

802.16c™

IEEE Standard for
Local and metropolitan area networks

Part 16: Air Interface for Fixed Broadband Wireless Access Systems— Amendment 1: Detailed System Profiles for 10–66 GHz

IEEE Computer Society
and the
IEEE Microwave Theory and Techniques Society

Sponsored by the
LAN/MAN Standards Committee



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**Part 16: Air Interface for Fixed Broadband
Wireless Access Systems—
Amendment 1: Detailed System Profiles for
10–66 GHz**

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of the
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Approved 11 December 2002

IEEE-SA Standards Board

Abstract: This amendment updates and expands Clause 12 of IEEE Std 802.16-2001, which concerns system profiles that list sets of features and functions to be used in typical implementation cases. Errors and inconsistencies in IEEE Std 802.16-2001 are also corrected. The scope is limited to 10–66 GHz.

Keywords: fixed broadband wireless access networks, metropolitan area network, millimeter waves, microwaves, WirelessMAN™ standards

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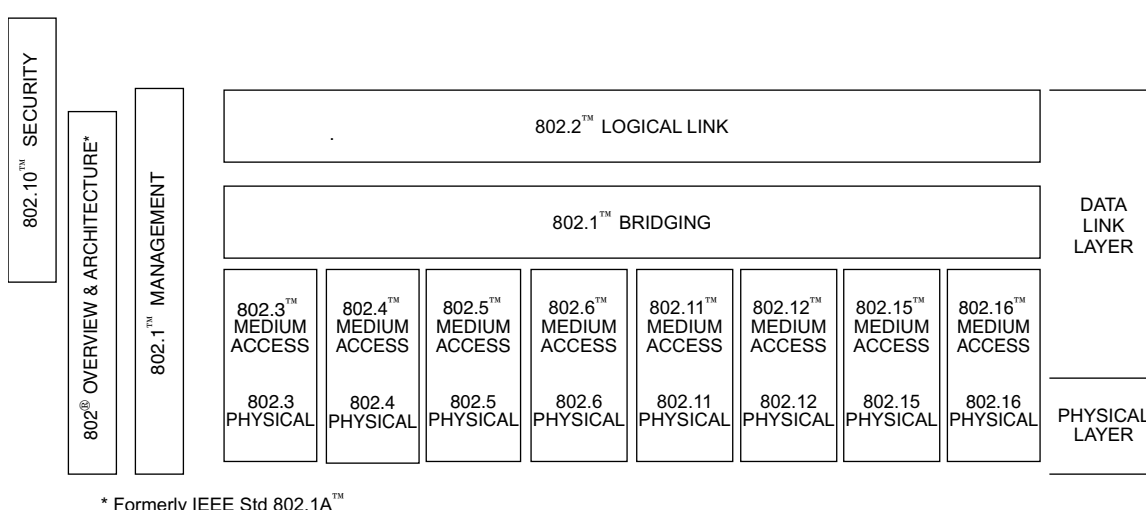
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Introduction

(This introduction is not part of IEEE Std 802.16c-2002, IEEE Standard for Local and metropolitan area networks—Part 16: Air Interface for Fixed Broadband Wireless Access Systems—Amendment 1: Detailed System Profiles for 10–66 GHz.)

This amendment updates and expands Clause 12 of IEEE Std 802.16-2001, which concerns system profiles that list sets of features and functions to be used in typical implementation cases. Errors and inconsistencies in IEEE Std 802.16-2001 are also corrected. The scope is limited to 10–66 GHz.

IEEE Std 802.16 is part of a family of standards for local and metropolitan area networks. The relationship between the standard and other members of the family is shown below. (The numbers in the figure refer to IEEE standard designations.¹)



This family of standards deals with the Physical and Data Link layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) Basic Reference Model (ISO/IEC 7498-1: 1994). The access standards define seven types of medium access technologies and associated physical media, each appropriate for particular applications or system objectives. Other types are under investigation.

The standards defining the technologies noted above are as follows:

- IEEE Std 802 *Overview and Architecture*. This standard provides an overview to the family of IEEE 802 Standards.
- IEEE Std 802.1B™ and 802.1k™ [ISO/IEC 15802-2] *LAN/MAN Management*. Defines an OSI management-compatible architecture, and services and protocol elements for use in a LAN/MAN environment for performing remote management.
- IEEE Std 802.1D™ *Media Access Control (MAC) Bridges*. Specifies an architecture and protocol for the interconnection of IEEE 802 LANs below the MAC service boundary.
- IEEE Std 802.1E™ [ISO/IEC 15802-4] *System Load Protocol*. Specifies a set of services and protocol for those aspects of management concerned with the loading of systems on IEEE 802 LANs.

¹The IEEE standards referred to in the above figure and list are trademarks owned by the Institute of Electrical and Electronics Engineers, Incorporated.

- IEEE Std 802.1F™ *Common Definitions and Procedures for IEEE 802 Management Information.*
- IEEE Std 802.1G™ [ISO/IEC 15802-5] *Remote Media Access Control (MAC) Bridging. Specifies extensions for the interconnection, using non-LAN communication technologies, of geographically separated IEEE 802 LANs below the level of the logical link control protocol.*
- IEEE Std 802.1H™ [ISO/IEC TR 11802-5] *Media Access Control (MAC) Bridging of Ethernet V2.0 in Local Area Networks.*
- IEEE Std 802.2 [ISO/IEC 8802-2] *Logical Link Control.*
- IEEE Std 802.3 *CSMA/CD Access Method and Physical Layer Specifications.*
- IEEE Std 802.4 [ISO/IEC 8802-4] *Token Passing Bus Access Method and Physical Layer Specifications.*
- IEEE Std 802.5 [ISO/IEC 8802-5] *Token Ring Access Method and Physical Layer Specifications.*
- IEEE Std 802.6 [ISO/IEC 8802-6] *Distributed Queue Dual Bus Access Method and Physical Layer Specifications.*
- IEEE Std 802.10 *Interoperable LAN/MAN Security.*
- IEEE Std 802.11 [ISO/IEC DIS 8802-11] *Wireless LAN Medium Access Control (MAC) and Physical Layer Specifications.*
- IEEE Std 802.12 [ISO/IEC 8802-12] *Demand Priority Access Method, Physical Layer and Repeater Specifications.*
- IEEE Std 802.15 *Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for: Wireless Personal Area Networks.*
- IEEE Std 802.16 *Air Interface for Fixed Broadband Wireless Access Systems.*

In addition to the family of standards, the following is a recommended practice for a common Physical Layer technology:

- IEEE Std 802.7™ *IEEE Recommended Practice for Broadband Local Area Networks.*

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Local and metropolitan area networks**

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Wireless Access Systems—**

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10–66 GHz**

EDITORIAL NOTE—This amendment updates and expands Clause 12 of IEEE Std 802.16™-2001, which concerns system profiles that list sets of features and functions to be used in typical implementation cases. Errors and inconsistencies in IEEE Std 802.16-2001 are also corrected. The scope is limited to 10–66 GHz.

The editing instructions contained in this amendment define how to merge the material contained herein into the existing base standard (IEEE Std 802.16-2001) to form the comprehensive standard.

Editing instructions are shown in ***bold italic***. Three editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make small corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed either by using ~~striketrough~~ (to remove old material) or underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. Editorial notes will not be carried over into future editions. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

1. Overview

1.2.1 10–66 GHz licensed bands

Insert the following as paragraph two:

The single-carrier modulation air interface specified herein for 10–66 GHz shall be known as the “WirelessMAN™-SC” air interface.

3. Definitions

Change the definition 3.3 to read:

3.3 Basic Connection: Connection that is established during ~~initial subscriber station registration~~ subscriber station initial ranging and that ~~which~~ is used to transport delay-intolerant MAC management messages.

Change the definition 3.25 and move it to retain alphabetical order:

3.25 Primary mManagement eConnection: A connection that is established during initial subscriber station ~~registration~~ registration ranging that is used to transport delay-tolerant medium access control management messages.

Delete definition 3.42:

~~**3.42 service flow class:** A grouping of service flow properties to allow higher layer entities and external applications to request service flows with desired quality of service (QoS) parameters in a globally consistent way.~~

Insert the following definition at its correct alphabetical position:

3.43 Secondary Management Connection: A connection that is established during subscriber station registration that is used to transport standards based (SNMP, DHCP, etc.) management messages.

Delete definition 3.44:

~~**3.44 service flow name:** An ASCII string that is used to reference a set of quality of service (QoS) parameters that (partially) define a service flow.~~

6. MAC common part sublayer (CPS)

6.1.1.1.2 Semantics of the service primitive

Change the first paragraph to read:

The parameters of the primitive are as follows:

```
MAC_CREATE_CONNECTION.request
(
    MAC Address
    scheduling service type,
    convergence sublayer,
    service flow parameters,
    payload header suppression indicator,
    length indicator,
    encryption indicator,
    Packing on/off indicator,
    Fixed-length or variable-length SDU indicator,
    SDU length (only needed for fixed-length SDU connections),
    CRC request,
    ARQ parameters,
    sequence number
)
```

6.1.1.10.4 Effect of receipt

Change the paragraph to read:

The receipt of this primitive causes the MAC entity to process the MAC SDU through the MAC sublayer and to pass the appropriately formatted PDUs to the PHY ~~transmission-CS~~ transmission convergence sublayer for transfer to peer MAC sublayer entities, using the CID specified.

6.1.1.11.2 Semantics of service primitive

Change the first paragraph to read:

The parameters of the primitive are as follows:

```
MAC_DATA.indication
(
    Connection ID,
    length,
    data,
    reception status,
    CS pass-through,
    encryption flag
)
```

6.2.1 Addressing and connections

Change the first paragraph to read:

Each SS shall have a 48-bit universal MAC address, as defined in IEEE Std 802®-2001. This address uniquely defines the SS from within the set of all possible vendors and equipment types. It is used during the registration initial ranging process to establish the appropriate connections for an SS. It is also used as part of the authentication process by which the BS and SS each verify the identity of each other.

Change the third paragraph to read:

For bearer services, the higher layers of the BS set up BS initiates the set-up of connections based upon the provisioning information distributed to the BS. The registration of an SS, or the modification of the services contracted at an SS, stimulates the higher layers of the BS to initiate the setup of the connections.

6.2.2.1.1 Generic MAC header

Change the second paragraph to read:

The fields of the Generic MAC header are defined in Table 3. Every header is encoded, starting with the HT and encryption control (EC) fields. The coding of these fields is such that the first byte of a MAC header shall never have the value of 0xFF, where 'X' means 'don't care'. This prevents false detection on the stuff byte used in the ~~transmission CS~~ transmission convergence sublayer.

6.2.2.3 MAC Management Messages

Change the first paragraph to read:

A set of MAC Management Messages are defined. These messages shall be carried in the Payload of the MAC PDU. All MAC Management Messages begin with a Management Message Type field and may contain additional fields. MAC Management Messages on the Basic, Broadcast, and Initial Ranging connections shall neither be fragmented nor packed. MAC Management Messages on the Primary Management Connection may be packed and/or fragmented. The format of the Management Message is given in Figure 24. The encoding of the Management Message Type field is given in Table 13. MAC management messages shall not be carried on Transport Connections. MAC management messages that do not contain all required parameters or contain erroneously encoded parameters shall be silently discarded.

Change Table 13, as follows:

21	MCA-REQ	Multicast Assignment Request	<u>Basic-Primary Management</u>
22	MCA-RSP	Multicast Assignment Response	<u>Basic-Primary Management</u>

6.2.2.3.3 Uplink Channel Descriptor message

Change the fourth paragraph, as follows:

Mini-slot Minislot size

The size n of the minislot for this uplink channel in units of Physical Slots. Allowable values are $n = 2^m$, where m is an integer ranging from 0 through 7.

6.2.2.3.6 Ranging response (RNG-RSP) message

Change the last two paragraphs to read:

The following parameters shall be included in the RNG-RSP message:

Timing Adjust Information
Power Adjust Information
~~Frequency Adjust Information~~
Ranging Status

The following parameters may be included in the RNG-RSP message:

Downlink Frequency Override
Uplink Channel ID Override
Downlink Operational Burst Profile
Basic CID

A required parameter if the RNG-RSP message is being sent on the Initial Ranging CID in response to a RNG-REQ message that was sent on the Initial Ranging CID.

Primary Management CID

A required parameter if the RNG-RSP message is being sent on the Initial Ranging CID in response to a RNG-REQ message that was sent on the Initial Ranging CID.

SS MAC Address (48-bit)

A required parameter when the CID in the MAC header is the Initial Ranging CID.

Frequency Adjust Information

6.2.2.3.7 Registration Request (REG-REQ) message

Change the fourth paragraph to read:

The REG-REQs may contain the following TLV parameters stored in or generated by the SS:

Vendor ID Encoding (of the SS; see 11.4.3)

SS Capabilities Encodings (excluding UL CID support, physical parameters supported, and bandwidth allocation support) (see 11.4.1)

Convergence Sublayer Capabilities (see 11.4.5.1).

6.2.2.3.8 Registration Response (REG-RSP) message

Change the fourth paragraph to read:

The following parameters shall be included in the REG-RSP:

MAC Version (see 11.4.4)

Secondary Management CID

~~Hashed message authentication code (HMAC) Tuple~~ (see 11.4.10)

Change the last paragraph to read:

The following parameter may be included in the REG-RSP if the REG-REQ contained the Vendor ID Encoding for the SS:

Vendor-specific extensions information (see 11.4.11)

6.2.2.3.9.1 Security Association Add (SA Add) message

Insert the following row to the bottom of Table 26:

Attribute	Contents
HMAC Digest	Keyed secure hash algorithm (SHA) message

Change 6.2.2.3.9.3 to read:

6.2.2.3.9.3 Authorization Reply (Auth Reply) message

Sent by the BS to a client SS in response to an Authorization Request, the Authorization Reply message contains an Authorization Key, the key's lifetime, the key's sequence number, and a list of SA-Descriptors identifying the Primary and Static SAs the requesting SS is authorized to access and their particular properties (e.g., type, cryptographic suite). The Authorization Key shall be encrypted with the SS's public key. The SA-Descriptor list shall include a descriptor for the Basic CID reported to the BS in the corresponding Auth Request. The SA-Descriptor list may include descriptors of Static SAIDs that the SS is authorized to access.

The Auth Reply may also contain PKM configuration settings that override the default timer values.

Code: 5

Attributes are shown in Table 28.

Table 28—Auth Reply attributes

Attribute	Contents
AUTH-Key	Authorization (AUTH) Key, encrypted with the target client SS's public key
Key-Lifetime	Authorization Key's active lifetime
Key-Sequence-Number	Authorization key sequence number
(one or more) SA-Descriptor(s)	Each compound SA-Descriptor Attribute specifies an SAID and additional properties of the SA
<u>PKM Configuration settings (optional)</u>	<u>PKM timer values</u>

6.2.2.3.10 Dynamic Service Addition—Request (DSA-REQ) message

Change the last paragraph to read:

~~If Privacy is enabled, the DSA-REQ Message shall contain the following:~~

HMAC Tuple (see 11.4.10)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). The HMAC Tuple Attribute shall be the final Attribute in the Dynamic Service Message's Attribute list.

6.2.2.3.11 Dynamic Service Addition—Response (DSA-RSP) message

Change the last paragraph to read:

If Privacy is enabled, the DSA-REQ Message shall contain the following:

HMAC Tuple (see 11.4.10)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). The HMAC Tuple Attribute shall be the final Attribute in the Dynamic Service Message's Attribute list.

6.2.2.3.12 Dynamic Service Addition—Acknowledge (DSA-ACK) message

Change the last paragraph to read:

If Privacy is enabled, the DSA-REQ Message shall contain the following:

HMAC Tuple (see 11.4.10)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). The HMAC Tuple Attribute shall be the final Attribute in the Dynamic Service Message's Attribute list.

6.2.2.3.13 DSC-REQ—Request (DSC-REQ) message

Change the subclause title to read: “Dynamic Service ChangeDSC—Request (DSC-REQ) message”.

Change the last paragraph to read:

If Privacy is enabled, the DSA-REQ Message shall also contain:

HMAC Tuple (see 11.4.10)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). The HMAC Tuple Attribute shall be the final Attribute in the Dynamic Service Message's Attribute list.

6.2.2.3.14 Dynamic Service Change—Response (DSC-RSP) message

Change the last paragraph to read:

Regardless of success or failure, if Privacy is enabled, the DSA-REQ Message shall contain the following:

HMAC Tuple (see 11.4.10)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). The HMAC Tuple Attribute shall be the final Attribute in the Dynamic Service Message's Attribute list.

6.2.2.3.15 Dynamic Service Change—Acknowledge (DSC-ACK) message

Change the last paragraph to read:

If Privacy is enabled, the DSA-REQ Message shall contain the following:

HMAC Tuple (see 11.4.10)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). The HMAC Tuple Attribute shall be the final Attribute in the Dynamic Service Message's Attribute list.

6.2.2.3.16 Dynamic Service Deletion—Request (DSD-REQ) message

Change the last paragraph to read:

If Privacy is enabled, the DSA-REQ Message shall include the following:

HMAC Tuple (see 11.4.10)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). The HMAC Tuple Attribute shall be the final Attribute in the Dynamic Service Message's Attribute list.

6.2.2.3.17 Dynamic Service Deletion—Response (DSD-RSP) message

Change the last paragraph to read:

If Privacy is enabled, the DSA-REQ Message shall include:

HMAC Tuple (see 11.4.10)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). The HMAC Tuple Attribute shall be the final Attribute in the Dynamic Service Message's Attribute list.

6.2.2.3.24 SS Basic Capability Response (SBC-RSP) message

Change Table 50, as follows:

Table 50—SS SBC-RSP message format

Syntax	Size	Notes
SBC-RSP_Message_Format() {		
Management Message Type = 27	8 bits	
~~Confirmation Code~~	~~8 bits~~	
TLV Encoded Attributes	Variable	TLV specific
}		

6.2.6 Bandwidth allocation and request mechanisms

Change the first paragraph to read:

Note that at registration during network entry and initialization every SS is assigned three dedicated CIDs for the purpose of sending and receiving control messages. Three connections are used to allow differentiated levels of QoS to be applied to the different connections carrying MAC management traffic. Increasing (or decreasing) bandwidth requirements is necessary for all services except incompressible constant bit rate UGS connections. The needs of incompressible UGS connections do not change between connection establishment and termination. The requirements of compressible UGS connections, such as channelized T1, may increase or decrease depending on traffic. Demand Assigned Multiple Access (DAMA) services are given resources on a demand assignment basis, as the need arises.

6.2.7.2 Framed (burst) FDD

Change the first paragraph to read:

In a framed (burst) FDD system, the uplink and downlink channels are located on separate frequencies and the downlink data can be transmitted in bursts. A fixed duration frame is used for both uplink and downlink transmissions. This facilitates the use of different modulation types. It also allows simultaneous use of both full-duplex subscriber stations (which can transmit and receive simultaneously) and optionally half-duplex subscriber stations (which cannot). If half-duplex subscriber stations are used, the bandwidth controller shall not allocate uplink bandwidth for a half-duplex subscriber station at the same time that it is expected to receive data on the downlink channel, including allowance for the propagation delay, and Tx/Rx and Rx/Tx Transition Gaps.

6.2.7.5 Uplink Map

Change the first paragraph to read:

The uplink map (UL-MAP) message defines the usage for the uplink minislots using a series of IEs, which define the usage of each uplink interval. The UL-MAP defines the uplink usage in terms of the offset, in units of minislots, of the burst relative to the Allocation Start Time (8.2.6.1.2). The UL-MAP defines the uplink usage in terms of the offset from the previous IE start (the length) in numbers of minislots.

6.2.7.5.2 Uplink minislot definition

Change the subclause as follows:

6.2.7.5.2 Uplink minislot definition Minislots

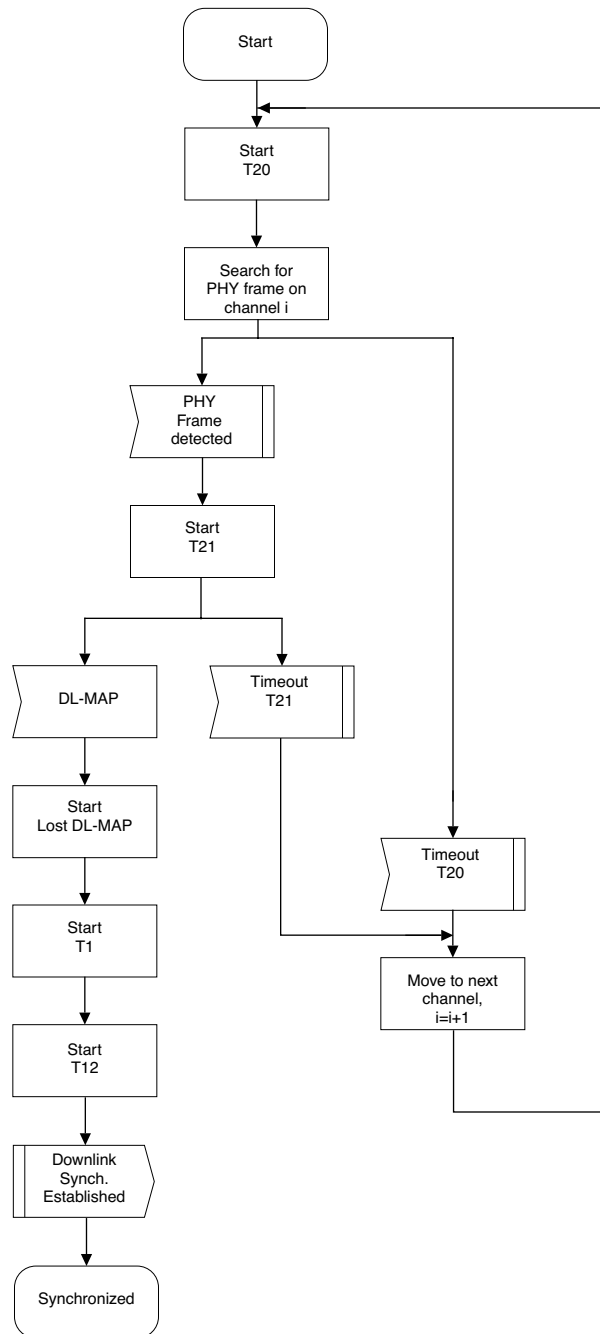
The uplink bandwidth allocation map (UL-MAP) uses units of minislots. The size of the minislot is specified as a number function of PHY slots (PS) and is carried in the Uplink Channel Descriptor for each uplink channel. One mini-slot contains n PHY slots (PS), where n is an integer ranging from 0 through 255. There is no implication that any MAC PDU can actually be transmitted in a single minislot.

6.2.9 Network entry and initialization

Replace the second paragraph with the following:

The procedure can be divided into the following phases:

- a) Scan for downlink channel and establish synchronization with the BS
- b) Obtain transmit parameters (from UCD message)
- c) Perform ranging
- d) Negotiate basic capabilities
- e) Authorize SS and perform key exchange
- f) Perform registration
- g) Establish IP connectivity
- h) Establish time of day
- i) Transfer operational parameters
- j) Set up connections

6.2.9.2 Obtain downlink parameters*Replace Figure 46 with the following figure:***Figure 46—Obtaining downlink synchronization**

6.2.9.3 Obtain uplink parameters

Replace Figure 48 with the following figure:

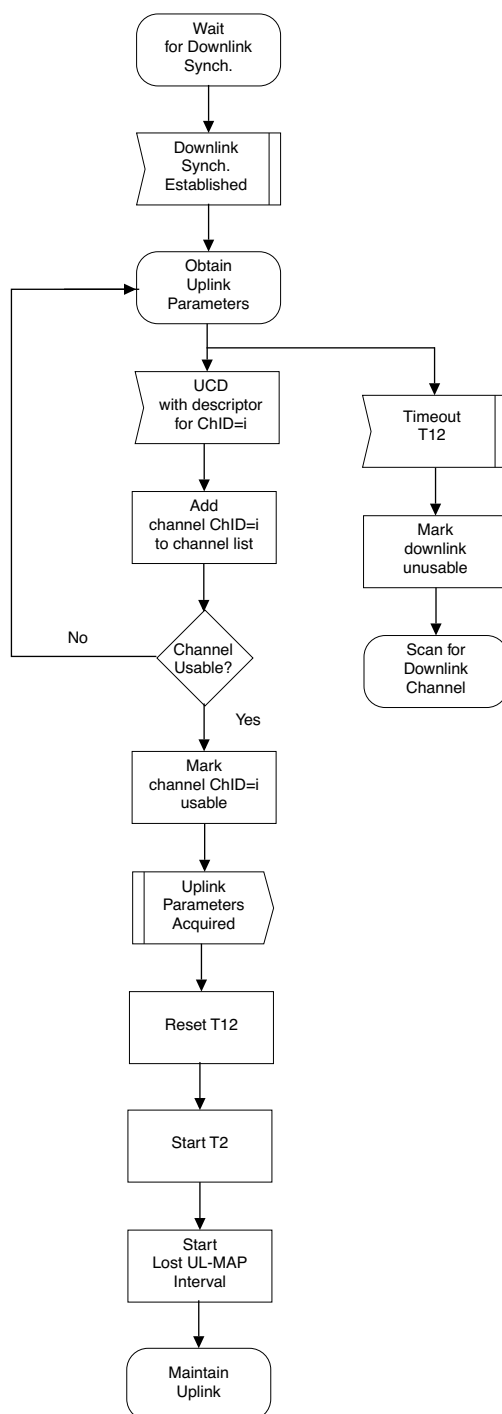


Figure 48—Obtaining uplink parameters

6.2.9.5 Initial ranging and automatic adjustments

Change the seventh paragraph to read:

Once the BS has successfully received the RNG-REQ message, it shall return a RNG-RSP message addressed to the individual SS. Within the RNG-RSP message shall be the Basic and Primary Management CIDs assigned to this SS. The message shall also contain information on RF power level adjustment and offset frequency adjustment as well as any timing offset corrections. At this point the BS shall start using invited Initial Maintenance Intervals addressed to the SS's Basic CID to complete the ranging process.

Replace Figure 50 with Figure 50a and Figure 50b as follows:

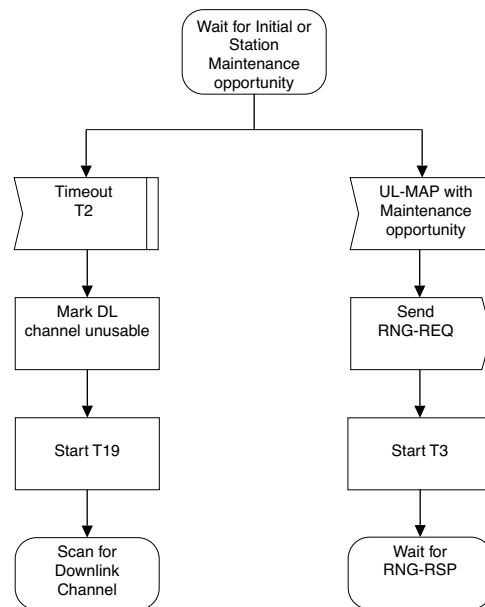


Figure 50a—Initial Ranging—SS (part 1)

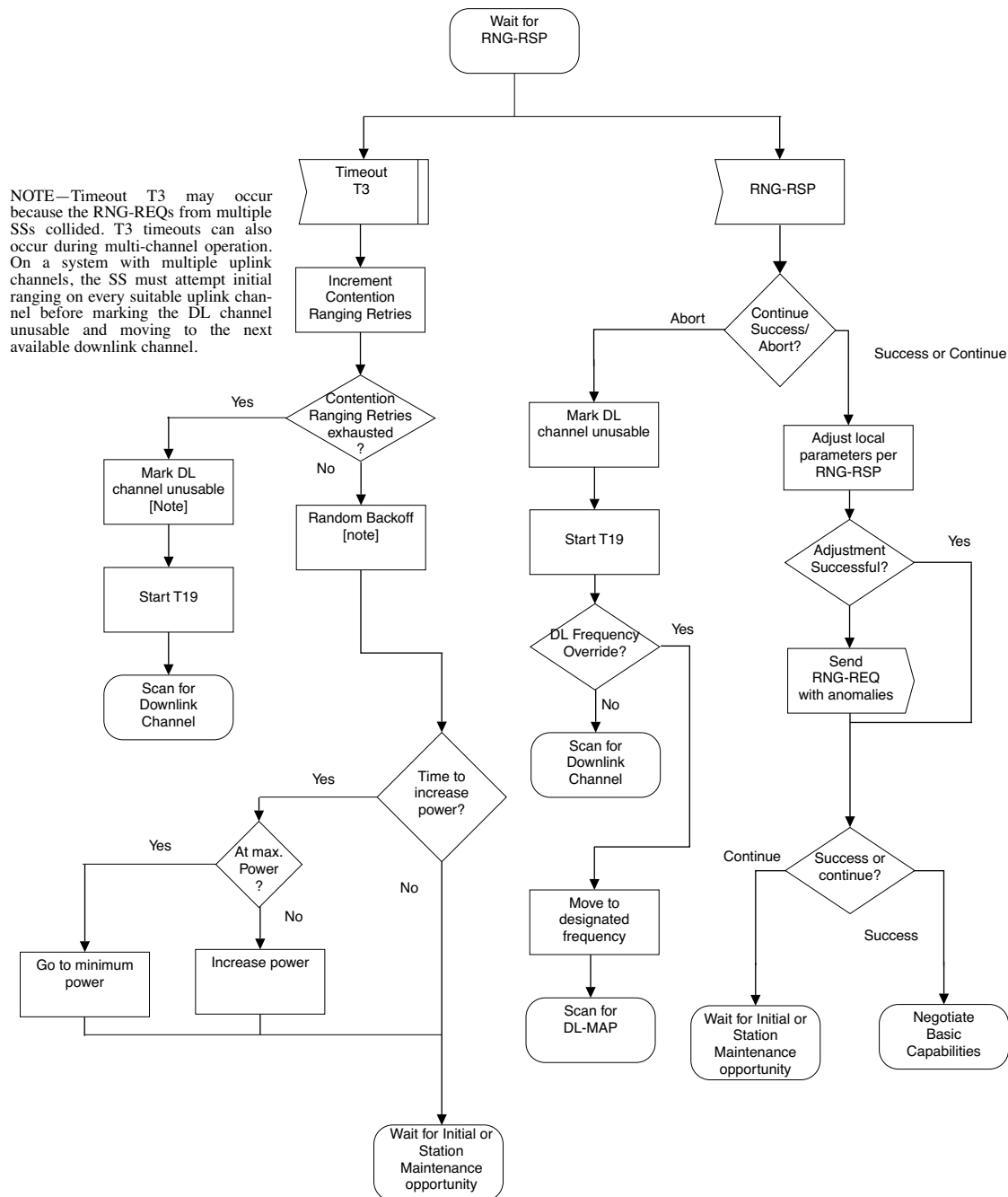


Figure 50b—Initial Ranging—SS (part 2)

Replace Figure 51 with Figure 51a and Figure 51b as follows:

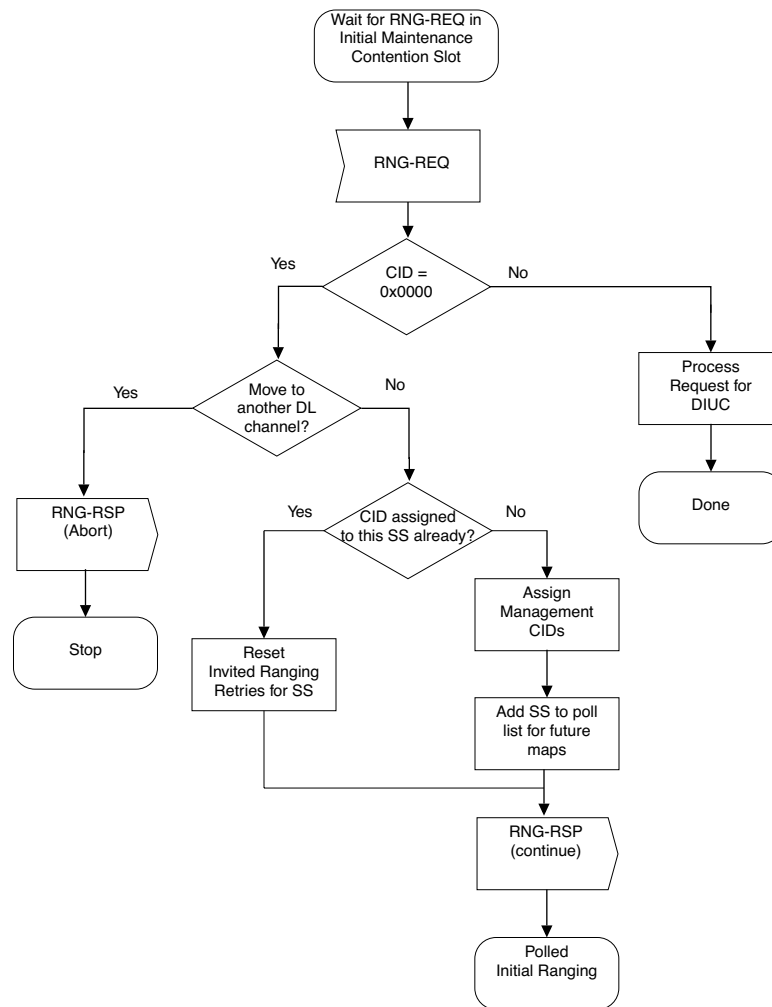


Figure 51a—Initial Ranging—BS