



Office of
Science and
Technology

Technical
Standards
Branch

Federal
Communications
Commission

Cellular System Mobile Station - Land Station Compatibility Specification

OST Bulletin No. 53

JULY 1983
(SUPERSEDES APRIL 1981 ISSUE)

**Cellular System
Mobile Station - Land Station
Compatibility Specification**

**Any questions concerning the subject matter
presented in this Bulletin should be addressed to:**

**John A. Reed
Federal Communications Commission
Technical Standards Branch
Office of Science and Technology
Washington, D.C. 20554**

Phone: (202) 653-6288

PREFACE

These technical requirements form a compatibility (see Note 1) standard for cellular mobile telecommunications systems. Their purpose is to ensure that a mobile station can obtain service in any cellular system. These requirements do not address the quality or reliability of that service, nor do they cover equipment performance or measurement procedures.

To ensure compatibility, it is essential that both radio-system parameters and call-processing procedures be specified. The speech-filtering, modulation, and RF-emission parameters commonly encountered in two-way radio systems have been updated and expanded to reflect the unique radio plan upon which cellular systems are based. The sequence of call processing steps that the mobile and land stations execute to establish calls has been specified along with the digital control messages and analog signals that are exchanged between the two stations.

The land station is subject to fewer compatibility requirements than the mobile station. Radiated power levels, both desired and undesired, are fully specified for mobile stations to control the RF interference that one mobile station can cause another. Land stations are fixed in location and their interference is controlled by proper layout and operation of the system in which the station operates. Detailed call-processing procedures are specified for mobile stations to ensure a uniform response to all land stations. Land station call procedures, like power levels, are not specified in detail because they are a part of the overall design of the individual land system. This approach to writing the compatibility specification provides the land system designer with sufficient flexibility to respond to local service needs and to account for local topography and propagation conditions.

The basic radio-system parameters and call-processing procedures embodied in the compatibility specification have been derived from the Chicago and Baltimore-Washington developmental cellular systems. The cellular plan has been successfully demonstrated in a working system and can now be applied in commercial systems. As commercial systems are built and operated, additional capabilities, primarily in the area of call-processing procedures, will evolve. It is important to plan for the evolution that will take place in the early growth years of commercial operation by providing flexible procedures by which these specifications can be administered and updated.

NOTE:

1. **Compatibility, as used in connection with these standards, is understood to mean: Any mobile station is able to place and receive calls in any cellular system. Conversely all systems are able to place and receive calls for any mobile station. In a subscriber's home system, all call placement must be automatic. It is preferable that call placement be automatic when a mobile station is in roam status.**
2. **The term "mobile station" is defined as one "...intended to be used while in motion or during halts at unspecified points." It is assumed that mobile stations include portable units (e.g., hand-held 'personal' units) as well as units installed in vehicles.**
3. **This compatibility specification is based upon the specific US spectrum allocation for cellular systems.**
4. **Technical details are included for the operation of two systems in a geographic area, System A and System B, each with a separate set of control channels.**
5. **EIA PN 1376, Recommended Standards for 800 MHz Cellular Subscriber Units, and EIA PN 1377, Recommended Standards for 800 MHz Cellular Land Stations are not yet available. They will evolve as traditional EIA Radio Standards, recommending adequate specifications and measurement methods for cellular equipment.**
6. **Each cellular system is identified by a unique 15-bit digital code. A subset of the most significant bits of the system identification code can be used as a group identification. Groups of cellular systems can be formed for such purposes as providing customized services for all mobile stations whose home systems are members of the group.**

It is important that the administrative procedures adopted for assigning the system identification recognize the function of the group identification and permit cellular system operators to reserve appropriately-sized blocks of system identification codes.

MOBILE STATION - LAND STATION COMPATIBILITY SPECIFICATION

1.	DEFINITIONS	1-1
2.	MOBILE STATION	2-1
2.1	TRANSMITTER	1
2.1.1	FREQUENCY PARAMETERS	1
2.1.1.1	CHANNEL SPACING AND DESIGNATION	1
2.1.1.2	FREQUENCY TOLERANCE	1
2.1.2	POWER OUTPUT CHARACTERISTICS	1
2.1.2.1	CARRIER ON/OFF CONDITIONS	1
2.1.2.2	POWER OUTPUT AND POWER CONTROL	1
2.1.3	MODULATION CHARACTERISTICS	2
2.1.3.1	VOICE SIGNALS	2
2.1.3.1.1	COMPRESSOR	2
2.1.3.1.2	PRE-EMPHASIS	2
2.1.3.1.3	DEVIATION LIMITER	2
2.1.3.1.4	POST DEVIATION-LIMITER FILTER	3
2.1.3.2	WIDEBAND DATA SIGNALS	3
2.1.3.2.1	ENCODING	3
2.1.3.2.2	MODULATION AND POLARITY	3
2.1.4	LIMITATIONS ON EMISSIONS	3
2.1.4.1	BANDWIDTH OCCUPIED	3
2.1.4.2	CONDUCTED SPURIOUS EMISSIONS	3
2.1.4.2.1	SUPPRESSION INSIDE CELLULAR BAND	3
2.1.4.2.2	SUPPRESSION OUTSIDE CELLULAR BAND	4
2.1.4.3	RADIATED SPURIOUS EMISSIONS	4
2.2	RECEIVER	4
2.2.1	FREQUENCY PARAMETERS	4
2.2.1.1	CHANNEL SPACING AND DESIGNATION	4
2.2.2	DEMODULATION CHARACTERISTICS	4
2.2.2.1	VOICE SIGNALS	4
2.2.2.1.1	DE-EMPHASIS	4
2.2.2.1.2	EXPANDOR	4
2.2.3	LIMITATIONS ON EMISSIONS	4
2.2.3.1	CONDUCTED SPURIOUS EMISSIONS	4
2.2.3.1.1	SUPPRESSION INSIDE CELLULAR BAND	4
2.2.3.1.2	SUPPRESSION OUTSIDE CELLULAR BAND	5
2.2.3.2	RADIATED SPURIOUS EMISSIONS	5
2.2.4	OTHER RECEIVER PARAMETERS	5
2.3	SECURITY AND IDENTIFICATION	5
2.3.1	MOBILE IDENTIFICATION NUMBER	5
2.3.2	SERIAL NUMBER	7
2.3.3	STATION CLASS MARK	7
2.3.4	REGISTRATION MEMORY	7
2.3.5	ACCESS OVERLOAD CLASS	7
2.3.6	ACCESS METHOD	7
2.3.7	FIRST PAGING CHANNEL	8
2.3.8	HOME SYSTEM IDENTIFICATION	8
2.3.9	LOCAL CONTROL OPTION	8

2.3.10	PREFERRED-SYSTEM SELECTION	8
2.4	SUPERVISION	8
2.4.1	SUPERVISORY AUDIO TONE	8
2.4.1.1	SAT DETECTION	8
2.4.1.2	SAT TRANSMISSION	9
2.4.1.3	FADE TIMING STATUS	9
2.4.2	SIGNALING TONE	9
2.5	MALFUNCTION DETECTION	9
2.5.1	MALFUNCTION TIMER	10
2.5.2	FALSE TRANSMISSION	10
2.6	CALL PROCESSING	10
2.6.1	INITIALIZATION	10
2.6.1.1	RETRIEVE SYSTEM PARAMETERS	10
2.6.1.1.1	SCAN DEDICATED CONTROL CHANNELS	10
2.6.1.1.2	UPDATE OVERHEAD INFORMATION	10
2.6.1.2	PAGING CHANNEL SELECTION	11
2.6.1.2.1	SCAN PAGING CHANNELS	11
2.6.1.2.2	VERIFY OVERHEAD INFORMATION	11
2.6.2	IDLE	12
2.6.2.1	RESPONSE TO OVERHEAD INFORMATION	12
2.6.2.2	PAGE MATCH	14
2.6.2.3	ORDER	14
2.6.2.4	CALL INITIATION	15
2.6.2.5	NON-AUTONOMOUS REGISTRATION INITIATION	15
2.6.3	SYSTEM ACCESS	15
2.6.3.1	SET ACCESS PARAMETERS	15
2.6.3.2	SCAN ACCESS CHANNELS	15
2.6.3.3	RETRIEVE ACCESS ATTEMPT PARAMETERS	15
2.6.3.4	UPDATE OVERHEAD INFORMATION	16
2.6.3.5	SEIZE REVERSE CONTROL CHANNEL	17
2.6.3.6	DELAY AFTER FAILURE	17
2.6.3.7	SERVICE REQUEST	17
2.6.3.8	AWAIT MESSAGE	18
2.6.3.9	AWAIT REGISTRATION CONFIRMATION	19
2.6.3.10	ACTION ON REGISTRATION FAILURE	20
2.6.3.11	AUTONOMOUS REGISTRATION UPDATE	20
2.6.3.12	SERVING-SYSTEM DETERMINATION	20
2.6.3.13	ALTERNATE ACCESS CHANNEL	20
2.6.3.14	DIRECTED RETRY	20
2.6.4	MOBILE STATION CONTROL ON THE VOICE CHANNEL	20
2.6.4.1	LOSS OF RADIO-LINK CONTINUITY	20
2.6.4.2	CONFIRM INITIAL VOICE CHANNEL	21
2.6.4.3	ALERTING	21
2.6.4.3.1	WAITING FOR ORDER	21
2.6.4.3.2	WAITING FOR ANSWER	22
2.6.4.4	CONVERSATION	22
2.6.4.5	RELEASE	23

2.7	SIGNALING FORMATS	24
2.7.1	REVERSE CONTROL CHANNEL	24
2.7.2	REVERSE VOICE CHANNEL	29
3.	LAND STATION	3-1
3.1	TRANSMITTER	1
3.1.1	FREQUENCY PARAMETERS	1
3.1.1.1	CHANNEL SPACING AND DESIGNATION	1
3.1.1.2	FREQUENCY TOLERANCE	1
3.1.2	POWER OUTPUT CHARACTERISTICS	1
3.1.3	MODULATION CHARACTERISTICS	1
3.1.3.1	VOICE SIGNALS	1
3.1.3.1.1	COMPRESSOR	1
3.1.3.1.2	PRE-EMPHASIS	1
3.1.3.1.3	DEVIATION LIMITER	1
3.1.3.1.4	POST DEVIATION-LIMITER FILTER	1
3.1.3.2	WIDEBAND DATA SIGNALS	2
3.1.3.2.1	ENCODING	2
3.1.3.2.2	MODULATION AND POLARITY	2
3.1.4	LIMITATIONS ON EMISSIONS	2
3.1.4.1	BANDWIDTH OCCUPIED	2
3.1.4.2	CONDUCTED SPURIOUS EMISSIONS	2
3.1.4.3	RADIATED SPURIOUS EMISSIONS	2
3.1.4.4	INTERMODULATION	2
3.2	RECEIVER	2
3.2.1	FREQUENCY PARAMETERS	2
3.2.1.1	CHANNEL SPACING AND DESIGNATION	2
3.2.2	DEMODULATION CHARACTERISTICS	3
3.2.2.1	VOICE SIGNALS	3
3.2.2.1.1	DE-EMPHASIS	3
3.2.2.1.2	EXPANDOR	3
3.2.3	LIMITATIONS ON EMISSIONS	3
3.2.4	OTHER RECEIVER PARAMETERS	3
3.3	SECURITY AND IDENTIFICATION	3
3.4	SUPERVISION	3
3.4.1	SUPERVISORY AUDIO TONE	3
3.4.1.1	SAT DETECTION	3
3.4.1.2	SAT TRANSMISSION	3
3.4.1.3	FADE TIMING STATUS	3
3.4.2	SIGNALING TONE DETECTION	4
3.5	MALFUNCTION DETECTION	4
3.6	CALL PROCESSING	4
3.6.1	OVERHEAD FUNCTIONS FOR MOBILE STATION INITIATION	4
3.6.2	MOBILE STATION CONTROL ON THE CONTROL CHANNEL	4
3.6.2.1	OVERHEAD INFORMATION	4
3.6.2.2	PAGE	5
3.6.2.3	ORDER	5
3.6.2.4	LOCAL CONTROL	5

3.6.3	LAND STATION SUPPORT OF SYSTEM ACCESS BY MOBILE STATIONS	5
3.6.3.1	OVERHEAD INFORMATION	5
3.6.3.2	REVERSE CONTROL CHANNEL SEIZURE BY A MOBILE STATION	6
3.6.3.3	RESPONSE TO MOBILE STATION MESSAGES	6
3.6.4	MOBILE STATION CONTROL ON VOICE CHANNEL	7
3.6.4.1	LOSS OF RADIO-LINK CONTINUITY	7
3.6.4.2	INITIAL VOICE CHANNEL CONFIRMATION	7
3.6.4.3	ALERTING	7
3.6.4.3.1	WAITING FOR ORDER	7
3.6.4.3.2	WAITING FOR ANSWER	8
3.6.4.4	CONVERSATION	8
3.7	SIGNALING FORMATS	10
3.7.1	FORWARD CONTROL CHANNEL	10
3.7.1.1	MOBILE STATION CONTROL MESSAGE	11
3.7.1.2	OVERHEAD MESSAGE	14
3.7.1.2.1	SYSTEM PARAMETER OVERHEAD MESSAGE	14
3.7.1.2.2	GLOBAL ACTION OVERHEAD MESSAGE	16
3.7.1.2.3	REGISTRATION ID MESSAGE	18
3.7.1.2.4	CONTROL-FILLER MESSAGE	20
3.7.1.3	DATA RESTRICTIONS	21
3.7.2	FORWARD VOICE CHANNEL	23

- PL_m . The mobile station RF power level.
- R_m . Indicates whether registration is enabled or not.
- RCF_m . Identifies whether the mobile station must read a control-filler message before accessing a system on a reverse control channel.
- $REGID_m$. The stored value of the last registration number ($REGID_r$) received on a forward control channel.
- $REGINCR_m$. Identifies increments between registrations by a mobile station.
- S_m . Identifies whether the mobile station must send its serial number when accessing a system.
- SCC_m . A digital number which is stored and used to identify which SAT frequency a mobile station should be receiving.
- SID_p . The home system identification stored in the mobile station's permanent security and identification memory.
- SID_{s-p} . One of a number of system identifications stored in the mobile station's semi-permanent security and identification memory.
- SID_r . The system identification received on a forward control channel.
- SID_m . The stored system identification.
- $WFOM_m$. Identifies whether a mobile station must wait for an overhead message train before accessing a system on a reverse control channel.

Orders. The following orders can be sent to a mobile station from a land station:

- **Alert.** The alert order is used to inform the user that a call is being received.
- **Audit.** The audit order is used by a land station to determine whether the mobile station is active in the system.
- **Change Power.** The change power order is used by a land station to change the RF power level of a mobile station.
- **Intercept.** The intercept order is used to inform the user of a procedural error made in placing the call.
- **Maintenance.** The maintenance order is used by a land station to check the operation of a mobile station. All functions are similar to alert but the alerting device is not activated.
- **Release.** The release order is used to disconnect a call that is being established or is already established.
- **Reorder.** The reorder order is used to inform the user that all facilities are in use and the call should be placed again.
- **Send Called-Address.** The send called-address order is used to inform the mobile station that it must send a message to the land station with dialed-digit information.
- **Stop Alert.** The stop alert order is used to inform a mobile station that it must discontinue alerting the user.

Paging. The act of seeking a mobile station when an incoming call has been placed to it.

Paging Channel. A forward control channel which is used to page mobile stations and send orders.

Registration. The steps by which a mobile station identifies itself to a land station as being active in the system at the time the message is sent to the land station.

Release Request. A message sent from a mobile station to a land station indicating that the user desires to disconnect the call.

Reverse control channel (RECC). The control channel used from a mobile station to a land station.

Reverse Voice Channel (RVC). The voice channel used from a mobile station to a land station.

Roamer. A mobile station which operates in a cellular system other than the one from which service is subscribed.

Scan of Channels. The procedure by which a mobile station examines the signal strength of each forward control channel.

Seizure Precursor. The initial digital sequence transmitted by a mobile station to a land station on a reverse control channel.

Signaling Tone. A 10-kilohertz tone transmitted by a mobile station on a voice channel to: 1) confirm orders, 2) signal flash requests, and 3) signal release requests.

Status Information. The following status information is used in this section to describe mobile station operation:

- **Serving-System Status.** Indicates whether a mobile station is tuned to channels associated with System A or System B.
- **First Registration ID Status.** Indicates whether a mobile station has received a registration ID message since initialization.
- **Local Control Status.** Indicates whether a mobile station must respond to local control messages or not.
- **Roam Status.** Indicates whether a mobile station is in its home system or not.
- **Termination Status.** Indicates whether a mobile station must terminate the call when it is on a voice channel.

Supervisory Audio Tone (SAT). One of three tones in the 6-kilohertz region that are transmitted by a land station and transponded by a mobile station.

System Identification (SID). A digital identification associated with a cellular system; each system is assigned a unique number.

Voice Channel. A channel on which a voice conversation occurs and on which brief digital messages may be sent from a land station to a mobile station or from a mobile station to a land station.

MOBILE STATION - LAND STATION COMPATIBILITY SPECIFICATION

1. DEFINITIONS

Access Channel. A control channel used by a mobile station to access a system to obtain service.

Analog Color Code. An analog signal (see SAT) transmitted by a land station on a voice channel and used to detect capture of a mobile station by an interfering land station and/or the capture of a land station by an interfering mobile station.

BCH Code. Bose-Chaudhuri-Hocquenghem Code.

Busy-Idle Bits. The portion of the data stream transmitted by a land station on a forward control channel that is used to indicate the current busy-idle status of the corresponding reverse control channel.

Control Channel. A channel used for the transmission of digital control information from a land station to a mobile station or from a mobile station to a land station.

Digital Color Code (DCC). A digital signal transmitted by a land station on a forward control channel that is used to detect capture of a land station by an interfering mobile station.

Flash Request. A message sent on a voice channel from a mobile station to a land station indicating that a user desires to invoke special processing.

Forward control channel (FOCC). A control channel used from a land station to a mobile station.

Forward Voice Channel (FVC). A voice channel used from a land station to a mobile station.

Group Identification. A subset of the most significant bits of the system identification (SID) that is used to identify a group of cellular systems.

Handoff. The act of transferring a mobile station from one voice channel to another.

Home Mobile Station. A mobile station which operates in the cellular system from which service is subscribed.

Land Station. A station in the Domestic Public Cellular Radio Telecommunications Service, other than a mobile station, used for radio communications with mobile stations.

Mobile Identification Number (MIN). The 34-bit number which is a digital representation of the 10-digit directory telephone number assigned to a mobile station.

Mobile Station. A station in the Domestic Public Cellular Radio Telecommunications Service intended to be used while in motion or during halts at unspecified points. It is assumed that mobile stations include portable units (e.g., hand-held 'personal' units) as well as units installed in vehicles.

Mobile Station Class. The following mobile station classes are defined for this section:

- class I. High power station.
- class II. Mid-range power station.
- class III. Low power station.

Numeric Information. Numeric information is used to describe the operation of the mobile station. The following subscripts are used to clarify the use of the numeric information:

"s" to indicate a value stored in a mobile station's temporary memory,

"sv" to indicate a stored value that varies as a mobile station processes various tasks,

"sl" to indicate the stored limits on values that vary,

"r" to indicate a value received by a mobile station over a forward control channel,
"p" to indicate a value set in a mobile station's permanent security and identification memory, and
"s-p" to indicate a value stored in a mobile station's semi-permanent security and identification memory.

The numeric indicators are:

- ACCOLC_p. A four-bit number used to identify which overload class field controls access attempts.
- BIS_s. Identifies whether a mobile station must check for an idle-to-busy transition on a reverse control channel when accessing a system.
- CCLIST_s. The list of control channels to be scanned by a mobile station processing the Directed-Retry Task (see Section 2.6.3.14).
- CMAX_s. The maximum number of channels to be scanned by a mobile station when accessing a system.
- CPA_s. Identifies whether the access functions are combined with the paging functions on the same set of control channels.
- DTX_s. Identifies whether the mobile station is permitted to use the discontinuous transmission mode on the voice channel.
- E_s. The stored value of the E field sent on the forward control channel. E_s identifies whether a home mobile station must send only MIN1_p, or both MIN1_p and MIN2_p, when accessing the system.
- EX_p. Identifies whether home mobile stations must send MIN1_p, or both MIN1_p and MIN2_p, when accessing the system. EX_p differs from E_s in that the information is stored in the mobile station's security and identification memory.
- FIRSTCHA_s. The number of the first control channel used for accessing a system.
- FIRSTCHP_s. The number of the first control channel used for paging mobile stations.
- LASTCHA_s. The number of the last control channel used for accessing a system.
- LASTCHP_s. The number of the last control channel used for paging mobile stations.
- LT_s. Identifies whether the next access attempt is required to be the last try.
- MIN1_p. The 24-bit number which corresponds to the 7-digit directory telephone number assigned to a mobile station.
- MIN2_p. The 10-bit number which corresponds to the 3-digit area code assigned to a mobile station.
- MAXBUSY_s. The maximum number of busy occurrences allowed on a reverse control channel.
- MAXSZTR_s. The maximum number of seizure attempts allowed on a reverse control channel.
- N_s. The number of paging channels that a mobile station must scan.
- NBUSY_s. The number of times a mobile station attempts to seize a reverse control channel and finds the reverse control channel busy.
- NSZTR_s. The number of times a mobile station attempts to seize a reverse control channel and fails.
- NXTREG_{s-p}. Identifies when a mobile station must make its next registration to a system.

2. MOBILE STATION

2.1 TRANSMITTER

2.1.1 FREQUENCY PARAMETERS

2.1.1.1 CHANNEL SPACING AND DESIGNATION

The mobile station transmit channel at 825.030 MHz (and the corresponding land station transmit channel at 870.030 MHz) shall be termed channel number 1. See Section 22.902 of the Commission's Rules.

2.1.1.2 FREQUENCY TOLERANCE

See Section 22.101(a) of the Commission's Rules.

2.1.2 POWER OUTPUT CHARACTERISTICS

2.1.2.1 CARRIER ON/OFF CONDITIONS

The carrier-off condition is defined as a power output at the transmitting antenna connector not exceeding -60 dBm. When commanded to the carrier-on condition on a reverse control channel, a mobile station transmitter must come to within 3 dB of the specified output power (see Section 2.1.2.2) and to within the required stability (see Section 2.1.1.2) within 2 ms. Conversely, when commanded to the carrier-off condition, the transmit power must fall to a level not exceeding -60 dBm within 2 ms.

Whenever a transmitter is more than 1 kHz from its initial or final value during channel switching, the transmitter carrier must be inhibited to a power output level not greater than -60 dBm.

2.1.2.2 POWER OUTPUT AND POWER CONTROL

The maximum effective radiated power with respect to a half-wave dipole (ERP) for any class mobile station transmitter is 8 dBW (6.3 Watts). An inoperative antenna assembly must not degrade the spurious emission levels as defined in Section 2.1.4.2. See Sections 22.107(b) and 22.904 of the Commission's Rules.

The nominal ERP for each class of mobile station transmitter is:

Class I 6 dBW (4.0 Watts)

Class II 2 dBW (1.6 Watts)

Class III -2 dBW (0.6 Watts)

A mobile station transmitter must be capable of reducing power in steps of 4 dB on command from a land station (see Sections 2.6.3.3, 2.6.3.5, 3.7.1.1, 3.7.1.2.4, and 3.7.2) The nominal levels are given in Table 2.1.2-1. Each power level must be maintained within the range of +2 dB and -4 dB of its nominal level over the ambient temperature range of -30 degrees Celsius to +60 degrees Celsius, and over the supply voltage range of ± 10 percent from the nominal value, accumulative.

Table 2.1.2-1

MOBILE STATION NOMINAL POWER LEVELS

Mobile Station Power Level (PL)	Mobile Attenuation Code (MAC)	Nominal ERP (dBW)		
		I	II	III
0	000	6	2	-2
1	001	2	2	-2
2	010	-2	-2	-2
3	011	-6	-6	-6
4	100	-10	-10	-10
5	101	-14	-14	-14
6	110	-18	-18	-18
7	111	-22	-22	-22

2.1.3 MODULATION CHARACTERISTICS

2.1.3.1 VOICE SIGNALS

The (FM) modulator is preceded by the following four voice-processing stages (in the order listed):

- Compressor
- Pre-Emphasis
- Deviation Limiter
- Post Deviation-Limiter Filter (See Section 22.907(a) of the Commission's Rules.)

2.1.3.1.1 COMPRESSOR

This stage must include the compressor portion of a 2:1 syllabic compandor. For every 2 dB change in input level to a 2:1 compressor within its operating range, the change in output level is a nominal 1 dB. The compressor must have a nominal attack time of 3 ms and a nominal recovery time of 13.5 ms as defined by the CCITT. (Reference: Recommendation G162, CCITT Plenary Assembly, Geneva, May-June 1964, Blue Book, Vol. 111, P. 52.)

The nominal reference input level to the compressor is that corresponding to a 1000 Hz acoustic tone at the expected nominal speech volume level. This level must produce a nominal ± 2.9 kHz peak frequency deviation of the transmitted carrier.

2.1.3.1.2 PRE-EMPHASIS

The pre-emphasis characteristic must have a nominal +6 dB/octave response between 300 and 3000 Hz.

2.1.3.1.3 DEVIATION LIMITER

For audio (voice) inputs applied to the transmitter voice-signal processing stages, a mobile station must limit the instantaneous frequency deviation to ± 12 kHz. This requirement excludes

supervision signals (see Section 2.4) and wideband data signals (see Section 2.1.3.2). See Section 22.906 of the Commission's Rules.

2.1.3.1.4 POST DEVIATION-LIMITER FILTER

See Section 22.907(a)(1) of the Commission's Rules.

2.1.3.2 WIDEBAND DATA SIGNALS

2.1.3.2.1 ENCODING

The reverse control channel (RECC) and reverse voice channel (RVC) wideband data streams (see Section 2.7) must be further encoded such that each nonreturn-to-zero binary one is transformed to a zero-to-one transition, and each nonreturn-to-zero binary zero is transformed to a one-to-zero transition.

2.1.3.2.2 MODULATION AND POLARITY

The filtered wideband data stream must then be used to modulate the transmitter carrier using direct binary frequency shift keying. A one (i.e., high state) into the modulator must correspond to a nominal peak frequency deviation 8 kHz above the carrier frequency, and a zero into the modulator must correspond to a nominal peak frequency deviation 8 kHz below the carrier frequency. See Section 22.906 of the Commission's Rules.

2.1.4 LIMITATIONS ON EMISSIONS

See Section 22.907 of the Commission's Rules.

2.1.4.2.2 SUPPRESSION OUTSIDE CELLULAR BAND

Current FCC rules shall apply.

2.1.4.3 RADIATED SPURIOUS EMISSIONS

Radiated spurious emissions (from sources other than via the antenna connector) must meet levels corresponding to the conducted spurious requirements listed in Section 2.1.4.2.

2.2 RECEIVER

2.2.1 FREQUENCY PARAMETERS

2.2.1.1 CHANNEL SPACING AND DESIGNATION

The mobile station receive channel at 870.030 MHz (and the corresponding land station receive channel at 825.030 MHz) shall be termed channel number 1. See Section 22.902 of the Commission's Rules.

2.2.2 DEMODULATION CHARACTERISTICS

2.2.2.1 VOICE SIGNALS

The demodulator is followed by the following two voice-signal processing stages:

- De-Emphasis
- Expander

2.2.2.1.1 DE-EMPHASIS

The de-emphasis characteristic must have a nominal -6 dB per octave response between 300 and 3000 Hz.

2.2.2.1.2 EXPANDOR

This stage must include the expander portion of a 2:1 syllabic compandor. For every 1 dB change in input level to a 1:2 expander, the change in output level is a nominal 2 dB. The signal expansion must follow all other demodulation signal processing (including the 6 dB/octave de-emphasis and filtering). The expander must have a nominal attack time of 3 ms and a nominal recovery time of 13.5 ms as defined by the CCITT. (Reference: Recommendation G162, CCITT Plenary Assembly, Geneva, May-June 1964, Blue Book, Vol. 111, P. 52.)

The nominal reference input level to the expander is that corresponding to a 1000 Hz tone from a carrier with a ± 2.9 kHz peak frequency deviation.

2.2.3 LIMITATIONS ON EMISSIONS

2.2.3.1 CONDUCTED SPURIOUS EMISSIONS

2.2.3.1.1 SUPPRESSION INSIDE CELLULAR BAND

Any RF signals emitted by the receiver and falling within the mobile station receive band must not exceed -80 dBm, as measured at the antenna connector. Additionally, signals falling within the mobile station transmit band must not exceed -60 dBm, as measured at the antenna connector.

2.2.3.1.2 SUPPRESSION OUTSIDE CELLULAR BAND

See Subpart C, Part 15 of the Commission's Rules.

2.2.3.2 RADIATED SPURIOUS EMISSIONS

See Subpart C, Part 15 of the Commission's Rules.

2.2.4 OTHER RECEIVER PARAMETERS

System performance is predicated upon receivers meeting EIA minimum performance standard PN 1376 (Recommended Standards for 800 MHz Cellular Subscriber Units).

2.3 SECURITY AND IDENTIFICATION

2.3.1 MOBILE IDENTIFICATION NUMBER

A 34-bit binary mobile identification number (MIN) is derived from the mobile station's 10-digit directory telephone number by the following procedure (see also Section 2.7.1).

- (1) The first three digits are mapped into 10 bits (corresponding to MIN_2) by the following coding algorithm:
 - (a) Represent the 3-digit field as $D_1D_2D_3$, with the digit 0 having the value 10.
 - (b) Compute $100D_1 + 10D_2 + D_3 - 111$.
 - (c) Convert the result in step (b) to binary by a standard decimal-to-binary conversion (see table below).
- (2) The second three digits are mapped into the 10 most significant bits of MIN_1 , by the coding algorithm described in (1).
- (3) The last four digits are mapped into the 14 least significant bits of MIN_1 , as follows:
 - (a) The thousands digit should be mapped into four bits by a Binary-Coded-Decimal (BCD) conversion, as specified in the table below.
 - (b) The last three digits are mapped into 10 bits by the coding algorithm described in (1).

DECIMAL-TO-BINARY CONVERSION

decimal number	binary number
1	000000001
2	000000010
3	000000011
4	000000100
.	.
.	.
998	1111100110
999	1111100111

THOUSANDS-DIGIT BCD MAPPING PROCEDURE

Thousands Digit	Binary Sequence
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
0	1010

In the following example the 10-digit directory telephone number 321 456-7890 is encoded into MIN2 and MIN1 using the procedure described above:

- MIN2. The 10-bit MIN2 is derived from the first three digits of the telephone number (i.e., 321):
 - i. $D_1 = 3; D_2 = 2; D_3 = 1.$
 - ii. $100 D_1 + 10 D_2 + D_3 - 111 =$
 $100(3) + 10(2) + (1) - 111 = 210.$
 - iii. 210 in binary is '00 1101 0010'.

Therefore MIN2 is '00 1101 0010'.

- MIN1. The 10 most significant bits of MIN1 are derived from the second three digits of the telephone number (i.e., 456):
 - i. $D_1 = 4; D_2 = 5; D_3 = 6.$
 - ii. $100 D_1 + 10 D_2 + D_3 - 111 =$
 $100(4) + 10(5) + (6) - 111 = 345.$
 - iii. 345 in binary is '0101 0110 01'.

The next four most significant bits of MIN1 are derived from the thousands digit of the telephone number (i.e., 7) by BCD conversion:

7 in BCD is '01 11'.

The 10 least significant bits of MIN1 are derived from the last three digits of the telephone number (i.e., 890):

- i. $D_1 = 8; D_2 = 9; D_3 = 10.$
- ii. $100 D_1 + 10 D_2 + D_3 - 111 =$
 $100(8) + 10(9) + (10) - 111 = 789.$
- iii. 789 in binary is '11 0001 0101'.

Therefore MIN1 is '0101 0110 0101 1111 0001 0101'.

2.3.2 SERIAL NUMBER

The serial number is a 32-bit binary number that uniquely identifies a mobile station to any cellular system. It must be factory-set and not readily alterable in the field. The circuitry that provides the serial number must be isolated from fraudulent contact and tampering. Attempts to change the serial number circuitry should render the mobile station inoperative.

2.3.3 STATION CLASS MARK

Class-of-station information referred to as the station class mark (SCM_p) must be stored in a mobile station. The digital representation of this class mark is specified in the table below.

Station Class Marks

Power Class (See Section 2.1.2.2)	SCM_p
class I	XX00
class II	XX01
class III	XX10
reserved	XX11
Station Types	
continuous transmission*	00XX
discontinuous transmission*	01XX
reserved	10XX
reserved	11XX

*When DTX_s is set to '1', the mobile station may use the discontinuous transmission mode on the voice channel. Otherwise, the mobile station must use the continuous transmission mode.

2.3.4 REGISTRATION MEMORY

If the mobile station is equipped for autonomous registration, then a minimum of four 21-bit (20 data bits plus an overflow bit) next registration ($NXTREG_{s-p}$) and corresponding 15-bit system identification (SID_{s-p}) pairs must be retained when the mobile station power is turned off. The data retention time under power-off condition must be longer than 48 hours. If the integrity of the stored data can not be guaranteed after the mobile station is disconnected from the vehicle battery, then the memory must be set to zero when power is re-applied to the mobile station.

2.3.5 ACCESS OVERLOAD CLASS

A four-bit number ($ACCOLC_p$) must be stored in the mobile station and used to identify which overload class field controls access attempts by the mobile station (see Section 2.6.3.4).

2.3.6 ACCESS METHOD

A one-bit access method (EX_p) must be stored in the mobile station and used to determine if the extended address word must be included in all access attempts (see Section 2.6.3.7).

2.3.7 FIRST PAGING CHANNEL

An eleven-bit first paging channel ($FIRSTCHP_p$) must be stored in the mobile station and used to identify the channel number of the first paging channel when the mobile station is "home" (see Section 2.6.1.1.2).

2.3.8 HOME SYSTEM IDENTIFICATION

A 15-bit system identification (SID_p) must be stored in the mobile station and used to identify the mobile station's home system (see Section 2.6.1.1.2).

2.3.9 LOCAL CONTROL OPTION

A means must be equipped within the mobile station to enable or disable the local control option (see Sections 2.6.2.1 and 2.6.2.5).

2.3.10 PREFERRED-SYSTEM SELECTION

A means must be provided within the mobile station to identify the preferred system as either System A or System B.

2.4 SUPERVISION

2.4.1 SUPERVISORY AUDIO TONE

The supervisory audio tone (SAT), will be one of the three frequencies, 5970, 6000, or 6030 Hz. The SAT is added to the voice transmission by a land station (see Section 3.4.1). A mobile station must detect, filter, and modulate the transmitted voice channel carrier with this tone. Transmission of the SAT by a mobile station must be suspended during transmission of wideband data on the reverse voice channel (see Section 2.7.2), but must *not* be suspended when signaling tone is sent (see Section 2.4.2).

While a valid SAT is detected and the measured SAT determination does not agree with the SAT color code (SCC_r) received in the mobile station control message (see Sections 3.7.1.1 and 3.7.2), the receiver audio must be muted. See Section 22.906(b) of the Commission's Rules.

2.4.1.1 SAT DETECTION

A mobile station must make the following decisions to determine which SAT, or none, is present:

Measured Frequency of Incoming Signal	Measured SAT Determination	where
$f < f_1$	No valid SAT	$f_1 = 5955 \pm 5\text{Hz}$.
$f_1 \leq f < f_2$	SAT = 5970	$f_2 = 5985 \pm 5\text{Hz}$.
$f_2 \leq f < f_3$	SAT = 6000	$f_3 = 6015 \pm 5\text{Hz}$.
$f_3 \leq f < f_4$	SAT = 6030	$f_4 = 6045 \pm 5\text{Hz}$.
$f_4 \leq f$	No valid SAT	
No SAT Received	No valid SAT	

The determination of SAT is not required to be made continuously, but should be performed at least every 250 ms.

2.4.1.2 SAT TRANSMISSION

The transmission requirements for the SAT signal, including time delays in the transmitter, receiver and any equalization circuits, are summarized as follows:

- Steady-state phase error at 5970, 6000 or 6030 Hz 0 \pm 20 degrees
- Phase Step Response Settle to within 10 percent of final steady-phase error in \leq 250 ms
- Tone Modulation Index 1/3 radian \pm 10 percent (Δf - \pm 2 kHz)

2.4.1.3 FADE TIMING STATUS

When an SAT determination is made a mobile station must perform the following:

- If no valid SAT is detected or the measured SAT determination does not agree with the SAT color code (SCC_r) received in the mobile station control message (See Sections 3.7.1.1 and 3.7.2), the fade timing status must be enabled (see Section 2.6.4.1).
- Otherwise, the fade timing status must be disabled (see Section 2.6.4.1).

2.4.2 SIGNALING TONE

Signaling tone must be 10 kHz \pm 1 Hz and produce a nominal frequency deviation of \pm 8 kHz. See Section 22.906(b) of the Commission's Rules.

2.5 MALFUNCTION DETECTION

2.5.1 MALFUNCTION TIMER

A timer separate from and independent of all other functions must be running continuously whenever power is applied to the transmitter of a mobile station.

If the mobile station is software-controlled, sufficient reset commands must be interspersed throughout the mobile station logic program to ensure that the timer never expires as long as the proper sequence of operations is taking place; similar means must be provided, as appropriate, in hardware-controlled designs.

If the timer expires, a malfunction must be assumed and the mobile station must be inhibited from transmitting. The maximum time allowed for expiration of the timer is 60 seconds.

This supersedes the requirement for a transmitter carrier-on indicator.

2.5.2 FALSE TRANSMISSION

A protection circuit must be provided to minimize the possibility of false transmitter operation caused by component failure within the mobile station.

2.6 CALL PROCESSING

The following sections describe mobile station operation as controlled by a land station. Frequent references are made to the corresponding sections in the land station section and to the messages that flow between a land station and a mobile station. It is helpful to read sections 2.6 and 3.6 in parallel and examine the message formats in sections 2.7 and 3.7 at the same time.

When power is applied to a mobile station, it should enter the Retrieve System Parameters Task (see Section 2.6.1.1). Each task from section 2.6.1.1 to 2.6.4.5 contains information describing which tasks must be entered when a given task is completed.

2.6.1 INITIALIZATION

2.6.1.1 RETRIEVE SYSTEM PARAMETERS

If the preferred system (see Section 2.3.10) is System A, set the serving-system status to enabled; if the preferred system is System B, set the serving-system status to disabled.

The mobile station must then enter the Scan Dedicated Control Channels Task (see Section 2.6.1.1.1).

2.6.1.1.1 SCAN DEDICATED CONTROL CHANNELS

If the serving-system status is enabled, a mobile station must examine the signal strength on each of the dedicated control channels assigned nationwide to System A. If the serving-system status is disabled, a mobile station must examine the signal strength on each of the dedicated control channels assigned nationwide to System B.

The mobile station must then enter the Update Overhead Information Task (see Section 2.6.1.1.2).

2.6.1.1.2 UPDATE OVERHEAD INFORMATION

Overhead messages are sent in a group called an overhead message train (see Section 3.7.1.2). The mobile station must use the value given in the NAWC (number of additional words coming) field of the system parameter overhead message in the train to determine that all messages of the train have been received. The END field must be used as a cross-check. For NAWC-counting purposes, inserted control-filler messages (see Section 3.7.1) must not be counted as part of the overhead message train.

If the mobile station receives a BCH-code-correct but unrecognizable overhead message in the train, the mobile station must count that message as part of the train for NAWC-counting purposes, but must not attempt to execute the message.

The mobile station must tune to the strongest dedicated control channel and, within 3 seconds, receive a system parameter message (see Section 3.7.1.2) and update the following numeric information:

- System identification (SID_s). Set the 14 most significant bits of SID_s to the value of the $SID1$ field. Set the least significant bit of SID_s to '1' if the serving-system status is enabled; otherwise, set the bit to '0'.
- Number of paging channels (N_p). Set N_p to 1 plus the value of the $N-1$ field.
- First paging channel ($FIRSTCHP_s$). Set $FIRSTCHP_s$ according to the following algorithm:
 - i. If $SID_s = SID_p$, $FIRSTCHP_s = FIRSTCHP_p$ (see Section 2.3.7).
 - ii. If $SID_s \neq SID_p$ and the serving-system status is enabled, set $FIRSTCHP_s$ to the first dedicated control channel for System A (834.990 MHz mobile Tx, 879.990 MHz land Tx).
 - iii. If $SID_s \neq SID_p$ and the serving-system status is disabled, set $FIRSTCHP_s$ to the first dedicated control channel for System B (835.020 MHz mobile Tx, 880.020 MHz land Tx).
- Last paging channel ($LASTCHP_s$). Set $LASTCHP_s$ according to the following algorithm:
 - i. If the serving-system status is enabled, $LASTCHP_s = FIRSTCHP_s - N_p + 1$.
 - ii. If the serving-system status is disabled, $LASTCHP_s = FIRSTCHP_s + N_p - 1$.

If the mobile station is equipped for autonomous registration, the mobile station must:

- Set registration increment ($REGINCR_s$) to its default value of 450.
- Set the first registration ID status to enabled.

The mobile station must then enter the Paging Channel Selection Task (see Section 2.6.1.2).

If the mobile station cannot complete this task on the strongest dedicated control channel, it may tune to the second strongest dedicated control channel and attempt to complete this task within a second 3-second interval. If it cannot complete this task on either of the two strongest control channels, the mobile station may check the serving-system status: If the serving-system status is enabled, it may be disabled; if the serving-system status is disabled, it may be enabled. The mobile station must then enter the Scan Dedicated Control Channels Task (see Section 2.6.1.1.1).

2.6.1.2 PAGING CHANNEL SELECTION

2.6.1.2.1 SCAN PAGING CHANNELS

The mobile station must examine the signal strength on each of channels $FIRSTCHP_s$ to $LASTCHP_s$ (see Section 2.6.1.1.2).

The mobile station must then enter the Verify Overhead Information Task (see Section 2.6.1.2.2).

2.6.1.2.2 VERIFY OVERHEAD INFORMATION

The mobile station must set the Wait-for-Overhead-Message bit ($WFOM_s$) to '0'; the mobile station must then tune to the strongest paging channel and, within 3 seconds, receive an overhead message train (see Section 3.7.1.2) and update the following:

- **System identification:** Set the 14 most significant bits of SID_r to the value of the SID_1 field. Set the least significant bit of SID_r to '1' if the serving-system status is enabled; otherwise, set the bit to '0'.
- **ROAM status:** The mobile station must compare the received system identification (SID_r) with the stored system identification (SID_s). If $SID_r = SID_s$, the mobile station must compare SID_r with SID_p . If $SID_p = SID_s$, the mobile station must set the ROAM status to disabled. If $SID_p \neq SID_s$, the mobile station must set the ROAM status to enabled.

If $SID_r \neq SID_s$, the mobile station must enter the Retrieve System Parameters Task (see Section 2.6.1.1).

- **Local control status:** If the local control option is enabled within the mobile station (see Section 2.3.9) and the bits of the home system identification (SID_p) that comprise the group identification match the corresponding bits of SID_s , then the local control status must be enabled. Otherwise, the local control status must be disabled.

The mobile station must then enter the Response to Overhead Information Task (see Section 2.6.2.1).

If the mobile station cannot complete this task on the strongest paging channel, it may tune to the second strongest paging channel and attempt to complete this task within a second 3-second interval. If it cannot complete this task on either of the two strongest paging channels, the mobile station may check the serving-system status: If the serving-system status is enabled, it may be disabled; if the serving-system status is disabled, it may be enabled. The mobile station must then enter the Scan Dedicated Control Channels Task (see Section 2.6.1.1.1).

2.6.2 IDLE

During the Idle Task, a mobile station must execute each of the following four (sub)tasks (see Sections 2.6.2.1, 2.6.2.2, 2.6.2.3, 2.6.2.4) at least every 46.3 ms, the periodicity of word blocks on the forward control channel. If the mobile station is not listening to a control channel of the preferred system, it may exit this task and enter the Retrieve System Parameters Task (see Section 2.6.1.1).

2.6.2.1 RESPONSE TO OVERHEAD INFORMATION

Whenever a mobile station receives an overhead message train (see Section 3.7.1.2), the mobile station must compare SID_s with SID_r . If $SID_s \neq SID_r$, the mobile station must exit the Idle Task and enter the Initialization Task (see Section 2.6.1).

If $SID_s = SID_r$, the mobile station must update the following numeric values using information contained in the system parameter overhead message:

- **Serial number bit (S_p).** Set S_p to the value in the S field.
- **Registration bit (R_p).** If the roam status is disabled, set R_p to the value of the REGH field; if the roam status is enabled, set R_p to the value of the REGR field.
- **Extended address bit (E_p).** Set E_p to the value in the E field.
- **Discontinuous transmission bit (DTX_p).** Set DTX_p to the value of the DTX field.
- **Number of paging channels (N_p).** Set N_p to 1 plus the value of the N-1 field.
- **Read-control-filler bit (RCF_p).** Set RCF_p to the value of the RCF field.
- **Combined paging/access bit (CPA_p).** Set CPA_p to the value of the CPA field.
- **Number of access channels ($CMAX_p$).** Set $CMAX_p$ to 1 plus the value of the CMAX-1 field.

- Determine control channel boundaries for accessing the system (FIRSTCHA_s and LASTCHA_s) by using the following algorithm:
 - I. If the serving-system status is enabled,
 - a. If CPA_s=1, set FIRSTCHA_s to the first dedicated control channel for System A (834.990 MHz mobile Tx, 879.990 MHz land Tx).
 - b. If CPA_s=0, set FIRSTCHA_s to the value of the first dedicated control channel for System A minus N_s.
 - c. LASTCHA_s = FIRSTCHA_s - CMAX_s+1.
 - II. If the serving-system status is disabled,
 - a. If CPA_s=1, set FIRSTCHA_s to the first dedicated control channel for System B (835.020 MHz mobile Tx, 880.020 MHz land Tx).
 - b. If CPA_s=0, set FIRSTCHA_s to the value of the first dedicated control channel for System B plus N_s.
 - c. LASTCHA_s = FIRSTCHA_s + CMAX_s-1.

The mobile station must then respond as indicated to each of the following messages, if received in the overhead message train. The order in which the mobile station must respond to the messages, if two or more are received, is given by their order in the following list:

1. Local Control Messages

If the local control status is enabled (see Section 2.6.1.2.2) the mobile station must respond to the local control messages.

2. New Access Channel Set Message

- a. The mobile station must set FIRSTCHA_s to the value of the NEWACC field of the message.
- b. The mobile station must set LASTCHA_s according to the following algorithm:
 - i. If the serving-system status is enabled, LASTCHA_s = NEWACC_s - CMAX_s+1.
 - ii. If the serving-system status is disabled, LASTCHA_s = NEWACC_s + CMAX_s-1.

3. Registration Increment Message

If the mobile station is equipped for autonomous registration, the mobile station must set REGINCR_s to the value of the REGINCR field in the message.

4. Registration ID Message

If the mobile station is equipped for autonomous registration, the mobile station must perform the following:

- a. The mobile station must set REGID_s to the value of the REGID field of the received message and set the first-registration ID status to disabled (see Section 2.6.1.1.2).
- b. The mobile station must then attempt to find SID_s among the SID_{s-p} values stored in the registration memory (see Section 2.3.4).
- c. If SID_s is found among the SID_{s-p} values stored in the registration memory, the mobile station must perform the following:
 - i. The mobile station must use the following (or an equivalent) algorithm to review the NXTREG_{s-p} associated with the SID_{s-p} to determine if REGID_s has cycled through zero:

- If $NXTREG_{m-p}$ is greater than or equal to $REGID_m + REGINCR_m + 5$, then $NXTREG_{m-p}$ must be replaced by the greater of 0 and the value $NXTREG_{m-p} - 2^{20}$.
 - Otherwise do not change $NXTREG_{m-p}$.
- ii. The mobile station must then compare $REGID_m$ with the $NXTREG_{m-p}$ associated with the SID_{m-p} .
- If $REGID_m$ is greater than or equal to $NXTREG_{m-p}$ and autonomous registration is enabled, the mobile station must enter the System Access Task with a "registration" indication (see Section 2.6.3).
 - If $REGID_m$ is greater than or equal to $NXTREG_{m-p}$ and autonomous registration is not enabled, then set $NXTREG_{m-p}$ equal to $REGID_m$.
 - Otherwise, the mobile station must ignore the message and continue to process messages in the overhead message train.
- d. If SID_m is not found among the SID_{m-p} values stored in the registration memory, the mobile station must perform the following:
- If autonomous registration is enabled, the mobile station must exit this task and enter the System Access Task with a "registration" indication supplied (see Section 2.6.3).
 - Otherwise, the mobile station must ignore the message and continue to process messages in the overhead message train.
5. Rescan Message
- The mobile station must immediately exit this task and enter the Initialization Task (see Section 2.6.1).
6. Any Other Message
- Ignore message/see Section 22.915(d) of the Commission's Rules.

2.6.2.2 PAGE MATCH

The mobile station must monitor mobile station control messages for page messages (see Section 3.7.1.1).

- If the ROAM status is disabled, the mobile station must attempt to match $MIN1_p$ to $MIN1_r$ for one-word messages and both $MIN1_p$ and $MIN2_p$ to $MIN1_r$ and $MIN2_r$, respectively, for two-word messages. All decoded MIN bits must match to cause the mobile station to respond to the message.
- If the ROAM Status is enabled, the mobile station must attempt to match both $MIN1_p$ and $MIN2_p$ to $MIN1_r$ and $MIN2_r$, respectively. All decoded MIN bits must match to cause the mobile station to respond to the order.

When a match occurs, the mobile station must enter the System Access Task with a "page response" indication (see Section 2.6.3).

2.6.2.3 ORDER

The mobile station must monitor mobile station control messages for orders and must attempt to match both $MIN1_p$ and $MIN2_p$ to $MIN1_r$ and $MIN2_r$, respectively. All decoded MIN bits must match to cause the mobile station to respond to the order. The responses to the following orders are:

- Audit order. The mobile station must enter the System Access Task (see Section 2.6.3) with an "order" indication.

- Local control order. The action to be taken depends on the local control field.
- Any other order. Ignore order/see Section 22.915(d) of the Commission's Rules.

2.6.2.4 CALL INITIATION

When the user desires to initiate a call, the System Access Task (see Section 2.6.3) must be entered with an "origination" indication.

2.6.2.5 NON-AUTONOMOUS REGISTRATION INITIATION

If $R_s=1$, the mobile station may initiate a non-autonomous registration by entering the System Access Task (see Section 2.6.3) with a "registration" indication.

2.6.3 SYSTEM ACCESS

2.6.3.1 SET ACCESS PARAMETERS

When the System Access Task is started, a timer, called the access timer, must be set as follows:

- If this is an origination, to a maximum of 12 seconds,
- if this is a page response, to a maximum of 6 seconds,
- if this is an order response, to a maximum of 6 seconds,
- if this is a registration, to a maximum of 6 seconds.

The mobile station must set the last-try code (LT_p) to '0' and then enter the Scan Access Channels Task (see Section 2.6.3.2).

2.6.3.2 SCAN ACCESS CHANNELS

The mobile station must examine the signal strength on each of the channels $FIRSTCHA_n$ to $LASTCHA_n$ and choose up to two channels with the strongest signals. See Response to Overhead Information Task (Section 2.6.2.1) for access channel set determination.

The mobile station must then tune to the strongest access channel and enter the Retrieve Access Attempts Parameters Task (see Section 2.6.3.3).

2.6.3.3 RETRIEVE ACCESS ATTEMPT PARAMETERS

The mobile station must set the maximum-number-of-seizure-attempts allowed ($MAXSZTR_{m}$) to a maximum of 10, and the maximum-number-of-busy-occurrences ($MAXBUSY_{m}$) to a maximum of 10.

The mobile station must then initialize the following to zero:

- Number of busy occurrences ($NBUSY_{m}$)
- Number of unsuccessful seizure attempts ($NSZTR_{m}$)

The mobile station must then examine the read control-filler bit (RCF_p).

- If $RCF_p=0$, the mobile station must then within 400 ms (+100 ms, -0 ms) set DCC_p to the value in the DCC field of a received message and set the power level (PL_p) to 0.
- If $RCF_p=1$, the mobile station must then within 1000 ms (+100 ms, -0 ms) read a control-filler message, set DCC_p and $WFOM_p$ to the values in the DCC and WFOM fields of the message, respectively, and set PL_p to the power level given by Table 2.1.2-1 for the value of the CMAC field of the message and the mobile station power class (see Sections 2.1.2.2, 2.3.3, and

3.7.1.2.4).

If the DCC field or the control-filler message is not received within the time allowed, then the mobile station must examine the access timer. If the access timer has expired, the mobile station must enter the Serving-System Determination Task (see Section 2.6.3.12). If the access timer has not expired, the mobile station must enter the Alternate Access Channel Task (see Section 2.6.3.13).

The mobile station must then set BIS_s to '1' and examine the WFOM_s bit.

- If WFOM_s = 1, the mobile station must enter the Update Overhead Information Task (see Section 2.6.3.4).
- If WFOM_s = 0, the mobile station must wait a random delay. Each time it waits a random delay, a different random delay must be generated with the time uniformly distributed in the interval 0 to 92 ± 1 ms and, if quantized, with granularity no more than 1 ms. The mobile station must then enter the Seize Reverse Control Channel Task (see Section 2.6.3.5).

2.6.3.4 UPDATE OVERHEAD INFORMATION

If this task is not completed within 1.5 seconds, the mobile station must exit this task and enter the Serving-System Determination Task (see Section 2.6.3.12). If the Update Overhead Information Task is completed, the mobile station must enter the Seize Reverse Control Channel Task (see Section 2.6.3.5)

The mobile station must receive an overhead message train (see Section 3.7.1.2) and act as indicated below in response to the following global action messages, if received in the overhead message train:

- Overload Control Message.
 - If this access is an origination, the mobile station must examine the value of the overload class field (OLC) identified by ACCOLC_p. If the identified OLC field is set to '0', the mobile station must exit this task and enter the Serving-System Determination Task (see Section 2.6.3.12); if the identified OLC field is set to '1', the mobile station must continue to respond to messages in the overhead message train.
 - Otherwise, the mobile station must continue to respond to messages in the overhead message train.

- Access Type Parameters Message.

The busy-idle status bit (BIS_s) must be set to the value of the BIS field of the received message.

- Access Attempt Parameters Message.

The mobile station must update the following parameters:

- If this access is a page response,
 - a. Maximum number of seizure tries allowed ($MAXSZTR_{sd}$) must be set to the value of the $MAXSZTR-PGR$ field of the received message.
 - b. Maximum number of busy occurrences allowed ($MAXBUSY_{sd}$) must be set to the value of the $MAXBUSY-PGR$ field of the received message.
- Otherwise,
 - a. Maximum number of seizure tries allowed ($MAXSZTR_{sd}$) must be set to the value of the $MAXSZTR-OTHER$ field of the received message.
 - b. Maximum number of busy occurrences allowed ($MAXBUSY_{sd}$) must be set to the value of the $MAXBUSY-OTHER$ field of the received message.

After the overhead message train is received and processed as required above, the mobile station must wait a random time. Each time this task is executed, a different random delay must be generated, distributed uniformly in the interval 0 to 750 ms, and if quantized, with granularity no greater than 1 ms. At the end of the delay, the mobile station must enter the Seize Reverse Control Channel Task (see Section 2.6.3.5).

2.6.3.5 SEIZE REVERSE CONTROL CHANNEL

The mobile station must read the busy-idle status of the channel.

- If the channel is busy, the mobile station must increment $NBUSY_{sv}$ by 1.
 - If $NBUSY_{sv}$ exceeds $MAXBUSY_{sl}$, then the mobile station must exit this task and enter the Serving-System Determination Task (see Section 2.6.3.12).
 - If $NBUSY_{sv}$ does not exceed $MAXBUSY_{sl}$, then the mobile station must exit this task and the Delay After Failure Task must be executed (see Section 2.6.3.6).
- If the channel is idle, then the mobile station must set $NBUSY_{sv}$ to zero, turn on the transmitter at the power level indicated by PL_1 (see Sections 2.6.3.3 and 2.1.2.2), wait the proper delay (see Section 2.1.2.1) until the transmitter is within 3 dB of the required power level, and then start to send the message to the land station (see Section 2.7.1).

If $BIS_1=0$, then the mobile station must enter the Service Request Task (see Section 2.6.3.7); if $BIS_1=1$, then upon starting to send the message, the mobile station must continuously monitor the busy-idle status of the channel.

- If the channel becomes busy before the first 56 bits of the message are sent, the mobile station must immediately stop sending the message and turn off the transmitter.
- If the channel fails to change to busy by the time the mobile station has sent 104 bits, then the mobile station must immediately stop sending the message and turn off the transmitter.

In either of these cases, the mobile station must then increment the count of seizure failures ($NSZTR_{sv}$) by 1 and compare the result with the maximum number of seizure attempts allowed ($MAXSZTR_{sl}$).

- If $NSZTR_{sv}$ exceeds $MAXSZTR_{sl}$, the mobile station must exit this task and enter the Serving-System Determination Task (see Section 2.6.3.12).
 - If $NSZTR_{sv}$ does not exceed $MAXSZTR_{sl}$, the mobile station must exit this task and enter the Delay After Failure Task (see Section 2.6.3.6).
- If the busy-idle status changes to busy after 56 bits and before 104 bits are sent, then the mobile station must enter the Service Request Task (see Section 2.6.3.7).

2.6.3.6 DELAY AFTER FAILURE

The mobile station must examine the access timer. If the access timer has expired, the mobile station must enter the Serving-System Determination Task (see Section 2.6.3.12). If the access timer has not expired, the mobile station must wait a random time. Each time it enters this task, it must generate a different time, uniformly distributed in the interval 0 to 200 ms, and if quantized, with granularity no greater than 1 ms. The mobile station must then enter the Seize Reverse Control Channel Task (see Section 2.6.3.5).

2.6.3.7 SERVICE REQUEST

The mobile station must continue to send its message to the land station. The information which must be sent is as follows (with the formats given in Section 2.7.1):

- Word A must always be sent.
- If $E_p = 1$, or
 $LT_p = 1$, or
the ROAM status is enabled, or
the ROAM status is disabled and $EX_p = 1$, or
the access is an "order confirmation", or
the access is a "registration", or
the mobile station was paged with a two-word
mobile station control message,
Word B must be sent.
- If $S_p = 1$,
Word C must be sent.
- If the access is an "origination",
Word D must be sent.
- If the access is an "origination" and 9 to 16 digits were dialed,
Word E must be sent.

When the mobile station has sent its complete message, it must continue to send unmodulated carrier for a nominal duration of 25 ms and then turn off the transmitter.

The next task to be entered depends on the type of access by the mobile station:

- If the access is an order confirmation, the mobile station must enter the Serving-System Determination Task (see Section 2.6.3.12).
- If the access is an origination, the mobile station must enter the Await Message Task (see Section 2.6.3.8).
- If the access is a page response, the mobile station must enter the Await Message Task (see Section 2.6.3.8).
- If the access is a registration request, the mobile station must enter the Await Registration Confirmation Task (see Section 2.6.3.9).

2.6.3.8 AWAIT MESSAGE

If this task is not completed within 5 seconds, the mobile station must enter the Serving-System Determination Task (see Section 2.6.3.12).

The mobile station must monitor mobile station control messages (see Section 3.7.1.1). If the mobile station sent Word B as part of the Service Request (see Section 2.6.3.7), then the mobile station must attempt to match $MIN1_p$ and $MIN2_p$ to $MIN1_r$ and $MIN2_r$, respectively; otherwise, the mobile station must attempt to match only $MIN1_p$ to $MIN1_r$.

The mobile station must respond as indicated to any of the following messages if all decoded MIN bits match.

If the access is an origination or page response:

- Initial voice channel designation message: (see Section 3.7.1.1) The mobile station must update the parameters set in the message. If $R_p = 1$ and the mobile station is equipped for autonomous registration, the mobile station must enter the Autonomous Registration Update Task (see Section 2.6.3.11), supplying a "success" indication and then enter the Initial Voice Channel Confirmation Task (see Section 2.6.4.2). Otherwise, the mobile station must enter the Initial Voice Channel Confirmation Task.
- Directed-retry message: (see Section 3.7.1.1). If the mobile station is equipped for directed retry, it must respond to the directed-retry message as follows:

If the mobile station encounters the start of a new message before it receives all four words of the directed-retry message, it must exit this task and enter the **Serving-System Determination Task** (see Section 2.6.3.12).

The mobile station must set the last-try code (LT_s) according to the $ORDQ$ field of the message:

- If $ORDQ = '000'$, set LT_s to '0'.
- If $ORDQ = '001'$, set LT_s to '1'.

The mobile station must then clear $CCLIST_s$, and examine each $CHANPOS$ field in Words 3 and 4 of the message. For each nonzero $CHANPOS$ field, the mobile station must calculate a corresponding channel number according to the following algorithm:

- i. If the serving-system status is enabled, subtract $CHANPOS$ from $FIRSTCHA_s + 1$.
- ii. If the serving-system status is disabled, add $CHANPOS$ to $FIRSTCHA_s - 1$.

The mobile station must then determine whether each channel number is within the set allocated to cellular systems, and if so, list the channel number in $CCLIST_s$.

After completing its response to the directed-retry message, the mobile station must examine the access timer. If the access timer has expired, the mobile station must enter the **Serving-System Determination Task** (see Section 2.6.3.12). If the access timer has not expired, the mobile station must enter the **Directed-Retry Task** (see Section 2.6.3.14).

If the access is an origination:

- **Intercept:** The mobile station must enter the **Serving-System Determination Task** (see Section 2.6.3.12).
- **Reorder:** The mobile station must enter the **Serving-System Determination Task** (see Section 2.6.3.12).

If the access is a page response:

- **Release:** The mobile station must enter the **Serving-System Determination Task** (see Section 2.6.3.12).

If the access is an origination and the user terminates a call during this task, the termination status must be enabled so that the call can be released on a voice channel (see Section 2.6.4.4) instead of on a control channel.

2.6.3.9 AWAIT REGISTRATION CONFIRMATION

If this task is not completed within 5 seconds, the mobile station must exit this task and enter the **Action on Registration Failure Task** (see Section 2.6.3.10).

The mobile station must monitor mobile station control messages (see Section 3.7.1.1). If the mobile station sent Word B as part of the Service Request (see Section 2.6.3.7), then the mobile station must attempt to match $MIN1_p$ and $MIN2_p$ to $MIN1_r$ and $MIN2_r$, respectively; otherwise, the mobile station must attempt to match only $MIN1_p$ to $MIN1_r$.

The mobile station must respond as indicated to any of the following messages if all decoded MIN bits match:

- **Release order** (see Section 3.7.1.1). The mobile station must exit this task and enter the **Action on Registration Failure Task** (see Section 2.6.3.10).
- **Order confirmation** (see Section 3.7.1.1). If the mobile station is equipped for autonomous registration and autonomous registration is enabled, the mobile station must enter the **Autonomous Registration Update Task** (see Section 2.6.3.11), supplying a "success" indication; the mobile station must then enter the **Serving-System Determination Task** (see Section 2.6.3.12). Otherwise,

the mobile station must enter the Serving-System Determination Task (see Section 2.6.3.12).

2.6.3.10 ACTION ON REGISTRATION FAILURE

If the mobile station is equipped for autonomous registration and autonomous registration is enabled, the mobile station must enter the Autonomous Registration Update Task (see Section 2.6.3.11), supplying a "failure" indication; the mobile station must then enter the Serving-System Determination Task (see Section 2.6.3.12). Otherwise, the mobile station must enter the Serving-System Determination Task (see Section 2.6.3.12).

2.6.3.11 AUTONOMOUS REGISTRATION UPDATE

If the first-registration ID status is enabled, return to the invoking task. Otherwise the mobile station must attempt to find SID_p among the $SID_{p \rightarrow}$ values stored in the registration memory and create an entry for SID_p if it is not found. The mobile station must then update the $NXTREG_{p \rightarrow}$ associated with the $SID_{p \rightarrow}$ according to the following:

- If a "success" indication was supplied to the Registration Update Task, the mobile station must update the next registration ID to: $NXTREG_{p \rightarrow} = REGID_p + REGINCR_p$.
- If a "failure" indication was supplied to the Registration Update Task, the mobile station must generate a random number ($NRANDOM_{p \rightarrow}$). Each time this step is executed, a different random number must be generated, uniformly distributed in the interval 0 to 10, and with granularity no more than 1.

The mobile station must then update the next registration ID to:
 $NXTREG_{p \rightarrow} = REGID_p + NRANDOM_{p \rightarrow}$.

The mobile station must then return to the invoking task.

2.6.3.12 SERVING-SYSTEM DETERMINATION

If the serving-system status does not correspond to the preferred system, the mobile station may enter the Retrieve System Parameters Task (see Section 2.6.1.1); otherwise, it must enter the Paging Channel Selection Task (see Section 2.6.1.2).

2.6.3.13 ALTERNATE ACCESS CHANNEL

If the mobile station is tuned to the strongest access channel, it may tune to the second strongest channel and then enter the Retrieve Access Attempt Parameters Task (see Section 2.6.3.3). Otherwise, it must enter the Serving-System Determination Task (see Section 2.6.3.12).

2.6.3.14 DIRECTED RETRY

The mobile station must examine the signal strength on each of the channels listed in $CCLIST_p$ and choose up to two channels with the strongest signals. The mobile station must then tune to the strongest access channel and enter the Retrieve Access Attempt Parameters Task (see Section 2.6.3.3).

2.6.4 MOBILE STATION CONTROL ON THE VOICE CHANNEL

2.6.4.1 LOSS OF RADIO-LINK CONTINUITY

While the mobile station is tuned to a voice channel, it must monitor the fade timing status (see Section 2.4.1.3). If the fade timing status is enabled, a fade timer must be started; each time the fade timing status is disabled, the timer must be reset. If the timer counts to 5 seconds, the mobile station must turn off its transmitter; and enter the Serving-System Determination Task (see Section

2.6.3.12).

2.6.4.2 CONFIRM INITIAL VOICE CHANNEL

Within 100 ms of the receipt of the initial voice channel designation (see Section 3.7.1.1), the mobile station must determine whether the channel number is within the set allocated to cellular systems, and

- If it is within the allocated set, the mobile station must tune to the designated voice channel, turn on the transmitter at the power level indicated by the V_{MAC} field of the initial voice channel message (see Sections 2.1.2.2 and 3.7.1.1), turn on the SAT transponder (see Section 2.4.1), and set the stored SAT Color Code (SCC) to the value of the SCC field of the initial voice channel message (see Section 3.7.1.1).
 - If this is an origination access, the mobile station then must enter the Conversation Task (see Section 2.6.4.4).
 - If this is a page response access, the mobile station then must enter the Waiting for Order Task (see Section 2.6.4.3.1).
- Otherwise, the mobile station must enter the Serving-System Determination Task (see Section 2.6.3.12).

2.6.4.3 ALERTING

2.6.4.3.1 WAITING FOR ORDER

When this task is entered, an order timer must be set to 5 seconds. The following may occur:

- If the order timer expires the mobile station must turn off the transmitter; then the mobile station must enter the Serving-System Determination Task (see Section 2.6.3.12).
- Within 100 ms of the receipt of any of the orders listed below (see Section 3.7.2), the mobile station must compare SCC_i to the present SAT color code (PSCC) field in the received message. If SCC_i ≠ PSCC, the order must be ignored. If SCC_i = PSCC, the action to be taken for each order is as follows:
 - Handoff. Turn on signaling tone for 50 ms, turn off signaling tone, turn off transmitter, adjust power level, tune to new channel, adjust to new SAT, set SCC_i to the value of the SCC field of the message (see Section 2.4.1), turn on transmitter, reset fade timer, remain in the Waiting for Order Task, and reset the order timer to 5 seconds.
 - Alert. Turn on signaling tone, wait 500 ms, and enter the Waiting for Answer Task (see Section 2.6.4.3.2).
 - Release. Enter Release Task (see Section 2.6.4.5).
 - Audit. Send order confirmation message to land station (see Section 2.7.2), remain in the Waiting for Order Task, and reset the order timer to 5 seconds.
 - Maintenance. Turn on signaling tone, wait 500 ms, and enter the Waiting for Answer Task (see Section 2.6.4.3.2).
 - Change power. Adjust the transmitter to the power level indicated by the order qualification code (see Sections 3.7.1.1 and 2.1.2.2) and send order confirmation message to land station (see Section 2.7.2). Remain in the Waiting for Order Task, and reset the order timer to 5 seconds.
 - Local Control. If the local control status is enabled (see Section 2.6.1.2.2) and a local control order is received, the local control field must be examined to determine the action and confirmation to take.

- Any other order. Ignore order/see Section 22.915(d) of the Commission's Rules.

2.6.4.3.2 WAITING FOR ANSWER

When this task is entered, an alert timer must be set to 65 seconds (-0, +20%). The following may occur:

- If the alert timer expires the mobile station must turn off the transmitter; then the mobile station must enter the Serving-System Determination Task (see Section 2.6.3.12).
- If the user answers, signaling tone must be turned off and the Conversation Task (see Section 2.6.4.4) must be entered.
- Within 100 ms of the receipt of any of the orders listed below, the mobile station must compare SCC_i to the PSCC field in the received message. If SCC_i ≠ PSCC, the order must be ignored. If SCC_i = PSCC, the action to be taken for each order is as follows:
 - Handoff. Turn off signaling tone for 500 ms, turn on signaling tone for 50 ms, turn off signaling tone, turn off transmitter, adjust power level, tune to new channel, adjust to new SAT, set SCC_i to the value of the SCC field of the message (see Section 2.4.1), turn on transmitter, reset fade timer, and turn on signaling tone. Then remain in the Waiting for Answer Task.
 - Alert. Remain in the Waiting for Answer Task, and reset the alert timer to 65 seconds.
 - Stop Alert. Turn off signaling tone, and enter the Waiting for Order Task (see Section 2.6.4.3.1).
 - Release. Turn off signaling tone, wait 500 ms, and then enter the Release Task (see Section 2.6.4.5).
 - Audit. Send order confirmation message to land station (see Section 2.7.2) and remain in the Waiting for Answer Task.
 - Maintenance. Remain in the Waiting for Answer Task, and reset the alert timer to 65 seconds.
 - Change power. Adjust the transmitter to the power level indicated by the order qualification code (see Sections 3.7.1.1 and 2.1.2.2) and send order confirmation message to land station (see Section 2.7.2). Remain in the Waiting for Answer Task.
 - Local Control. If the local control status is enabled (see Section 2.6.1.2.2) and a local control order is received, the local control field must be examined to determine the action and confirmation to take.
- Any other order. Ignore order /see Section 22.915(d) of the Commission's Rules.

2.6.4.4 CONVERSATION

When this task is entered, a release-delay timer must be set to 500 ms. If the termination status is enabled (see Section 2.6.3.8), the mobile station must set the termination status to disabled, wait 500 ms and then enter the Release Task (see Section 2.6.4.5).

The following may occur:

- If the user terminates the call, the release-delay timer must be examined. If the timer has expired, the Release Task must be entered (see Section 2.6.4.5). If the timer has not expired, the mobile station must wait until the timer expires and then enter the Release Task.
- If the user requests a flash, a flash must be processed by turning on signaling tone for 400 ms. If a valid order (one which is not ignored) is received while processing a flash, the flash must be terminated immediately and the order must be processed. Flashes so terminated are not

considered valid.

- Within 100 ms of the receipt of any of the orders listed below, the mobile station must compare SCC₁ to the PSCC field in the received message. If SCC₁ ≠ PSCC, the order must be ignored. If SCC₁ = PSCC, the action to be taken for each order is as follows:
 - Handoff. Turn on signaling tone for 50 ms, turn off signaling tone, turn off transmitter, adjust power level, tune to new channel, adjust to new SAT, set SCC₁ to the value of the SCC field of the message (see Section 2.4.1), turn on transmitter, reset fade timer, and remain in the Conversation Task.
 - Send Called-Address.
 - If received within 10 seconds of the completion of the last valid flash, send the called-address to the land station (see Section 2.7.2) and remain in the Conversation Task.
 - Otherwise, ignore the order and remain in the Conversation Task.
 - Alert. Turn on signaling tone, wait 500 ms, and then enter the Waiting for Answer Task (see Section 2.6.4.3.2).
 - Release. Examine the release-delay timer. If the timer has expired, the mobile station must enter the Release Task (see Section 2.6.4.5). If the timer has not expired, the mobile station must wait until the timer expires and then enter the Release Task.
 - Audit. Send order confirmation message to land station (see Section 2.7.2) and remain in the Conversation Task.
 - Maintenance. Turn on signaling tone, wait 500 ms, and then enter the Waiting for Answer Task (see Section 2.6.4.3.2).
 - Change power. Adjust the transmitter to the power level indicated by the order qualification code (see Sections 3.7.1.1 and 2.1.2.2) and send order confirmation message to land station (see Section 2.7.2). Remain in the Conversation Task.
 - Local Control. If the local control status is enabled (see Section 2.6.1.2.2) and a local control order is received, the local control field must be examined to determine the action and confirmation to take.
 - Any other order. Ignore order/see Section 22.915(d) of the Commission's Rules.

2.6.4.5 RELEASE

The following must be performed:

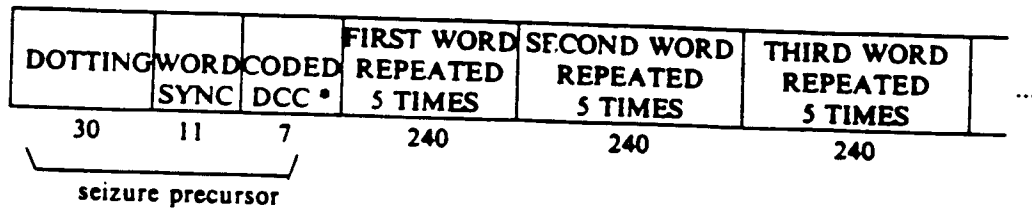
- Send signaling tone for 1.8 seconds. If a flash (see Section 2.6.4.4) was being sent when this task was entered, signaling tone must continue to be sent and the timing bridged so that no more than 1.8 seconds of signaling tone is sent.
- Stop sending signaling tone.
- Turn off the transmitter.

The mobile station must then enter the Serving-System Determination Task (see Section 2.6.3.12).

2.7 SIGNALING FORMATS

2.7.1 REVERSE CONTROL CHANNEL

The reverse control channel (RECC) is a wideband data stream sent from the mobile station to the land station. This data stream must be generated at a 10 kilobit/second \pm 1 bit/second rate. Figure 2.7.1-1 depicts the format of the RECC data stream.



DOTTING = 1010...101
WORD SYNC = 11100010010

* DIGITAL COLOR CODE - CODED PER TABLE 2.7.1-1.

REVERSE CONTROL CHANNEL MESSAGE STREAM (Mobile-to-Land)
Figure 2.7.1-1.

Table 2.7.1-1

CODED DIGITAL COLOR CODE

Received DCC	7-Bit Coded DCC
00	0000000
01	0011111
10	1100011
11	1111100

All messages begin with the RECC seizure precursor which is composed of a 30-bit dotting sequence (1010...101), an 11-bit word sync sequence (11100010010), and the coded digital color code (DCC). The 7-bit coded DCC is obtained by translating the received DCC according to Table 2.7.1-1.

Each word contains 48 bits, including parity, and is repeated five times; it is then referred to as a word block. A word is formed by encoding 36 content bits into a (48, 36) BCH code that has a distance of 5, (48 36; 5). The left-most bit (i.e., earliest in time) shall be designated the most-significant bit. The 36 most-significant bits of the 48-bit field shall be the content bits.

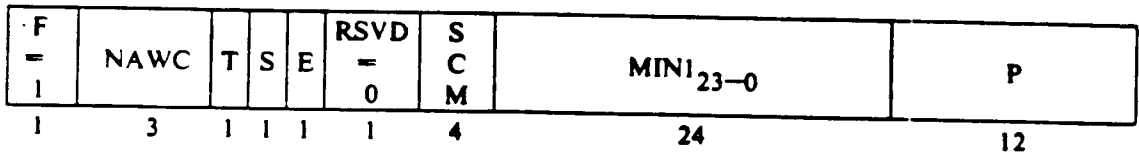
The generator polynomial for the code is the same as for the (40,28;5) code used on the forward control channel (see Section 3.7.1).

Each RECC message can consist of one to five words. The types of messages to be transmitted over the reverse control channel are:

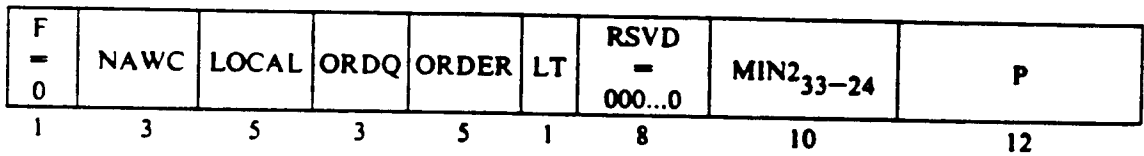
- Page Response Message
- Origination Message
- Order Confirmation Message
- Order Message

These messages are made up of combinations of the following five words:

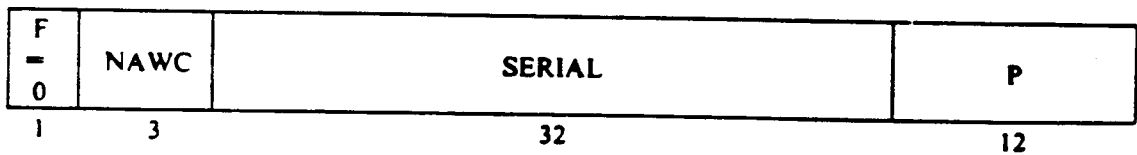
Word A - Abbreviated Address Word



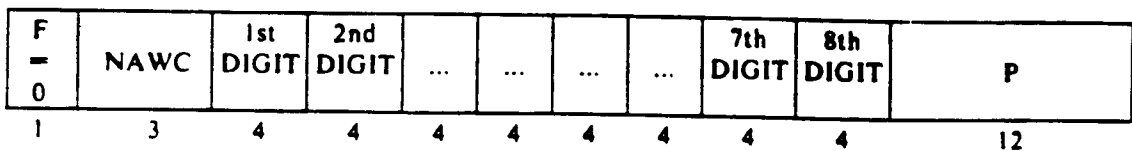
Word B - Extended Address Word



Word C - Serial Number Word



Word D - First Word of the Called-Address



Word E - Second Word of the Called-Address

F	NAWC	9th	10th					15th	16th	
-	-	DIGIT	DIGIT	...	...	...	...	DIGIT	DIGIT	P
0	000									
1	3	4	4	4	4	4	4	4	4	12

The interpretation of the data fields is as follows:

- F** - First word indication field. Set to '1' in first word and '0' in subsequent words.
- NAWC** - Number of additional words coming field.
- T** - T field. Set to '1' to identify the message as an origination or an order; set to '0' to identify the message as an order response or page response.
- S** - Send serial number field. If the serial number word is sent, set to '1'; if the serial number word is not sent, set to '0'.
- E** - Extended address field. If the extended address word is sent, set to '1'; if the extended address word is not sent, set to '0'.
- SCM** - The station class mark field (see Section 2.3.3).
- ORDER** - Order field. Identifies the order type (See Table 3.7.1-1).
- ORDQ** - Order qualifier field. Qualifies the order confirmation to a specific action (See Table 3.7.1-1).
- LOCAL** - Local control field. This field is specific to each system. The **ORDER** field must be set to local control (see Table 3.7.1-1) for this field to be interpreted.
- LT** - Last-try code field (see Section 2.6.3.8).
- MIN1** - First part of the mobile identification number field (see Section 2.3.1).
- MIN2** - Second part of the mobile identification number field (see Section 2.3.1).
- SERIAL** - Serial number field. Identifies the serial number of the mobile station (see Section 2.3.2).
- DIGIT** - Digit field (see Table 2.7.1-2).
- RSVD** - Reserved for future use; all bits must be set as indicated.
- P** - Parity field.

Examples of encoding called-address information into the called-address words are given below:

I. If the number 2# is entered, the word is:

NOTE	0010	1100	0000	0000	0000	0000	0000	0000	P
4	4	4	4	4	4	4	4	4	12

II. If the number 13792640 is entered, the word is:

NOTE	0001	0011	0111	1001	0010	0110	0100	1010	P
4	4	4	4	4	4	4	4	4	12

III. If the number *24273258 is entered, the words are:

Word D - First Word of the Called-Address

NOTE	1011	0010	0100	0010	0111	0011	0010	0101	P
4	4	4	4	4	4	4	4	4	12

Word E - Second Word of the Called-Address

NOTE	1000	0000	0000	0000	0000	0000	0000	0000	P
4	4	4	4	4	4	4	4	4	12

NOTE: These four bits depend on the type of message.

Table 2.7.1-2

DIGIT CODE

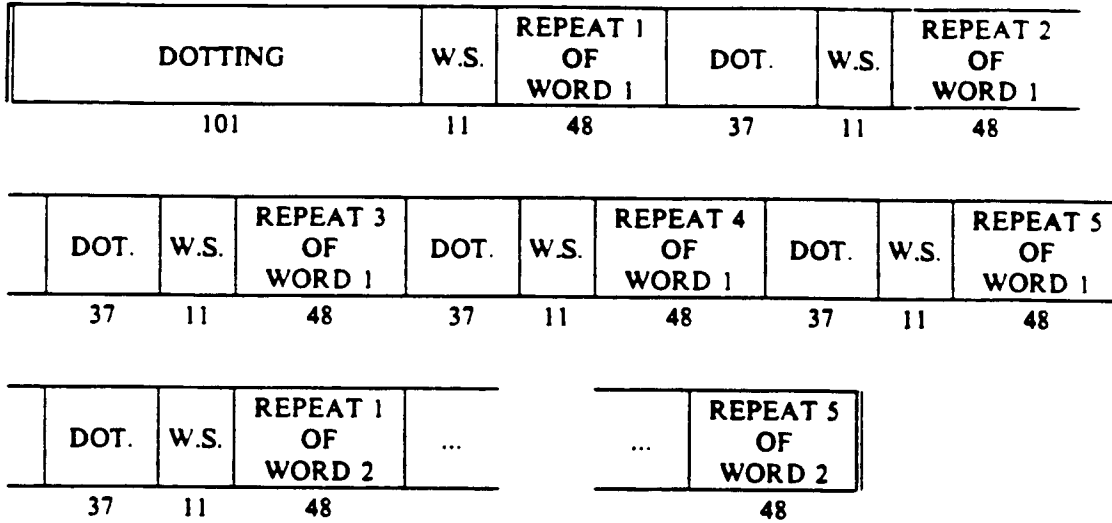
Digit	Code	Digit	Code
1	0001	7	0111
2	0010	8	1000
3	0011	9	1001
4	0100	0	1010
5	0101	*	1011
6	0110	#	1100
		Null	0000

NOTE:

- 1) The digit 0 is encoded as binary "ten"; not binary "zero."
- 2) The code 0000 is the null code, indicating no digit present.
- 3) All other four-bit sequences are reserved, and must not be transmitted.

2.7.2 REVERSE VOICE CHANNEL

The reverse voice channel (RVC) is a wideband data stream sent from the mobile station to the land station. This data stream must be generated at a 10 kilobit/second \pm 1 bit/second rate. Figure 2.7.2-1 depicts the format of the RVC data stream.



DOTTING = 1010...101

W.S. = 11100010010

REVERSE VOICE CHANNEL MESSAGE STREAM (Mobile-to-Land)

Figure 2.7.2-1.

A 37-bit dotting sequence (1010...101) and an 11-bit word sync sequence (11100010010) are sent to permit land stations to achieve synchronization with the incoming data, except at the first repeat of word 1 of the message where a 101-bit dotting sequence is used. Each word contains 48 bits, including parity, and is repeated five times together with the 37-bit dotting and 11-bit word sync sequences; it is then referred to as a word block. For a multi-word message, the second word block is formed the same as the first word block including the 37-bit dotting and 11-bit word sync sequences. A word is formed by encoding the 36 content bits into a (48, 36) BCH code that has a distance of 5, (48, 36; 5). The left-most bit (i.e., earliest in time) shall be designated the most-significant bit. The 36 most-significant bits of the 48-bit field shall be the content bits. The generator polynomial for the code is the same as for the (40,28;5) code used on the forward control channel (see Section 3.7.1).

Each RVC message can consist of one or two words. The types of messages to be transmitted over the reverse voice channel are:

- Order Confirmation Message
- Called-Address Message.

The message formats are as follows:

Order Confirmation Message

F	NAWC	T	LOCAL	ORDQ	ORDER	RSVD	P
=	=	=				=	
1	00	1				000...0	
1	2	1	5	3	5	19	12

Called-Address Message

Word 1 - First Word of the Called-Address

F	NAWC	T	1st DIGIT	2nd DIGIT	...	...	...	...	7th DIGIT	8th DIGIT	P
=	=	=									
1	01	0									
1	2	1	4	4	4	4	4	4	4	4	12

Word 2 - Second Word of the Called-Address

F	NAWC	T	9th DIGIT	10th DIGIT	...	...	...	...	15th DIGIT	16th DIGIT	P
=	=	=									
0	00	0									
1	2	1	4	4	4	4	4	4	4	4	12

The interpretation of the data fields is as follows:

- F - First word indication field. Set to '1' in first word and '0' in second word.
- NAWC - Number of additional words coming field.
- T - T field. Set to '1' to identify the message as an order confirmation. Set to '0' to identify the message as a called-address.
- DIGIT - Digit field (see Table 2.7.1-2).
- ORDER - Order field. Identifies the order type (see Table 3.7.1-1).
- ORDQ - Order qualifier field. Qualifies the order confirmation to a specific action (See Table 3.7.1-1).
- LOCAL - Local Control field. This field is specific to each system. The ORDER field must be set to local control (see Table 3.7.1-1) for this field to be interpreted.
- RSVD - Reserved for future use; all bits must be set as indicated.
- P - Parity field.

3. LAND STATION

3.1 TRANSMITTER

3.1.1 FREQUENCY PARAMETERS

3.1.1.1 CHANNEL SPACING AND DESIGNATION

The land station transmit channel at 870.030 MHz (and the corresponding mobile station transmit channel at 825.030 MHz) shall be termed channel number 1. See Section 22.902 of the Commission's Rules.

3.1.1.2 FREQUENCY TOLERANCE

See Section 22.101(a) of the Commission's Rules.

3.1.2 POWER OUTPUT CHARACTERISTICS

Maximum effective radiated power (ERP) and antenna height above average terrain (HAAT) must be coordinated locally on an ongoing basis. See Sections 22.107(b) and 22.904 of the Commission's Rules.

3.1.3 MODULATION CHARACTERISTICS

3.1.3.1 VOICE SIGNALS

The (FM) modulator is preceded by the following four voice-processing stages (in the order listed):

- Compressor
- Pre-Emphasis
- Deviation Limiter
- Post Deviation-Limiter Filter (See Section 22.907(a) of the Commission's Rules.)

3.1.3.1.1 COMPRESSOR

This stage must include the compressor portion of a 2:1 syllabic compandor. For every 2 dB change in input level to a 2:1 compressor within its operating range, the change in output level is a nominal 1 dB. The compressor must have a nominal attack time of 3 ms and a nominal recovery time of 13.5 ms as defined by the CCITT. (Reference: Recommendation G162, CCITT Plenary Assembly, Geneva, May-June 1964, Blue Book, Vol. 111, P. 52.)

The nominal reference input level to the compressor is that corresponding to a 1000 Hz acoustic tone at the expected nominal speech volume level. This level must produce a nominal ± 2.9 kHz peak frequency deviation of the transmitted carrier.

3.1.3.1.2 PRE-EMPHASIS

The pre-emphasis characteristic must have a nominal +6 dB/octave response between 300 and 3000 Hz.

3.1.3.1.3 DEVIATION LIMITER

For audio (voice) inputs applied to the transmitter voice-signal processing stages, a land station must limit the instantaneous frequency deviation to ± 12 kHz. This requirement excludes supervision signals (see Section 3.4) and wideband data signals (see Section 3.1.3.2). See Section 22.906 of the Commission's Rules.

3.1.3.1.4 POST DEVIATION-LIMITER FILTER

See Section 22.907(a)(2) of the Commission's Rules.

3.1.3.2 WIDEBAND DATA SIGNALS

3.1.3.2.1 ENCODING

The forward control channel (FOCC) and forward voice channel (FVC) wideband data streams (see Section 3.7) must be further encoded such that each nonreturn-to-zero binary one is transformed to a zero-to-one transition, and each nonreturn-to-zero binary zero is transformed to a one-to-zero transition.

3.1.3.2.2 MODULATION AND POLARITY

The filtered wideband data stream must then be used to modulate the transmitter carrier using direct binary frequency shift keying. A one (i.e., high state) into the modulator must correspond to a nominal peak frequency deviation 8 kHz above the carrier frequency, and a zero into the modulator must correspond to a nominal peak frequency deviation 8 kHz below the carrier frequency. See Section 22.906 of the Commission's Rules.

3.1.4 LIMITATIONS ON EMISSIONS

Radiated products from co-located transmitters shall not exceed spurious and harmonic level requirements which would apply to any of the transmitters operated singly.

See Section 22.907 of the Commission's Rules.

3.2 RECEIVER

3.2.1 FREQUENCY PARAMETERS

3.2.1.1 CHANNEL SPACING AND DESIGNATION

The land station receive channel at 825.030 MHz (and the corresponding mobile station receive channel at 870.030 MHz) shall be termed channel number 1. See Section 22.902 of the Commission's Rules.

3.2.2 DEMODULATION CHARACTERISTICS

3.2.2.1 VOICE SIGNALS

The demodulator is followed by the following two voice-signal processing stages:

- De-Emphasis
- Expander

3.2.2.1.1 DE-EMPHASIS

The de-emphasis characteristic must have a nominal -6 dB per octave response between 300 and 3000 Hz.

3.2.2.1.2 EXPANDOR

This stage must include the expander portion of a 2:1 syllabic compandor. For every 1 dB change in input level to a 1:2 expander, the change in output level is a nominal 2 dB. The signal expansion must follow all other demodulation signal processing (including the 6 dB/octave de-emphasis and filtering). The expander must have a nominal attack time of 3 ms and a nominal recovery time of 13.5 ms as defined by the CCITT. (Reference: Recommendation G162, CCITT Plenary Assembly, Geneva, May-June 1964, Blue Book, Vol. 111, P. 52.)

The nominal reference input level to the expander is that corresponding to a 1000 Hz tone from a carrier with a ± 2.9 kHz peak frequency deviation.

3.2.3 LIMITATIONS ON EMISSIONS

See Subpart C, Part 15 of the Commission's Rules.

3.2.4 OTHER RECEIVER PARAMETERS

System performance is predicated upon receivers meeting EIA minimum performance standard PN 1377 (Recommended Standards for 800 MHz Cellular Land Stations).

3.3 SECURITY AND IDENTIFICATION

(reserved).

3.4 SUPERVISION

3.4.1 SUPERVISORY AUDIO TONE

3.4.1.1 SAT DETECTION

(reserved).

3.4.1.2 SAT TRANSMISSION

Whenever a land station transmitter is active on a voice channel, one of the following tones must be modulated on the carrier with a frequency deviation of ± 2 kHz ± 10 percent:

- 5970 Hz.
- 6000 Hz.
- 6030 Hz.

The frequency tolerance of the tone must be ± 1 Hz. See Section 22.906(b) of the Commission's Rules.

3.4.1.3 FADE TIMING STATUS

(reserved).

3.4.2 SIGNALING TONE DETECTION

(reserved).

3.5 MALFUNCTION DETECTION

(reserved).

3.6 CALL PROCESSING

The following sections describe the land station operation to control the mobile station. Frequent references are made to the corresponding sections in the mobile section and to the messages that flow between the land station and the mobile station. It is helpful to read sections 2.6 and 3.6 in parallel and examine the message formats in sections 2.7 and 3.7 at the same time.

3.6.1 OVERHEAD FUNCTIONS FOR MOBILE STATION INITIATION

To control mobile stations executing the Initialization Task (see Section 2.6.1), the following information must be sent in the overhead message train (see Section 3.7.1.2 for the formats of the messages):

- First part of the system identification (SID1).
- Number of paging channels (N).

3.6.2 MOBILE STATION CONTROL ON THE CONTROL CHANNEL

3.6.2.1 OVERHEAD INFORMATION

To control mobile stations monitoring a control channel, the following overhead information must be sent in the system parameter overhead message (see Section 3.7.1.2 for the message formats):

- First part of the system identification (SID1).
- Serial number (S). To require that all mobile stations send their serial numbers during a system access, the S field must be set to '1'; otherwise it must be set to '0'.
- Registration (REGH, REGR). To enable registration for home mobile stations, the REGH field must be set to '1'; otherwise it must be set to '0'. To enable registration for roaming mobile stations, The REGR field must be set to '1'; otherwise it must be set to '0'. If registration is enabled, the land station must support both autonomous and non-autonomous registration by mobile stations.
- Extended Address (E). To require that all mobile stations send both MIN1 and MIN2 during a system access, the E field must be set to '1'; otherwise it must be set to '0'.
- Discontinuous transmission (DTX). To permit mobile stations to use the discontinuous transmission mode on the voice channel, the DTX field must be set to '1'; otherwise it must be set to '0'.
- Number of paging channels (N).
- Read control-filler message (RCF). To require that all mobile stations read a control-filler message before accessing a system on a reverse control channel, the RCF field must be set to '1'; otherwise it must be set to '0'.
- Combined paging/access (CPA). If the access functions are combined with the paging functions on the same set of control channels, the CPA field must be set to '1'. If the access functions are not on the same set of channels as the paging functions, the CPA field must be set to '0'.

- Number of access channels (CMAX).

The following overhead information is sent as required in messages appended to a system parameter overhead message (see Section 3.7.1.2 for messages formats):

- Local control. A system may customize operation for home mobile stations and for those roaming mobile stations whose home systems are members of a group by sending local control global action messages.
- New Access channels. If the access channel set is not the default set (see Section 2.6.2.1), the new access channel global action message must be sent with the NEWACC field set to the first access channel.
- Registration increment. Each time a mobile station with autonomous registration enabled registers, it increments its next registration ID by a fixed value (REGINCR_i; see Section 2.6.3.11). To change this value, the registration increment global action message must be sent with the REGINCR field appropriately set.
- Registration ID. The registration ID message must be sent in order to require that all mobile stations with autonomous registration enabled and with a given or lower next registration ID (NXTREG_{i-p}) register.
- Rescan. To require that all mobile stations enter the Initialization Task and scan the dedicated control channels, the rescan global action message must be sent.

3.6.2.2 PAGE

To page a mobile station, a mobile station control message must be sent (see Section 3.7.1.1). Home mobile stations may be paged with a one-word or a two-word message. Roaming mobile stations must be paged with a two-word message.

3.6.2.3 ORDER

Orders must be sent to mobile stations with a two-word mobile station control message (See Section 3.7.1.2). The following orders may be transmitted:

- Audit.
- Local control.

3.6.2.4 LOCAL CONTROL

A cellular system may customize operation for home mobile stations, and for those roaming mobile stations whose home systems are members of a group, by sending local orders with the order field set to local control (which informs the mobile station to examine the local control field), and by sending one or both of two local control global action overhead messages (see Sections 3.7.1.1, 3.7.1.2.2 and 3.7.2).

A group of systems is formed by participating systems agreeing to a common set of local control protocols and by using system identifications (SID) that have identical group identifications.

3.6.3 LAND STATION SUPPORT OF SYSTEM ACCESS BY MOBILE STATIONS

3.6.3.1 OVERHEAD INFORMATION

The following information must be sent on a forward control channel to support system access by mobile stations (see Section 3.7.1.2 for message formats):

- Digital color code (DCC). The DCC is transmitted from the land station to the mobile station. The mobile station then uses the DCC to identify to the land station which land station transmitter the mobile station is receiving.
- Control mobile attenuation code (CMAC). The CMAC must be transmitted from the land station to the mobile station in the control-filler message if the mobile station must adjust

its transmitter power level before accessing a system on a reverse control channel. The translation of the CMAC field to transmitter power level depends on the mobile station's power class as indicated by its station class mark (SCM_p) (see Sections 2.1.2.2 and 2.3.3). When not required, the CMAC field must be set to '000'. To require that mobile stations read a control-filler message prior to system access, the RCF field must be set to '1' in the system parameter overhead message.

- Wait-for-overhead-message (WFOM). If the mobile station must wait for an overhead message train before accessing a system on a reverse control channel, then the WFOM field must be set to '1' in the control-filler message; otherwise it must be set to '0'.
- Overload control (OLC). If the mobile stations assigned to one or more of the 16 overload classes must not access the system for originations on the reverse control channel, the overload control global action message must be appended to a system parameter overhead message. When this message is appended, the overload class fields corresponding to the restricted overload classes must be set to '0', and the remaining overload class fields must be set to '1'.
- Access type parameters. If a mobile station must not check for an idle-to-busy status transition on the reverse control channel when accessing a system, then the access type parameters global action message with the BIS field set to '0' must be appended to a system parameter overhead message; otherwise the BIS field must be set to '1' whenever the message is appended.
- Access attempt parameters. If the default values for the number of seizure attempts and/or the limit on the number of busy occurrences for mobile stations accessing the reverse control channel must not be used, then the access attempt parameters global action message must be appended to a system parameter overhead message.

3.6.3.2 REVERSE CONTROL CHANNEL SEIZURE BY A MOBILE STATION

If mobile stations must check for an idle-to-busy status transition on a reverse control channel when accessing a system (i.e., the BIS field is set to '1'), then whenever the land station receives a seizure precursor (see Section 2.7.1) which matches its encoded form of the digital color code with 1 or no bit errors, it must set the status of the busy-idle bits on the forward control channel to busy within 1.2 ms. of receipt of the last bit of the seizure precursor. The busy-idle bits must remain busy until the minimum of:

- 30 ms after the last bit of the last word of the message has been received, or,
- 175 ms. has elapsed.

3.6.3.3 RESPONSE TO MOBILE STATION MESSAGES

Whenever the mobile station sends a message to the land station, it is not required that the land station respond to the message. During periods of overload and/or high usage, it may be desirable to permit mobile stations to "time-out" rather than sending release or other orders which use system capacity.

The following responses to mobile station messages may be sent:

- Origination message. Send one of the following orders:
 - initial voice channel designation,
 - directed retry,
 - intercept,
 - reorder.

- **Page response message.** Send one of the following orders:
 - initial voice channel designation,
 - directed retry,
 - release.
- **Order message.** Send one of the following orders:
 - order confirmation,
 - release.
- **Order confirmation message.** No message is sent.

3.6.4 MOBILE STATION CONTROL ON VOICE CHANNEL

Whenever the mobile station is transmitting on a voice channel, changes in the status of the supervisory audio tone (SAT) and signaling tone (ST) are used to signal the occurrence of certain events during the progress of a call. These events include confirming orders, sending a release request, sending a flash request, and loss of radio-link continuity. The mobile station will signal these events by changing the status of the SAT and ST, abbreviated (SAT,ST), in a prescribed manner (see Section 2.6.4). These status changes must be detected by the land station and interpreted within the context of the task the land station is in as a message which identifies the event signaled by the mobile station. Requirements concerning these land station actions are described below. In the following sections, the (0,1) status shall always be treated as the (0,0) status.

In addition to the analog signaling to and from the mobile station, digital messages can be sent to the mobile station and received from the mobile station. The response to a digital message sent to the mobile station will be either be a digital message or a status change of SAT and ST.

3.6.4.1 LOSS OF RADIO-LINK CONTINUITY

(reserved).

3.6.4.2 INITIAL VOICE CHANNEL CONFIRMATION

Confirmation that a mobile station has successfully tuned to its initial designated voice channel will be received by the land station as a change in the SAT, ST status from (0,0) to (1,0).

If the confirmation is not received, the land station must either resend the message or turn off the voice channel transmitter.

Following confirmation, if the mobile station was paged, the land station must enter the Waiting for Order Task (see Section 3.6.4.3.1); otherwise, the land station must enter the Conversation Task (see Section 3.6.4.4).

3.6.4.3 ALERTING

3.6.4.3.1 WAITING FOR ORDER

When the mobile station confirms the initial voice channel designation after having been paged, it enters this task. The following orders can be sent to mobile station, with the resultant confirmation and action to be taken as follows:

- **Handoff.** The mobile station confirms the order by a change in the SAT, ST status from (1,0) to (1,1), with the (1,1) status held for 50 ms. The land station must remain in the Waiting for Order Task.
- **Alert.** The mobile station confirms the order by a change in the SAT, ST status from (1,0) to (1,1). The land station must then enter the Waiting for Answer Task (see Section

3.6.4.3.2).

- **Release.** The mobile station confirms the order by a change of the SAT, ST status from (1,0) to (1,1), with the (1,1) status held for 1.8 seconds. The land station must then turn off the transmitter.
- **Audit.** The mobile station confirms the order by a digital message (see Section 2.7.2). The land station must remain in the **Waiting for Order Task**.
- **Maintenance.** The mobile station confirms the order by a change in the SAT, ST status from (1,0) to (1,1). The land station must then enter the **Waiting for Answer Task** (see Section 3.6.4.3.2).
- **Change power.** The mobile station confirms the order by a digital message (see Section 2.7.2). The land station must remain in the **Waiting for Order Task**.
- **Local control.** The confirmation and action depend on the message.

3.6.4.3.2 WAITING FOR ANSWER

When this task is entered, an alert timer must be set to 30 seconds. The following orders can be sent with the confirmation and action to be taken as follows:

- **Handoff.** The mobile station confirms the order by changing the SAT, ST status from (1,1) to (1,0) for 500 ms followed by a change in the status from (1,0) to (1,1), with the (1,1) status held for 50 ms on the old channel. Then a (1,1) status is sent on the new channel. The land station must remain in the **Waiting for Answer Task**.
- **Alert.** No confirmation is received. The land station must reset the alert timer to 30 seconds, and remain in the **Waiting for Answer Task**.
- **Stop alert.** The mobile station confirms the order by a change in the SAT, ST status from (1,1) to (1,0). The land station must then enter the **Waiting for Order Task**.
- **Release.** The mobile station confirms the order by a change in the SAT, ST status from (1,1) to (1,0) for 500 ms followed by a change in the status from (1,0) to (1,1), with the (1,1) status held for 1.8 seconds. The land station must then turn off the transmitter.
- **Audit.** The mobile station confirms the order by a digital message (see Section 2.7.2). The land station must remain in the **Waiting for Answer Task**.
- **Maintenance.** No confirmation is received. The land station must reset the alert timer to 30 seconds and remain in the **Waiting for Answer Task**.
- **Change power.** The mobile station confirms the order by a digital message (see Section 2.7.2). The land station must remain in the **Waiting for Answer Task**.
- **Local control.** The confirmation and action depend on the message.

The mobile station signals an answer by a change in the SAT, ST status from (1,1) to (1,0). The land station must then enter the **Conversation Task** (see Section 3.6.4.4).

3.6.4.4 CONVERSATION

While the land station is in the **Conversation Task**, the following orders can be sent to the mobile station, with confirmation and action to be taken as follows:

- **Handoff.** The mobile station confirms the order by a change in the SAT, ST status from (1,0) to (1,1), with the (1,1) status held for 50 ms. The land station must remain in the **Conversation Task**.
- **Send called address.** The mobile station confirms the order by a digital message with the called-address information (see Section 2.7.2). The action to be taken will depend on the called-address information.

- **Alert.** The mobile station confirms the order by a change in the SAT, ST status from (1,0) to (1,1). The land station must then enter the **Waiting for Answer Task** (see Section 3.6.4.3.2).
- **Release.** The mobile station confirms the order by a change in the SAT, ST status from (1,0) to (1,1), with the (1,1) status held for 1.8 seconds. The land station must turn off the transmitter.
- **Audit.** The mobile station confirms the order by a digital message (see Section 2.7.2). The land station must remain in the **Conversation Task**.
- **Maintenance.** The mobile station confirms the order by a change in the SAT, ST status from (1,0) to (1,1). The land station must then enter the **Waiting for Answer Task** (see Section 3.6.4.3.2).
- **Change power.** The mobile station confirms the order by a digital message (see Section 2.7.2). The land station must remain in the **Conversation Task**.
- **Local control.** The confirmation and action depend on the message.

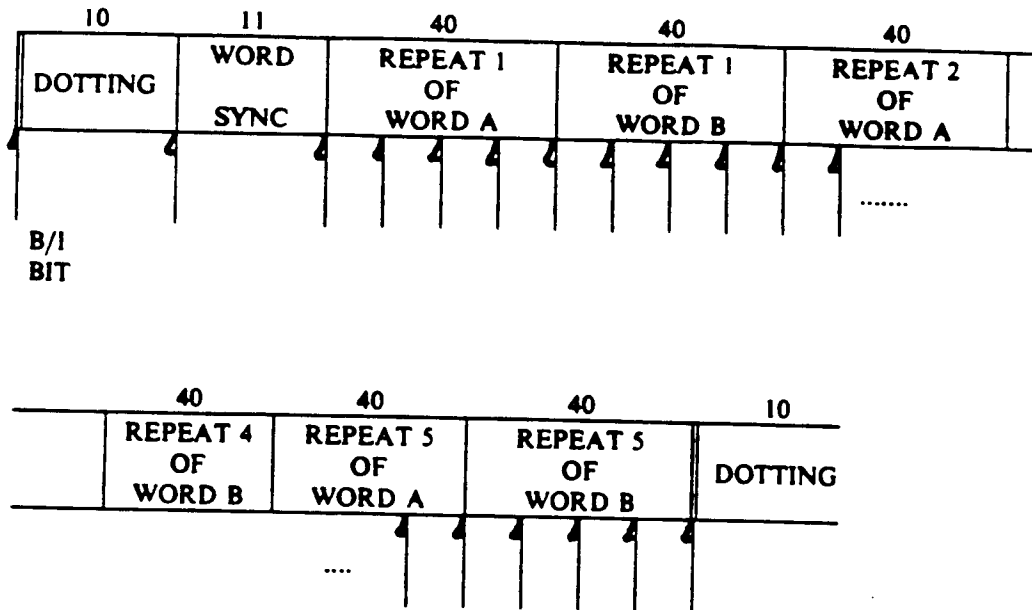
In addition, the following messages can be received autonomously from the mobile station:

- **Flash request.** The mobile station signals a flash by a change in the SAT, ST status from (1,0) to (1,1), with the (1,1) status held for 400 ms followed by a transition to the (1,0) status.
- **Release.** The mobile station signals a release by a change in the SAT, ST status from (1,0) to (1,1) with the (1,1) status held for 1.8 seconds. The land station must turn off the transmitter.

3.7 SIGNALING FORMATS

3.7.1 FORWARD CONTROL CHANNEL

The forward control channel (FOCC) is a continuous wideband data stream sent from the land station to the mobile station. This data stream must be generated at a 10 kilobit/second ± 0.1 bit/second rate. Figure 3.7.1-1 depicts the format of the FOCC data stream.



DOTTING = 1010...101
 WORD SYNC = 11100010010

NOTE:

- 1) A GIVEN MOBILE READS ONLY ONE OF THE TWO INTERLEAVED MESSAGES.
- 2) BUSY-IDLE BITS ARE INSERTED AT EACH ARROW.

FORWARD CONTROL CHANNEL MESSAGE STREAM (Land-to-Mobile)
 Figure 3.7.1-1.

Each forward control channel consists of three discrete information streams, called stream A, stream B, and busy-idle stream, that are time-multiplexed together. Messages to mobile stations with the least significant bit of their mobile identification number (see Section 2.3.1) equal to '0' are sent on stream A, and those with the least-significant bit of their mobile identification number equal to '1' are sent on stream B.

The busy-idle stream contains busy-idle bits, which are used to indicate the current status of the reverse control channel. The reverse control channel is busy if the busy-idle bit is equal to '0' and idle if the busy-idle bit is equal to '1'. A busy-idle bit is located at the beginning of each dotting sequence, at the beginning of each word sync sequence, at the beginning of the first repeat of word A, and after every 10 message bits thereafter.

A 10-bit dotting sequence (1010101010) and an 11-bit word sync sequence (11100010010) are sent to permit mobile stations to achieve synchronization with the incoming data. Each word contains 40 bits, including parity, and is repeated five times; it is then referred to as a word block. For a multi-word message, the second word block and subsequent word blocks are formed the same as the first word block including the 10-bit dotting and 11-bit word sync sequences. A word is formed by encoding 28 content bits into a (40, 28; 5)* BCH code. The left-most bit (i.e., earliest in time) shall be designated the most-significant bit. The generator polynomial for the (40, 28; 5) BCH code is

$$g_B(x) = X^{12} + X^{10} + X^8 + X^5 + X^4 + X^3 + X^0.$$

The code, a shortened version of the primitive (63, 51; 5) BCH code, is a systematic linear block code with the leading bit as the most significant information bit and the least-significant bit as the last parity-check bit.

Each FOCC message can consist of one or more words. The types of messages to be transmitted over the forward control channel are:

- Mobile station control message
- Overhead message
- Control-Filler message

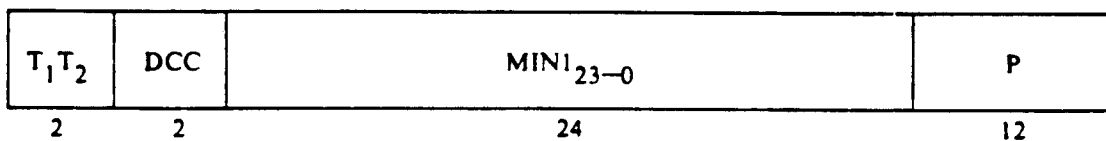
Control-filler messages may be inserted between messages and between word blocks of a multi-word message.

The following sections contain descriptions of the message formats that the land station transmits over either stream A or B. For purposes of format presentation and explanation, the busy-idle bits have been deleted in the discussion of the message formats.

3.7.1.1 MOBILE STATION CONTROL MESSAGE

The mobile station control message can consist of one, two, or four words.

Word 1 - Abbreviated Address Word



* 40 total bits, 28 information bits, distance 5

Word 2 - Extended Address Word

2	2	10	1	5	3	5	12
$T_1 T_2$ =	SCC= 11	MIN ₂₃₃₋₂₄	RSVD =0	LOCAL	ORDQ	ORDER	P
10	SCC≠ 11		VMAC	CHAN			
2	2	10	3	11			12

Word 3 - First Directed-Retry Word

$T_1 T_2$ =	SCC =	CHANPOS	CHANPOS	CHANPOS	RSVD =	P
10	11				000	
2	2	7	7	7	3	12

Word 4 - Second Directed-Retry Word

$T_1 T_2$ =	SCC =	CHANPOS	CHANPOS	CHANPOS	RSVD =	P
10	11				000	
2	2	7	7	7	3	12

The interpretation of the data fields is as follows:

- $T_1 T_2$ - Type field. If only Word 1 is sent, set to '00' in Word 1. If a multiple-word message is sent, set to '01' in Word 1 and set to '10' in each additional word.
- DCC - Digital color code field.
- MIN1 - First part of the mobile identification number field (see Section 2.3.1).
- MIN2 - Second part of the mobile identification number field (see Section 2.3.1).
- SCC - SAT color code (see Table 3.7.1-2).
- ORDER - Order field. Identifies the order type (see Table 3.7.1-1).
- ORDQ - Order qualifier field. Qualifies the order to a specific action (See Table 3.7.1-1).
- LOCAL - Local control field. This field is specific to each system. The ORDER field must be set to local control (see Table 3.7.1-1) for this field to be interpreted.
- VMAC - Voice mobile attenuation code field. Indicates the mobile station power level associated with the designated voice channel (see Table 2.1.2-1).

- CHAN — Channel number field. Indicates the designated voice channel.
- CHANPOS — Channel position field. Indicates the position of a control channel relative to the first access channel (FIRSTCHA).
- RSVD — Reserved for future use, all bits must be set as indicated.
- P — Parity field.

Table 3.7.1-1

ORDER AND ORDER QUALIFICATION CODES

Order Code	Order Qualification Code	Function
00000	000	page (or origination)
00001	000	alert
00011	000	release
00100	000	reorder
00110	000	stop alert
00111	000	audit
01000	000	send called-address
01001	000	intercept
01010	000	maintenance
01011	000	change power to power level 0 (see Section 2.1.2.2)
01011	001	change power to power level 1
01011	010	change power to power level 2
01011	011	change power to power level 3
01011	100	change power to power level 4
01011	101	change power to power level 5
01011	110	change power to power level 6
01011	111	change power to power level 7
01100	000	directed retry - not last try
01100	001	directed retry - last try
01101	000	non-autonomous registration - do not make whereabouts known
01101	001	non-autonomous registration - make whereabouts known
01101	010	autonomous registration - do not make whereabouts known
01101	011	autonomous registration - make whereabouts known
11110	000	local control

(All other codes are reserved)

Table 3.7.1-2

SAT COLOR CODE (SCC)

Bit Pattern	SAT Frequency
00	5970 Hz
01	6000 Hz
10	6030 Hz
11	(Not a channel designation)

3.7.1.2 OVERHEAD MESSAGE

A three-bit OHD field is used to identify the overhead message types. Overhead message type codes are listed in Table 3.7.1-3, and are grouped into the following functional classes:

- System parameter overhead message,
- Global action overhead message,
- Registration identification message,
- Control-filler message.

Overhead messages are sent in a group called an overhead message train. The first message of the train must be the system parameter overhead message. The desired global action messages and/or a registration ID message must be appended to the end of the system parameter overhead message. The total number of words in an overhead message train is one more than the value of the NAWC field contained in the first word of the system parameter overhead message. The last word in the overhead message train is identified by a '1' in the END field of that word; the END field of all other words in the train must be set to '0'. For NAWC-counting purposes, inserted control-filler messages (see Section 3.7.1) must not be counted as part of the overhead message train.

The system parameter overhead message must be sent every 0.8 ± 0.3 seconds on each of the following control channels:

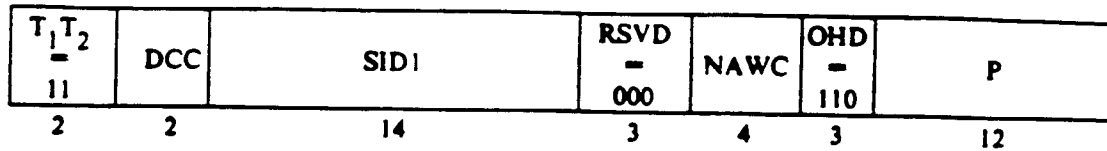
- Combined paging-access forward control channel (i.e., CPA = 1, see Section 3.7.1.2.1),
- Separate paging forward control channel (i.e., CPA = 0),
- Separate access forward control channel (i.e., CPA = 0) when the control-filler message is sent with the WFOM bit set to '1' (see Section 3.7.1.2.4).

The global action messages and the registration identification message are sent on an as needed basis.

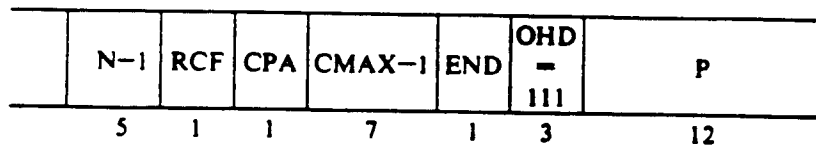
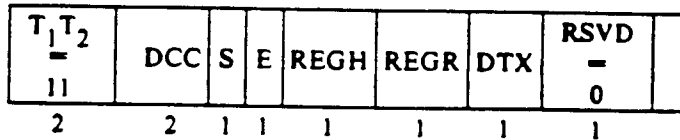
3.7.1.2.1 SYSTEM PARAMETER OVERHEAD MESSAGE

The system parameter overhead message consists of two words.

Word 1



Word 2



The interpretation of the data fields is as follows:

T₁T₂ - Type field. Set to '11' indicating an overhead word.

OHD - Overhead message type field. The OHD field of word 1 is set to '110' indicating the first word of the system parameter overhead message. The OHD field of word 2 is set to '111' indicating the second word of the system parameter overhead message.

DCC - Digital color code field.

SID1 - First part of the system identification field.

NAWC - Number of additional words coming field. In word 1 this field is set to one fewer than the total number of words in the overhead message train.

S - Serial number field.

E - Extended address field.

REGH - Registration field for home stations.

REGR - Registration field for roaming stations.

DTX - Discontinuous transmission field.

N-1 - N is the number of paging channels in the system.

RCF - Read-control-filler field.

CPA - Combined paging/access field.

CMAx-1 - CMAx is the number of access channels in the system.

END - End indication field. Set to '1' to indicate the last word of the overhead message train; set to '0' if not last word.

RSVD - Reserved for future use, all bits must be set as indicated.

P - Parity field.

3.7.1.2.2 GLOBAL ACTION OVERHEAD MESSAGE

Each global action overhead message consists of one word. Any number of global action messages can be appended to a system parameter overhead message.

The formats for the global action commands are as follows:

Rescan Global Action Message

$T_1 T_2$ =	DCC	ACT =	RSVD =	END	OHD =	P
11		0001	000...0		100	
2	2	4	16	1	3	12

Registration Increment Global Action Message

$T_1 T_2$ =	DCC	ACT =	REGINCR	RSVD =	END	OHD =	P
11		0010		0000		100	
2	2	4	12	4	1	3	12

New Access Channel Set Global Action Message

$T_1 T_2$ =	DCC	ACT =	NEWACC	RSVD =	END	OHD =	P
11		0110		00000		100	
2	2	4	11	5	1	3	12

Overload Control Global Action Message

T ₁ T ₂ = 11	DCC	ACT = 1000	O L C 0	O L C 1	O L C 2	O L C 3	O L C 4	O L C 5	O L C 6	O L C 7
2	2	4	1	1	1	1	1	1	1	1

O L C 8	O L C 9	O L C 10	O L C 11	O L C 12	O L C 13	O L C 14	O L C 15	END	OHD = 100	P
1	1	1	1	1	1	1	1	1	3	12

Access Type Parameters Global Action Message

T ₁ T ₂ = 11	DCC	ACT = 1001	BIS	RSVD= 000...0	END	OHD = 100	P
2	2	4	1	15	1	3	12

Access Attempt Parameters Global Action Message

T ₁ T ₂ = 11	DCC	ACT = 1010	MAXBUSY -PGR	MAXSZTR -PGR
2	2	4	4	4

MAXBUSY -OTHER	MAXSZTR -OTHER	END	OHD = 100	P
4	4	1	3	12

Local Control 1 Message

T ₁ T ₂ = 11	DCC	ACT = 1110	LOCAL CONTROL	END	OHD = 100	P
2	2	4	16	1	3	12

Local Control 2 Message

T ₁ T ₂ = 11	DCC	ACT = 1111	LOCAL CONTROL	END	OHD = 100	P
2	2	4	16	1	3	12

The interpretation of the data fields is as follows:

T_1T_2 - Type field. Set to '11' indicating overhead word.

ACT - Global action field. See Table 3.7.1-4.

BIS - Busy-idle status field.

DCC - Digital color code field.

OHD - Overhead message type field. Set to '100' indicating the global action message.

REGINCR - Registration increment field.

NEWACC - New access channel starting point field.

MAXBUSY-PGR - Maximum busy occurrences field (page response).

MAXBUSY-OTHER - Maximum busy occurrences field (other accesses).

MAXSZTR-PGR - Maximum seizure tries field (page response).

MAXSZTR-OTHER - Maximum seizure tries field (other accesses).

OLC N - Overload class field (N = 0 to 15).

END - End indication field. Set to '1' to indicate the last word of the overhead message train; set to '0' if not last word.

RSVD - Reserved for future use, all bits must be set as indicated.

LOCAL CONTROL - May be set to any bit pattern.

P - Parity field.

3.7.1.2.3 REGISTRATION ID MESSAGE

The registration ID message consists of one word. When sent, the message must be appended to a system parameter overhead message in addition to any global action messages.

T_1T_2 =	DCC	REGID	END	OHD =	P
11				000	
2	2	20	1	3	12

The interpretation of the data fields is as follows:

T_1T_2 - Type field. Set to '11' indicating overhead word.

- DCC — Digital color code field.
- OHD — Overhead message type field. Set to '000' indicating the registration ID message.
- REGID — Registration ID field.
- END — End indication field. Set to '1' to indicate last word of the overhead message train; set to '0' if not last word.
- P — Parity field.

Table 3.7.1-3

OVERHEAD MESSAGE TYPES

Code	Order
000	registration ID
001	control-filler
010	reserved
011	reserved
100	global action
101	reserved
110	word 1 of system parameter message
111	word 2 of system parameter message

Table 3.7.1-4

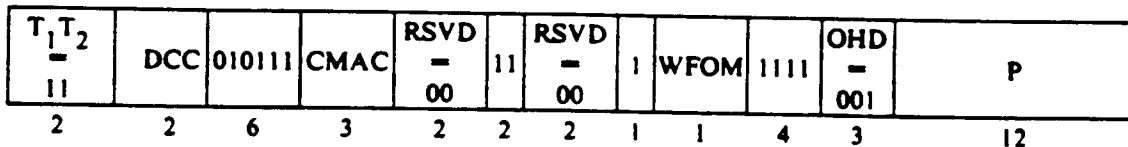
GLOBAL ACTION MESSAGE TYPES

Action Code	Type
0000	reserved
0001	rescan paging channels
0010	registration increment
0011	reserved
0100	reserved
0101	reserved
0110	new access channel set
0111	reserved
1000	overload control
1001	access type parameters
1010	access attempt parameters
1011	reserved
1100	reserved
1101	reserved
1110	local control 1
1111	local control 2

3.7.1.2.4 CONTROL-FILLER MESSAGE

The control-filler message consists of one word. It is sent whenever there is no other message to be sent on the forward control channel. It may be inserted between messages as well as between word blocks of a multi-word message. The control-filler message is chosen so that when it is sent, the 11-bit word sync sequence (11100010010) will not appear in the message stream, independent of the busy-idle bit status.

The control-filler message is also used to specify a control mobile attenuation code (CMAC) for use by mobile stations accessing the system on the reverse control channel, and a wait-for-overhead-message bit (WFOM) indicating whether or not mobile stations must read an overhead message train before accessing the system.



The interpretation of the data fields is as follows:

T₁T₂ - Type field. Set to '11' indicating overhead word.

DCC - Digital color code field.

CMAC — Control mobile attenuation field. Indicates the mobile station power level associated with the reverse control channel (see Table 2.1.2-1).

RSVD — Reserved for future use; all bits must be set as indicated.

WFOM — Wait-for-overhead-message field.

OHD — Overhead message type field. Set to '001' indicating the control-filler word.

P — Parity field.

3.7.1.3 DATA RESTRICTIONS

The 11-bit word-sync sequence (11100010010) is shorter than the length of a word, and therefore can be embedded in a word. Normally, embedded word-sync will not cause a problem because the next word to be sent will not have the word-sync sequence embedded in it. There are, however, three cases in which the word-sync sequence may appear periodically in the FOCC stream. They are:

- the overhead message,
- the control-filler message,
- Mobile station control messages with pages to mobile stations with certain central office codes.

These three cases are handled by 1) restricting the overhead message transmission rate to about once per second, 2) designing the control-filler message to exclude the word-sync sequence, taking into account the various busy-idle bits, and 3) restricting the use of certain central office codes.

If the mobile station control message (see Section 3.7.1.1) is examined with the MIN1 separated into NXX-X-XXX as described in Section 2.3.1 (where NXX is the central office code, N represents a number from 2-9, and X represents a number from 0-9), Table 3.7.1-5 can be constructed to identify the central office codes which will cause the word-sync word to be sent. If a number of mobile stations are paged consecutively with the same central office code, mobile stations that are attempting to synchronize to the data stream may not be able to do so because of the presence of the false word sync sequence. Therefore, the combinations of central office codes and groups of line numbers appearing in Table 3.7.1-5 must not be used for mobile stations.

Table 3.7.1-5

RESTRICTED CENTRAL OFFICE CODES

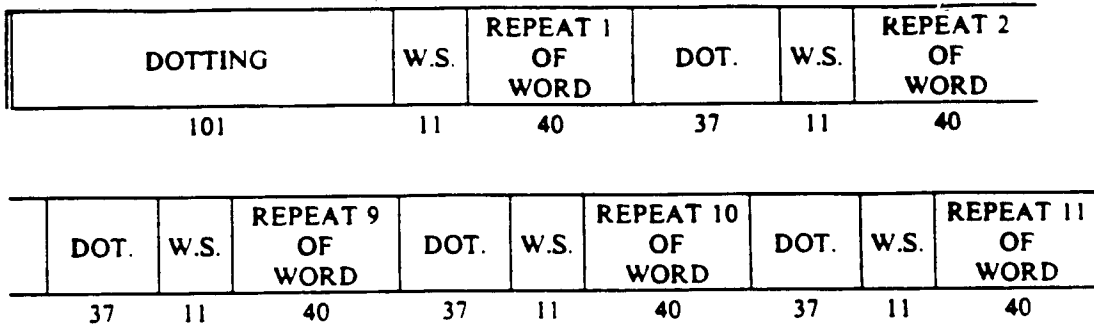
		Bit Pattern			Central Office Code	Thousands Digit
T ₁ T ₂	DCC	NXX	X	XXX		
01	11	000100(1)0000	...	...	175	0 to 9
01	11	000100(1)0001	...	...	176	0 to 9
01	11	000100(1)0010	...	...	177	0 to 9
01	11	000100(1)0011	...	...	178	0 to 9
01	11	000100(1)0100	...	...	179	0 to 9
01	11	000100(1)0101	...	...	170	0 to 9
01	11	000100(1)0110	...	...	181	0 to 9
01	11	000100(1)0111	...	...	182	0 to 9
0Z	11	100010(0)1000	...	...	663	0 to 9
0Z	11	100010(0)1001	...	...	664	0 to 9
0Z	11	100010(0)1010	...	...	665	0 to 9
0Z	11	100010(0)1011	...	...	666	0 to 9
0Z	Z1	110001(0)0100	...	...	899	0 to 9
0Z	Z1	110001(0)0101	...	...	800	0 to 9
0Z	ZZ	111000(1)0010	...	...	909	0 to 9
00	ZZ	011100(0)1001	0ZZZ	...	568	1 to 7
00	ZZ	111100(0)1001	0ZZZ	...	070	1 to 7
00	ZZ	001110(0)0100	10ZZ	...	339	8,9,0
00	ZZ	011110(0)0100	10ZZ	...	595	8,9,0
00	ZZ	101110(0)0100	10ZZ	...	851	8,9,0
00	ZZ	111110(0)0100	10ZZ	...	007	8,9,0
0Z	ZZ	000011(1)0001	0010	...	150	2
0Z	ZZ	000111(1)0001	0010	...	224	2
0Z	ZZ	001011(1)0001	0010	...	288	2
0Z	ZZ	001111(1)0001	0010	...	352	2
0Z	ZZ	010011(1)0001	0010	...	416	2
0Z	ZZ	010111(1)0001	0010	...	470	2
0Z	ZZ	011011(1)0001	0010	...	544	2
0Z	ZZ	011111(1)0001	0010	...	508	2
0Z	ZZ	100011(1)0001	0010	...	672	2
0Z	ZZ	100111(1)0001	0010	...	736	2
0Z	ZZ	101011(1)0001	0010	...	790	2
0Z	ZZ	101111(1)0001	0010	...	864	2
0Z	ZZ	110011(1)0001	0010	...	928	2
0Z	ZZ	110111(1)0001	0010	...	992	2
0Z	ZZ	111011(1)0001	0010	...	056	2
0Z	ZZ	111111(1)0001	0010	...	---	2

Note:

- 1) In each case, Z represents a bit that may be '1' or '0'.
- 2) Some codes are not used as central office codes in the US at this time. They are included for completeness.
- 3) The bit in parentheses is the busy-idle bit.

3.7.2 FORWARD VOICE CHANNEL

The forward voice channel (FVC) is a wideband data stream sent by the land station to the mobile station. This data stream must be generated at a 10 kilobit/second ± 0.1 bit/second rate. Figure 3.7.2-1 depicts the format of the FVC data stream.



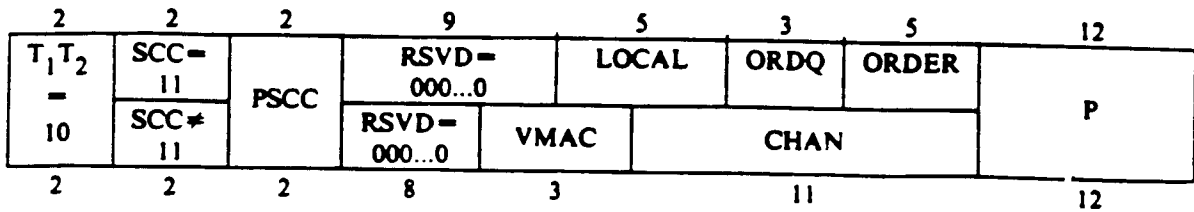
DOTTING = 1010...101
W.S. = 11100010010

FORWARD VOICE CHANNEL MESSAGE STREAM (Land-to-Mobile)
Figure 3.7.2-1.

A 37-bit dotting sequence (1010...101) and an 11-bit word sync sequence (11100010010) are sent to permit mobile stations to achieve synchronization with the incoming data, except at the first repeat of the word, where the 101-bit dotting sequence is used. Each word contains 40 bits, including parity, and is repeated eleven times together with the 37-bit dotting and 11-bit word sync sequences; it is then referred to as a word block. A word is formed by encoding the 28 content bits into a (40, 28) BCH code that has a distance of 5, (40, 28; 5). The left-most bit (i.e., earliest in time) shall be designated the most-significant bit. The 28 most-significant bits of the 40-bit field shall be the content bits. The generator polynomial is the same as that used for the forward control channel (see Section 3.7.1).

The mobile station control message is the only message transmitted over the forward voice channel. The mobile station control message consists of one word.

Mobile Station Control Message



The interpretation of the data fields is as follows:

- T₁T₂ - Type field. Set to '10'.
- SCC - SAT color code for new channel (see Table 3.7.1-2).
- PSCC - Present SAT color code. Indicates the SAT color code associated with the present channel.
- ORDER - Order field. Identifies the order type (see Table 3.7.1-1).
- ORDQ - Order Qualifier field. Qualifies the order to a specific action (See Table 3.7.1-1).
- LOCAL - Local Control field. This field is specific to each system. The ORDER field must be set to local control (see Table 3.7.1-1) for this field to be interpreted.
- VMAC - Voice mobile attenuation code field. Indicates the mobile station power level associated with the designated voice channel (see Table 2.1.2-1).
- CHAN - Channel number field. Indicates the designated voice channel.
- RSVD - Reserved for future use; all bits must be set as indicated.
- P - Parity field.