the RF Sub-System (RFSS). The RFSS ID is unique within a System.

Service Options
This field contains individual bits that indicate the type(s) of service being requested or
provided. The Service Options is broken into the following bit fields:

	E	P	D	M	R	Priority Level		
Bit	7	6	5	4	3	2	1	0

E - Emergency
This indicates if this service is to be specially processed as an emergency service.

0 = Normal or non-emergency status
1 = Emergency status requiring special processing

P - Protected
This indicates whether the resources (other than the control channel resources) should be in a protected mode (encrypted) or not.

0 = non protected mode
1 = protected mode

D - Duplex
This indicates the way the channel resource is to be used by the subscriber units.

0 = half duplex, the subscriber unit will be capable of transmitting but not simultaneously receiving on the assigned channel
1 = full duplex, the subscriber unit will be capable of transmitting and receiving simultaneously on the assigned channel

M - Mode
This indicates the data mode of the service

0 = circuit mode - the resources shall support circuit switch operation
1 = packet mode - the resources shall support packet switch operation

R - reserved
This bit is reserved and set to zero (0) by the sender and ignored by the receiver.

Priority Level
This indicates the relative importance attributed to the service that is being requested. For field values refer to "Priority Level field" in Project 25 - Trunking Control Channel Messages, reference 5.

SF - Implicit / Explicit MFID Format

This indicates whether the format employs an implicit standard MFID or not. This is equal to "1" for Implicit [MFID] Formats, in this case the standard Manufacturers ID ($00) is implied. SF is equal to "0" for Explicit [MFID] Format.

The SF field is only one bit long, so it can only indicate an MFID=$00 or not =$00. If a non-zero standard MFID (e.g., MFID=$01) is required, then SF=0, and the standard non-zero MFID (=$01) must be specified in octet 1 like any other MFID not equal to $00. Unfortunately, this means that these LC messages have only 7 octets available for information, as opposed to the eight available for the implied MFID=$00. MFID=$01 will be required only after the 64 opcodes of MFID=$00 are assigned. Also see the definition of MFID in this section.

Site ID

This 8-bit field indicates the identity of the site. The Site ID is unique within the RF Sub-system.

Source/Target Address

In general the inbound message contains the source address and the outbound message contains the target address.

Source Address

This field identifies the individual subscriber unit that originates or is responding to the transaction. It is equal to the working unit ID (WUID) of the originating subscriber unit. The WUID is assigned during registration and therefore may change when registration changes. This is a 24-bit vector that uniquely identifies the subscriber unit within the System. It shall utilize the Subscriber Unit Address as defined in Project 25 - Trunking Control Channel Messages, reference 5.

Source ID

This is the 24-bit Unit ID portion of the Subscriber Unit ID (SUID) of the subscriber unit that originates or is responding to the transaction. The SUID is composed of the WACN ID and the System ID and the Unit ID. The SUID uniquely addresses a subscriber unit within the entire universe of subscriber units.

Status

The Status field provides status information in two subfields: one for user status and one for unit status. For field values refer to "Status field" in Project 25 - Trunking Control Channel Messages, reference 5.

Subscriber Unit Address

The 24-bit Subscriber Unit Address will uniquely address a subscriber unit within the System.

Address value	Description
$00 0000	No unit
$00 0001 - $FF FFFC	Assignable Unit
$FF FFFD	System Default
$FF FFFE	Registration Default
$FF FFFF	ALL unit

No unit - this is a place holder for the subscriber unit address; it identifies no specific unit

Assignable Unit - these are the valid values to define a subscriber unit within a System

System Default - this is the special address to identify the FNE in general

Registration Default- this is the special address for a registration transaction prior to the subscriber unit receiving a valid unit address

ALL unit - this is the special address to identify all subscriber units

System ID

This is a 12 bit field to define the identity of the System. This is unique within the network.

System Services Available

This 24-bit field indicates the system level services which may be currently requested at this site. A "1" in the service position indicates the service is available.

For field values refer to "System Services Available field" in Project 25 - Trunking Control Channel Messages," reference 5.

There is currently the potential to support all the defined services as well as potential to identify 24 additional services. This is accomplished by supplying an extension service update category. There is the potential for three (3) additional services supported in the 'Normal' System Service category.

TYPE FLAG - will denote whether this is the 'Normal' set of System Services or the 'Extended' set. 'Normal' set = 0; 'Extended' set = 1

EXTENSION FLAG - will denote whether there are more system services to be indicated in the 'Extended' set of services. No extension = 0; Extension = 1

If there are no extension services beyond the capacity of the 'Normal' System Services set, then there is no 'Extended' System Services update necessary.

NETWORK ACTIVE FLAG - indicates whether this segment of the communication fixed end is connected to other segments or is an isolated segment.

        Isolated = 0
        Non-isolated = 1

System Services Supported

This 24-bit field indicates the system level services which this site is equipped to handle, though some or all of these may not be currently available. A "1" is the service position indicates that the service is supported. See the tables in System Services Available (Reference 5 "Project 25 - Trunking Control Channel Messages" TIA-102.AABC) for the definition of the service positions.

System Service Class

This is an 8-bit field that indicates the basics of what this control channel will support. For field values refer to "System Services Class field" in Project 25 - Trunking Control Channel Messages, reference 5.

Target Address

This field identifies the individual subscriber unit that terminates or is to respond to the transaction. It is equal to the working unit ID (WUID) of the terminating subscriber unit. The WUID is assigned during registration and therefore may change when registration changes. This is a 24-bit vector that uniquely identifies the subscriber unit within the System. It shall utilize the Subscriber Unit Address as defined in Project 25 - Trunking Control Channel Messages, reference 5.

Target ID

This is the 24-bit Unit ID portion of the Subscriber Unit ID (SUID) of the subscriber uni that terminates or is to respond to the transaction. The SUID is composed of the WACN ID and the System ID and the Unit ID. The SUID uniquely addresses a subscriber unit within the entire universe of subscriber units.

Transmit Offset and Transmit Offset VU

The Transmit Offset field specifies the relationship between the subscriber unit receive and transmit frequencies for the channel. For field values refer to "Transmit Offset or Transmit Offset VU" in Project 25 - Trunking Control Channel Messages, reference 5.

7.5 Link Control Word Usages

The following table shows the usage of each Link Control Word:

Table 3: Link Control Word Usage

		Trunked ISP	Trunked OSP	Conventional ISP	Conventional OSP
LC Function	**LCO Value**	↓	↓	↓	↓
Group Voice Channel User	0 (%00,0000)	x	x	x	x
Reserved	1 (%00,0001)				
Group Voice Channel Update	2 (%00,0010)		x		
Unit to Unit Voice Channel User	3 (%00,0011)	x	x	x	x
Group Voice Channel Update - Explicit	4 (%00,0100)		x		
Unit to Unit Answer Request	5 (%00,0101)		x		
Telephone Interconnect Voice Channel User	6 (%00,0110)	x	x	x	x
Telephone Interconnect Answer Request	7 (%00,0111)		x		
Reserved	8 (%00,1000)				
Reserved	9 (%00,1001)				
Reserved	10 (%00,1010)				
Reserved	11 (%00,1011)				
Reserved	12 (%00,1100)				
Reserved	13 (%00,1101)				
Reserved	14 (%00,1110)				
Call Termination/Cancellation	15 (%00,1111)	x	x	x	x
Group Affiliation Query	16 (%01,0000)		x		
Unit Registration Command	17 (%01,0001)		x		
Unit Authentication Command	18 (%01,0010)		x		
Status Query	19 (%01,0011)		x		
Status Update	20 (%01,0100)		x		
Message Update	21 (%01,0101)		x		
Call Alert	22 (%01,0110)		x		
Extended Function Command	23 (%01,0111)		x		
Channel Identifier Update	24 (%01,1000)		x		x
Channel Identifier Update - Explicit	25 (%01,1001)		x		
Reserved	26 (%01,1010)				
Reserved	27 (%01,1011)				
Reserved	28 (%01,1100)				
Reserved	29 (%01,1101)				
Reserved	30 (%01,1110)				
Reserved	31 (%01,1111)				
System Service Broadcast	32 (%10,0000)		x		x
Secondary Control Channel Broadcast	33 (%10,0001)		x		
Adjacent Site Status Broadcast	34 (%10,0010)		x		x
RFSS Status Broadcast	35 (%10,0011)		x		x
Network Status Broadcast	36 (%10,0100)		x		x
Protection Parameter Broadcast	37 (%10,0101)		x		
Secondary Control Channel Broadcast - Explicit	38 (%10,0110)		x		
Adjacent Site Status Broadcast - Explicit	39 (%10,0111)		x		
RFSS Status Broadcast - Explicit	40 (%10,1000)		x		
Network Status Broadcast - Explicit	41 (%10,1001)		x		
Reserved	42 – 63				