Table 8-4. Radio Channel Frame Interconnection Panel (ED-2R831-30) Connector Identification (Contd)

Jack (Plug)	Conn Type	Function
1	N	Tx Antenna 1
2	N	Tx Antenna 2
3	N	Tx Antenna 3
4	N	Tx Antenna 4
5	N	Tx Antenna 5
6	N	Tx Antenna 6
RECEIVE 0 ANTENNA INPUTS		
0	N	Rx 0 Antenna 0
1	N	Rx 0 Antenna 1
2	N	Rx 0 Antenna 2
3	N	Rx 0 Antenna 3
4	N	Rx 0 Antenna 4
5	N	Rx 0 Antenna 5
6	N	Rx 0 Antenna 6
RECEIVE 1 ANTENNA INPUTS		
0	N	Rx 1 Antenna 0
1	N	Rx 1 Antenna 1
2	N	Rx 1 Antenna 2
3	N	Rx 1 Antenna 3
4	N	Rx 1 Antenna 4
5	N	Rx 1 Antenna 5
6	N	Rx 1 Antenna 6
†These connectors are not used on the Growth RCF.		

Table 8-5. Radio Channel Frame Interconnection Panel (ED-2R831-30) Connector Identification

Jack (Plug)	Conn Type	Function
REFERENCE POWER DIVIDER (1:6)		
REF(PD30)*		
COM	SMA	15 MHz Reference Input
1	SMA	15 MHz to Shelf 1 PD1
2	SMA	15 MHz to Shelf 2 PD1

Table 8-5. Radio Channel Frame Interconnection Panel (ED-2R831-30) Connector Identification (Contd)

Jack (Plug)	Conn Type	Function
3	SMA	15 MHz to Shelf 3 PD1
4	SMA	15 MHz to Shelf 4 PD1
5	SMA	15 MHz to Shelf 5 PD1
6	SMA	Not Used
REFERENCE POWER DIVIDER (1:6)		
REF(PD30)†		
COM	SMA	15 MHz Reference Input
1	SMA	15 MHz to Shelf 0 PD1
2	SMA	15 MHz to Shelf 1 PD1
3	SMA	15 MHz to Shelf 2 PD1
4	SMA	15 MHz to Shelf 3 PD1
5	SMA	15 MHz to Shelf 4 PD1
6	SMA	15 MHz to Shelf 5 PD1
* Connections for P-RCF.		
† Connections for Growth RCF.		

Table 8-6. Radio Channel Frame Interconnection Panel (ED-2R831-30) Connector Identification

Jack (Plug)	Conn Type	Function
TRANSMIT ANTENNAS POWER COMBINERS (9:1)		
0 (PD20)		
J1	SMA	Tx Ant 1 Test to Tx SIG MON-0
J2 thru J10	SMA	
J11	SMA	Tx Output **0**
1 (PD21)		
J1	SMA	Tx Ant 1 Test to Tx SIG MON-1
J2 thru J10	SMA	
J11	SMA	Tx Output **1**
2 (PD22)		
J1	SMA	Tx Ant 2 Test to Tx SIG MON-2
J2 thru J10	SMA	
J11	SMA	Tx Output **2**

Table 8-6. Radio Channel Frame Interconnection Panel (ED-2R831-30) Connector Identification (Contd)

Jack (Plug)	Conn Type	Function
3 (PD23)		
J1	SMA	Tx Ant 3 Test to Tx SIG MON-3
J2 thru J10	SMA	
J11	SMA	Tx Output **3**
4 (PD24)		
J1	SMA	Tx Ant 4 Test to Tx SIG MON-4
J2 thru J10	SMA	
J11	SMA	Tx Output **4**
5 (PD25)		
J1	SMA	Tx Ant 5 Test to Tx SIG MON-5
J2 thru J10	SMA	
J11	SMA	Tx Output **5**
6 (PD26)		
J1	SMA	Tx Ant 6 Test to Tx SIG MON-6
J2 thru J10	SMA	
J11	SMA	Tx Output **6**

Table 8-7. Radio Channel Frame Interconnection Panel (ED-2R831-30, Connector Identification

Jack (Plug)	Conn Type	Function
REF	TNC	15 MHz Reference Input
SET UP 0†	N	Set Up Antenna (for future use)
RTU IN†	N	Radio Test Unit Input
RTU OUT†	N	Radio Test Unit Output
TRANSMIT ANTENNA OUTPUTS		
0	N	Tx Antenna 0
1	N	Tx Antenna 1
2	N	Tx Antenna 2
3	N	Tx Antenna 3
4	N	Tx Antenna 4
5	N	Tx Antenna 5
6	N	Tx Antenna 6

Table 8-7. Radio Channel Frame Interconnection Panel (ED-2R831-30, Connector Identification (Contd)

Jack (Plug)	Conn Type	Function
RECEIVE 0 ANTENNA INPUTS		
0	N	Rx 0 Antenna 0
1	N	Rx 0 Antenna 1
2	N	Rx 0 Antenna 2
3	N	Rx 0 Antenna 3
4	N	Rx 0 Antenna 4
5	N	Rx 0 Antenna 5
6	N	Rx 0 Antenna 6
RECEIVE 1 ANTENNA INPUTS		
0	N	Rx 1 Antenna 0
1	N	Rx 1 Antenna 1
2	N	Rx 1 Antenna 2
3	N	Rx 1 Antenna 3
4	N	Rx 1 Antenna 4
5	N	Rx 1 Antenna 5
6	N	Rx 1 Antenna 6
†These connectors are not used on the Growth RCF.		

Table 8-8. Radio Channel Frame Interconnection Panel (ED-2R831-30,) Connector Identification

Jack (Plug)	Conn Type	Function
RECEIVE 0 ANTENNAS POWER DIVIDERS (1:9)		
0 (PD1)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 0 Input from **0**
1 (PD2)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 0 Input from **1**
2 (PD3)		
J1	SMA	Not Used

Table 8-8. Radio Channel Frame Interconnection Panel (ED-2R831-30,) Connector Identification (Contd)

Jack (Plug)	Conn Type	Function
J2 thru J10	SMA	
J11	SMA	Rx 0 Input from **2**
3 (PD4)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 0 Input from **3**
4 (PD5)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 0 Input from **4**
5 (PD6)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 0 Input from **5**
6 (PD7)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 0 Input from **6**

Table 8-9. Radio Channel Frame Interconnection Panel (ED-2R831-30,) Connector Identification

Jack (Plug)	Conn Type	Function
RECEIVE 1 ANTENNAS POWER DIVIDERS (1:9)		
0 (PD11)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 1 Input from **0**
1 (PD12)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 1 Input from **1**
2 (PD13)		

Table 8-9. Radio Channel Frame Interconnection Panel (ED-2R831-30,) Connector Identification (Contd)

Jack (Plug)	Conn Type	Function
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 1 Input from **2**
3 (PD14)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 1 Input from **3**
4 (PD15)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 1 Input from **4**
5 (PD16)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 1 Input from **5**
6 (PD17)		
J1	SMA	Not Used
J2 thru J10	SMA	
J11	SMA	Rx 1 Input from **6**
Note: For other transmit and receive options, refer to SD-2R263-01 (P-RCF) or SD-2R264-01 (Growth RCF).		

Series II Cell Site Busbar Assembly Unit, KS24355, L1

The Cell Site Busbar Assembly Unit utilizes plug-in Circuit Breakers for 5.0 A, 15.0 A, and 25.0 A. It also uses screw-in Capacitors. This unit equips the growth RCF so that it can support 8 EDRUs per shelf.

The Growth Channel Frame Hardware is listed in the table below.

Table 8-10. Growth Radio Channel Frame (G-RCF) J41660B-2 Hardware

Item	Max Qty	Code	Eqpt Loc
Cable Tray Assembly	1		
Interconnection Panel	1	ED-2R831-30	
Tx, Rx Power Dividers (9:1)	21	KS24235, L5	
Tx, Rx Power Dividers (1:6)		KS24235, L6	

Table 8-10. Growth Radio Channel Frame (G-RCF) J41660B-2 Hardware

Item	Max Qty	Code	Eqpt Loc
Radio Channel Unit Shelf (Shelf 0-5)	6	ED-2R834-30	13, 21
Transmit Combiner	1	BBN2B	
+12V Power Converter	1	419AE	
Radio Channel Unit	12	ED-2R836-30	
Digital Radio Unit	6	ED-2R920-30	
Power Converter Unit		430AB (Req'd for EDRU)	
Enhanced Digital Radio Unit	Maximum 12 per shelf	44WR8	
Digital Facilities Interface (DFI)	1	TN1713B or TN3500B	
+5V Converter	1	430AB	
Receive Switch Divider (Manual)	2	BBN1	
*Busbar Assembly Unit (Manufactured 5/98 or later)	2	KS24355, L1	
Circuit Breaker, Plug-In, 15.0 A	2	KS24356, L6	
Circuit Breaker, Plug-In, 25.0 A	10	KS24356, L8	
Circuit Breaker, Plug-In, 5.0 A	3	KS24356, L4	

Note: This table is for hardware identification only. Do ***not*** use this table for ordering hardware items.
* Replaces Circuit Breaker Assembly ED-2R826-30 and Capacitor Panel Assembly ED-2R829-30.

Series II Mobile Switching Center (MSC) Interface

Two data links provide the control and reporting interface between the Cell Site and Mobile Switching Center (MSC). Either data link can control Cell Site functions through the Radio Control Complex (RCC). Each data link interfaces both of the processors located on the RCC. Only one processor is on-line at a time. The other is in a standby mode, tracking functions being performed by the on-line processor, in the event it is required to come on-line.

The on-line processor sends and receives control and data information over the Time Division Multiplexed (TDM) bus, which is always installed "red stripe up." Functions performed by the Cell Site units are controlled over the TDM bus. The on-line processor also supplies data and control to each of the Radio Channel Unit (RCUs).

Series II Cell Site architecture consists of three types of equipment frames:

1. **Radio Channel Frame (RCF)** — Primary and a maximum of two growth frames
2. **Linear Amplifier Frame (LAF)** — Two frames, maximum
3. **Antenna Interface Frame (AIF)** — Two frames, maximum.

The P-RCF contains the Radio Channel Complex (RCC) as well as the shelves for individual TDMA radios. The RCC controls the operation of the Cell Site equipment. The LAF provides RF signal combining and amplification equipment, while the AIF houses the Cell Site's reference frequency generator, receiver calibration generator, and the RF filter networks that transport the RF signal to and from the antennas.

A Radio Frame Set (RFS) consists of one, two, or three RCFs, all controlled by one RCC. There will be one or two LAFs and one or two AIFs per Cell Site. Note that each of the three RCFs may contain Digital Radio Units (DRUs) or Enhanced Digital Radio Units (EDRUs). The DRU or EDRU is the radio unit used with Series II TDMA. The DRU can be configured as a Voice radio (V-DRU) or a Locate radio (L-DRU). One DRU occupies two analog Radio Channel Unit (RCU) slots and provides three Digital Traffic Channels (DTCs). One EDRU occupies a single RCU slot and also provides three DTCs. The EDRU can be configured as a Control/ Traffic (C/T-EDRU) or as an L-EDRU.

Series II analog hardware frames. DRUs, EDRUs, and the TDMA radio hardware, can reside in the same Series II Cell Site RCFs as the analog 30-kHz RCUs. Hardware wise, converting from Series II Cell Site with analog radios to Series II TDMA radios is quite simple. For Series II TDMA, the plug-in DRUs and EDRUs are added in the existing radio slots in the RFS. Note that it takes two RCU slots for each DRU.

However, one DRU using a single carrier frequency supports three channels, while the RCU (analog unit) using a single carrier frequency supports only one channel. Note also, that an EDRU can perform all the same functions, and more, of a DRU and takes up only one RCU slot. DRUs and EDRUs may be added to the Series II Cell Site by replacing existing RCUs with DRUs or EDRUs. Additionally, one TDMA Radio Test Unit (TRTU) and one (analog) Radio Test Unit (RTU) Control Board (see Figure 8-12) are required for each digitally equipped Cell Site.

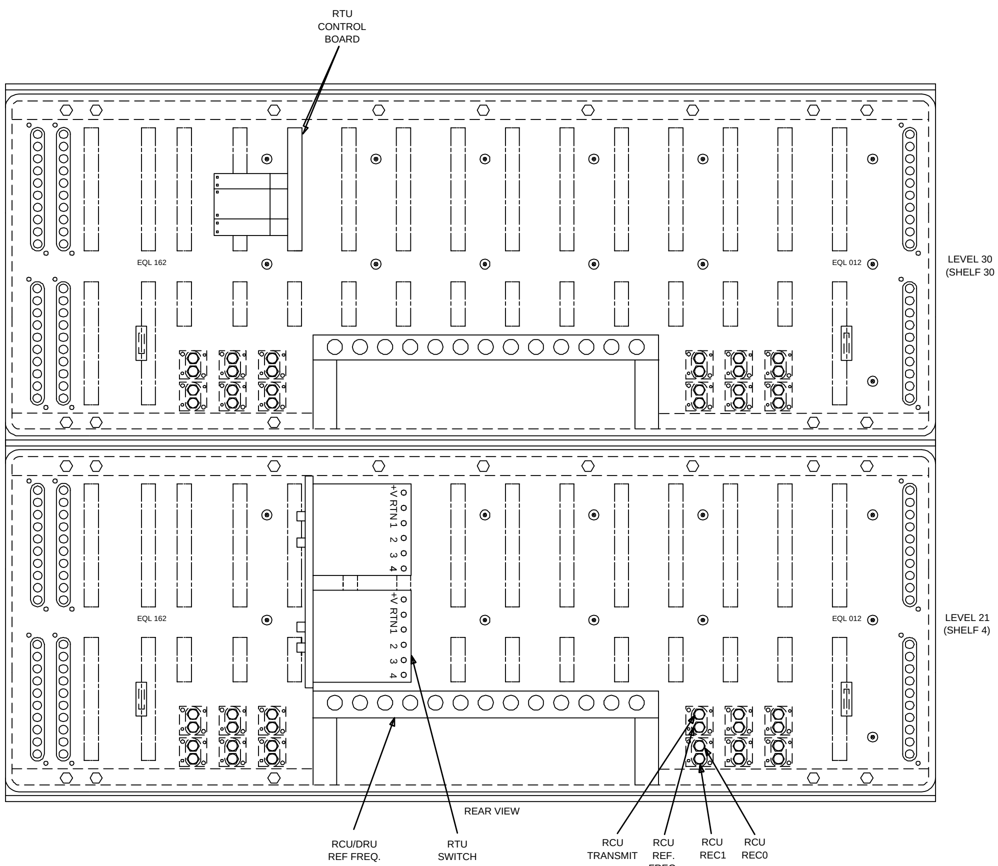


Figure 8-12. Radio Test Unit (RTU) Control Board (AYD8) and Switch Assembly (ED3R026-30) Location

The Series II Cell Site is based on a modular architecture. It includes controllers, radios, wideband linear amplifiers, antennas, and associated equipment for setting up and completing cellular calls. It can support AMPS, TDMA, and CDMA simultaneously through the same wideband linear amplifier and antennas.

The AMPS radio consists of a single plug-in unit—the radio channel unit (RCU) or the single-board RCU (SBRCU); either unit occupies one RCU slot. (The RCU consists of two circuit boards, and the SBRCU consists of a single circuit board. The RCU faceplate is wider than the SBRCU faceplate.) Similarly, the TDMA radio consists of a single plug-in unit, the digital radio unit (DRU) or the enhanced digital radio unit (EDRU); the DRU occupies two adjoining RCU slots, and the EDRU occupies one RCU slot. In contrast, the CDMA radio consists of an entire shelf of plug-in units.

Series II Cell Site Linear Amplifier Frame (LAF)

The major units of the Linear Amplifier Frame (LAF) are listed below and described in the paragraphs that follow:

- Frame Interface Assembly (FIA)
- Linearizer Unit (LZR)
- Linear Amplifier Unit (LAU).

The Linear Amplifier Frame (LAF) is designated as J41660C-1, C-2. All Cell Sites have at least one LAF with at least one Linear Amplifier Circuit (LAC). Two different (M)LACs are available depending on the output power needed. They are:

1. 100-Watt (M)LAC uses 10 Linear Amplifier Modules (LAMs).
2. 240-Watt (M)LAC uses 20 LAMs.

Three additional LACs may be configured as needed. A fully loaded LAF (LAF 0) may contain up to four LACs. An additional LAF, may be added and may be equipped with up to three LACs.

.

Table 8-11. Linear Amplifier Frame (LAF) Hardware

Item	Max Qty	Code	Eqpt Loc
Linear Amplifier Frame 0 (Primary)	1	J41660C-1, C-2	
Sniffer Combiner (For CDPD)	1	KS21604, L22A	
Frame Interface Assembly	1	ED-2R838-30	70
Box Fan	2	WP92103, L1	
Linear Amplifier Circuit (LAC)		J-41660CA-2, L6 (Full)	
Linear Amplifier Circuit (LAC)		J-41660CA-2, L5 (Half)	
Modular Linear Amplifier Circuit (MLAC)		J-41660CA-3	
RF Amplifier	1	KS23757, L1	
Fan Blower	1	WP92104, L1	
Linear Amplifier Module‡	10 or 20	ED-2R840-30	

* Up to three additional LACs can be provided in LAF 1.

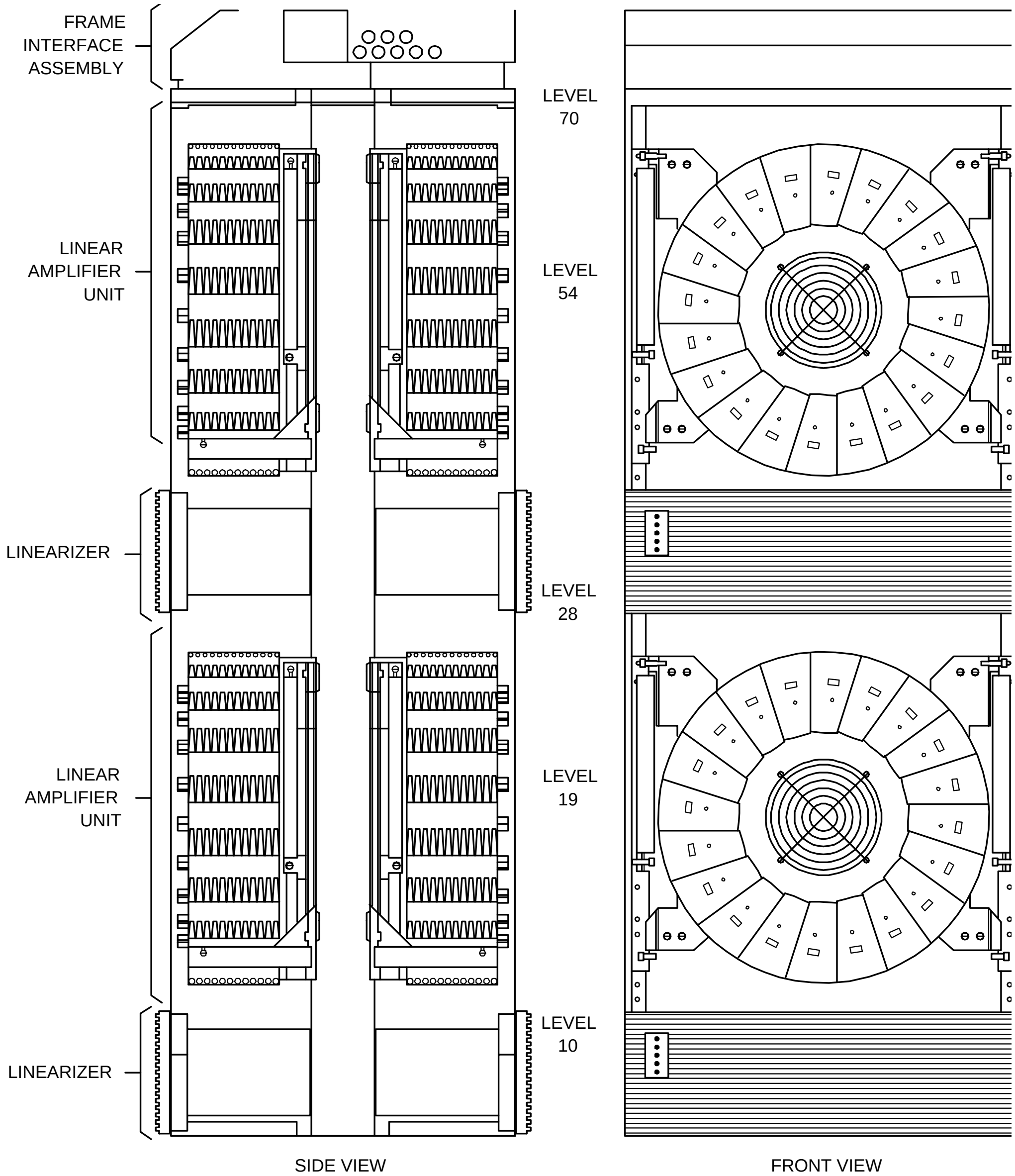


Figure 8-13. Linear Amplifier Frame (LAF) (J41660C-1)

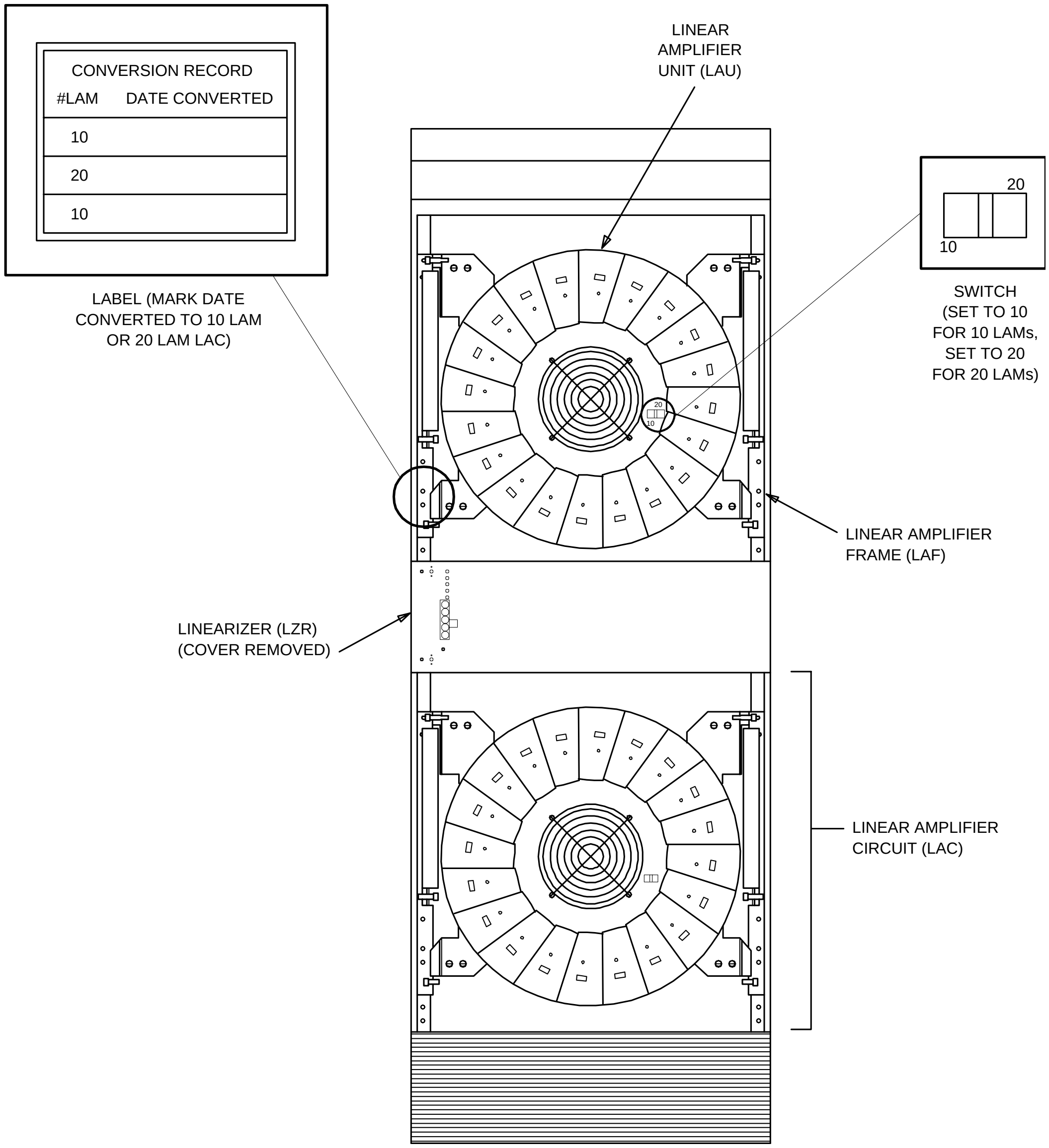


Figure 8-14. Linear Amplifier Frame (LAF) (Doors Removed)

Series II Cell Site Linear Amplifier Circuit J41660CA-1

The Linear Amplifier Unit (ED-2R839-30) and the Linearizer Unit (ED-2R841-30) make up a Linear Amplifier Circuit (LAC) (see Figure 8-15). Up to four LACs may be used. The Linear Amplifier Unit (LAU) has either 10 or 20 pie-shaped Linear Amplifier Modules (ED-2R840-30) operating in parallel. When all Linear Amplifier Modules (LAMs) are equipped, the maximum average output power is 240 watts.

The LAU has a power distribution board (AYM1), a 24-volt power filter, a cooling fan, and a temperature sensor. The output from the LAU is applied to the antenna interface frame. A splitter combiner assembly is also part of the LAU.

The term Linear Amplifier Circuit (LAC) (see Figure 8-16) is used to include all major functional parts of the Linear Amplifier Frame (LAF). The LAC provides high power amplification of many transmit signals and controls the intermodulation distortion. The LAC consists of the following:

- Combiner-Preamplifier Circuit
- Linear Amplifier Unit (LAU)
- Linearizer (LZR).

Transmit signals originating at the RCF(s) are combined and amplified to a level suitable for driving the input of the LZR. The LZR uses feed-forward, pre-distortion, and amplification of the input signal to cancel distortion and provides a level necessary for driving the LAU. The LZR provides continuous control of gain and phase to provide maximum distortion reduction. It also provides fault detection, power distribution, and overload protection for the LAC.

The LAU consists of 10 or 20 LAMs arranged in parallel, a splitter-combiner network, and a power distribution board. It amplifies the input signal to an output level of 240 watts when fully configured with 20 LAMs (approximately 120 watts when equipped with 10 LAMs). The +24 volt DC from the Cell Site power plant is applied to the filter capacitor bank in the FIA. From here, power feeders 0 through 3 supply +24 volt DC to the LAU and power feeder 4 supplies +24 volt DC to the LZR fan and to the Power Fault Monitor (PFM) board inside the LZR.

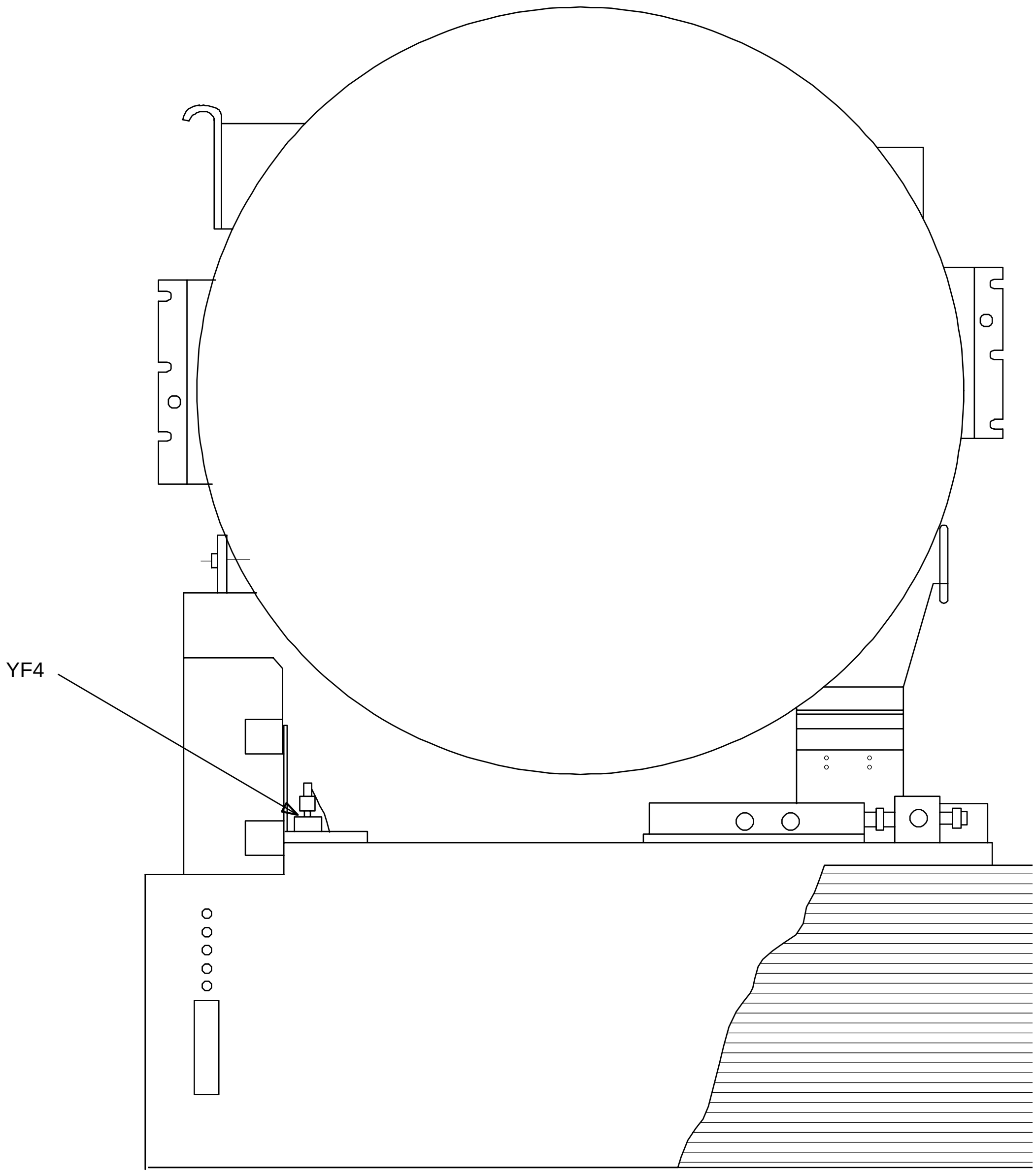


Figure 8-15. Linear Amplifier Circuit (LAC), Front View

The PFM board supplies +24 volt DC to the fan in the LAU; it also converts the +24 volt DC to +5 and ±15 volt DC and applies these to the LAU.

The PFM board distributes the gain and phase adjustment signals between various circuit boards in the LZR. It also monitors the fault status of the fans, LAMs, and the LZR internal circuits. The fault status is processed and passed to the AFI board in RCF0. When a critical fault condition occurs (for example, high temperature), the +5 volt bias to the LAU shuts down. This turns the LAU off and takes that particular LAC out of service. The fault condition continues to be monitored and the LAC put back into service automatically if the condition is cleared.

The PFM board also measures a portion of the LAC Radio Frequency (RF) output signal level (TX signal loop 2). If the measurement is too high, the PFM sends an attenuator control signal to the attenuator in the preamplifier to lower its gain.

Transmit signals from the RCF(s) are connected to one or more of the three inputs of the 3:1 power combiner located in the FIA. Each input has an adjustable attenuator for equalizing the RF path loss between the RCF(s) and the LAC combiner input. The combiner output is connected to the input of the preamplifier where the signal is amplified by 40 to 50 dB. The preamplifier has an externally accessible gain control for setting the preamplifier gain, hence, the desired LAC output power. It also can lower the gain from its set value through a feedback control from the PFM.

The preamplifier has two amplifiers connected in parallel so that a failure within the preamplifier will not shut down the whole LAC. The output of the two amplifiers is continuously monitored by the PFM board, and a failure of one is indicated by an LED on the PFM.

The output of the preamplifier is applied to and distortion correction circuits in the LZR. The RF output from the LZR is applied to the LAMs in the LAU, where it is amplified and applied through 50-dB coupler CP1 and high-power delay line DL2 to 10/50-dB coupler CP2 in the LZR. The 10-dB portion of CP2 is used to inject the distortion correction signal into the main path, while the 50-dB portion is used to couple off a signal for loop 2. The output of CP2 is coupled to circulator HY1, which sends the RF signal to the AIF and also sends a reflected TX (Transmit) signal back to the LZR.

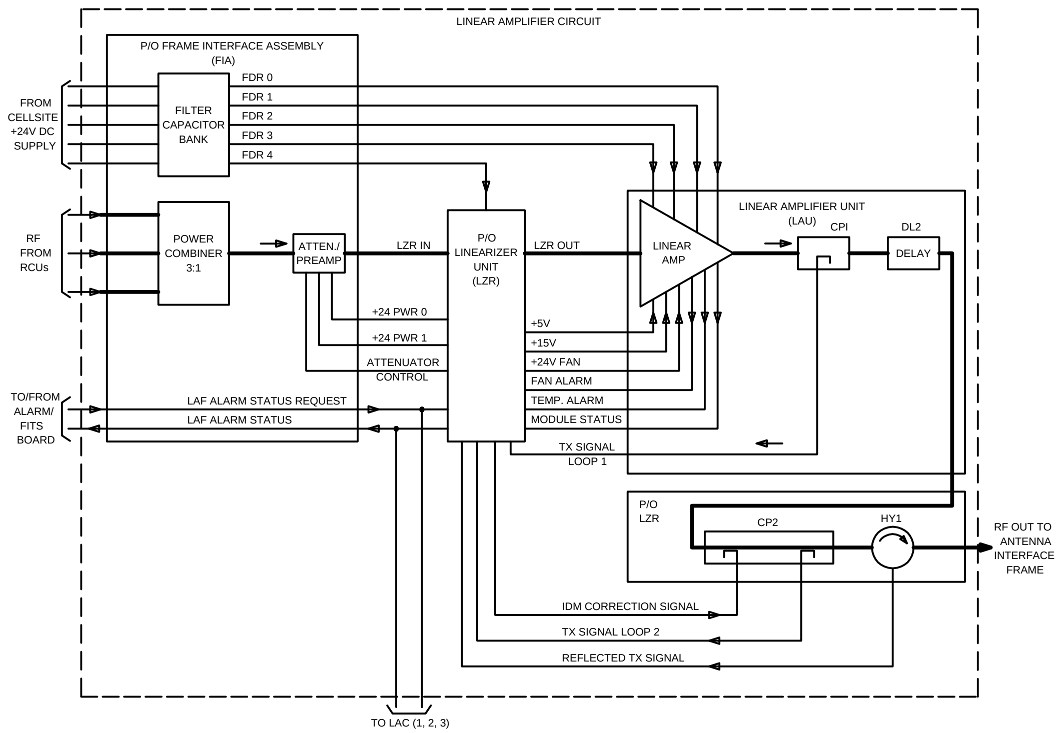


Figure 8-16. LAC Functional Diagram

Linear Amplifier Circuit (LAC) Drawings

The following list provides the Drawing code numbers for the Linear Amplifier hardware:

Code Number	LAC Drawing
SD2R265-01	Linear Amplifier Circuit
SD2R266-01	Linear Amplifier Frame
SD2R271-01	Series II Cell Site
J41660C	Linear Amplifier Frame
J41660CA	Linear Amplifier Circuit
ED2R839-30	Linear Amplifier Unit
ED2R840-30	Linear Amplifier Module
ED2R841-30	Linearizer Unit.

Series II Cell Site, Differences Between A/B-Series and C-Series Linear Amplifier Circuits (LACs)

This section describes the differences in alarm reporting between A/B-Series and C-Series Linear Amplifier Circuits (LACs). A description of LAC LED indicators (See Table 8-12, and Table 8-13) and field replaceable fuses is also provided.

C-Series LACs provide improved power circuitry and alarm indications. C-Series LACs are most easily distinguishable from A/B-Series LACs by the presence of the 10/20 LAM Switch on the circular power distribution (AYM) board on the Linear Amplifier Unit (LAU).

For additional information, consult Lucent Technologies Customer Information Bulletin 196A, "Improved "C" Linear Amplifier Circuit Features."

Table 8-12. Linear Amplifier Frame / Linear Amplifier Circuit (J41660CA-1) Controls and Indicators

Circuit Pack	Control/ Indicator	Type	Function
Linear Amplifier Unit ED-2R839-30			
AYM3	DS1-DS20	LED (Red)	Indicates +24-volt power failure to the associated Linear Amplifier Module.
Linearizer ED-2R841-30			
AYE1	SW1		Sets address of the LAC.
	SW2		Factory/field switch.
	SW3 SW4		Supplies pilot signal to the Gain Phase Adjuster AYF1.
AYG1	STATUS		
	Input Drive	LED (Red)	Indicates a problem with the RF input.
	Fans	LED (Red)	Indicates a fan failure.
	Preamplifier	LED (Red)	Indicates one or both input preamplifiers have failed.
	Linear Amplifier Unit	LED (Red)	Indicates a fan failure, high temperature, or LAM failures in the LAU.
	Linearizer	LED (Red)	Indicates a fan failure, power supply failure, or excessive intermodulation distortion in the Linearizer.

Table 8-13. Linear Amplifier Frame / Linear Amplifier Circuit (J41660CA-1) Fuses

Fuse	Designation	Voltage Supplied To Circuit	Location
LINEAR AMPLIFIER UNIT FAN	F9, 5A, +24V	Fan B2 in the LAU by Temp. Sensor EAP1 and filter FL1	19, 54
PREAMPLIFIER	F10, 2A, +24V F11, 2A, +24V	Attenuator Preamplifier PA1 in the Linearizer	10, 28
LINEARIZER FAN	F12, 3A, +24V	Fan B1 in the Linearizer by TB1	10, 28
FCA	F13, 10A, +24V	AYH2 board in the Linearizer	10, 28

Series II Cell Site Linear Amplifier Module ED-2R840-30

The Linear Amplifier Unit (LAU) is capable of handling 20 Linear Amplifier Modules (LAMs) (See Figure 8-17). Two sets of 10 modules must be used — one set may be non-amplifying modules.

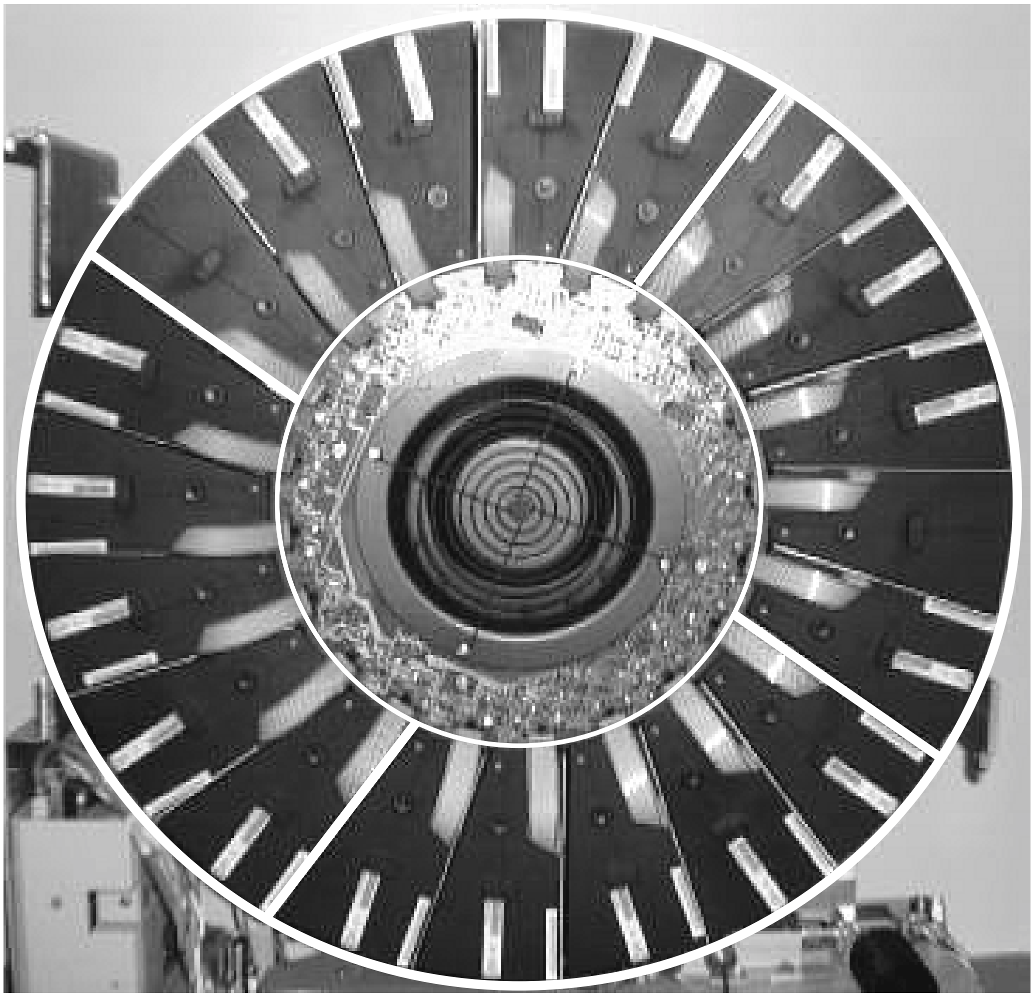


Figure 8-17. Linear Amplifier Module (LAM)

Series II Cell Site Linear Amplifier Unit (LAU)

The Linear Amplifier Unit (LAU) (see Figure 8-18) receives the Radio Frequency (RF) output from the linearizer unit (LZR) and applies it to an Linear Amplifier Module (LAM) where it is amplified and then processed out to the Antenna

Interface Frame (AIF). The LAU also contains a cooling fan and a temperature sensor (overheat sensor).

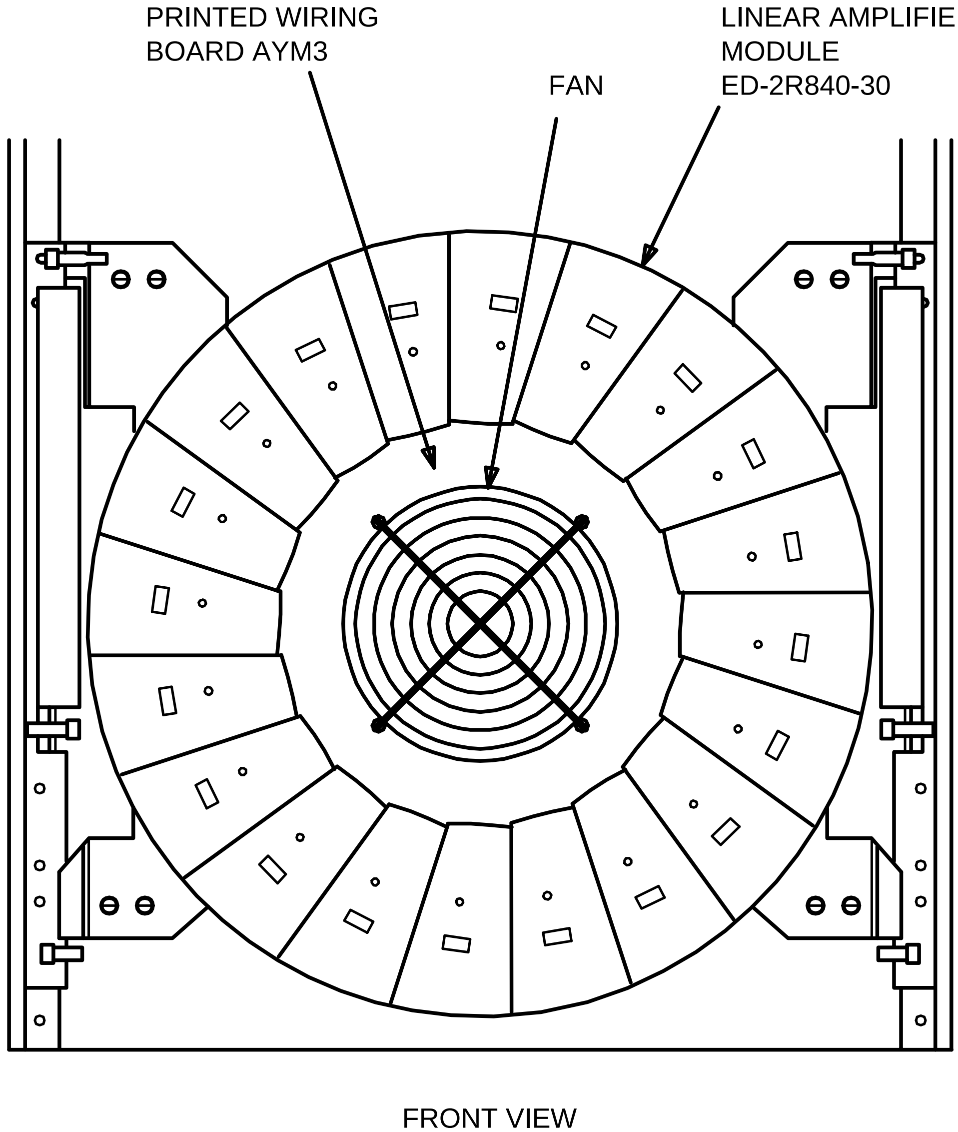


Figure 8-18. Linear Amplifier Unit ED-2R839-30

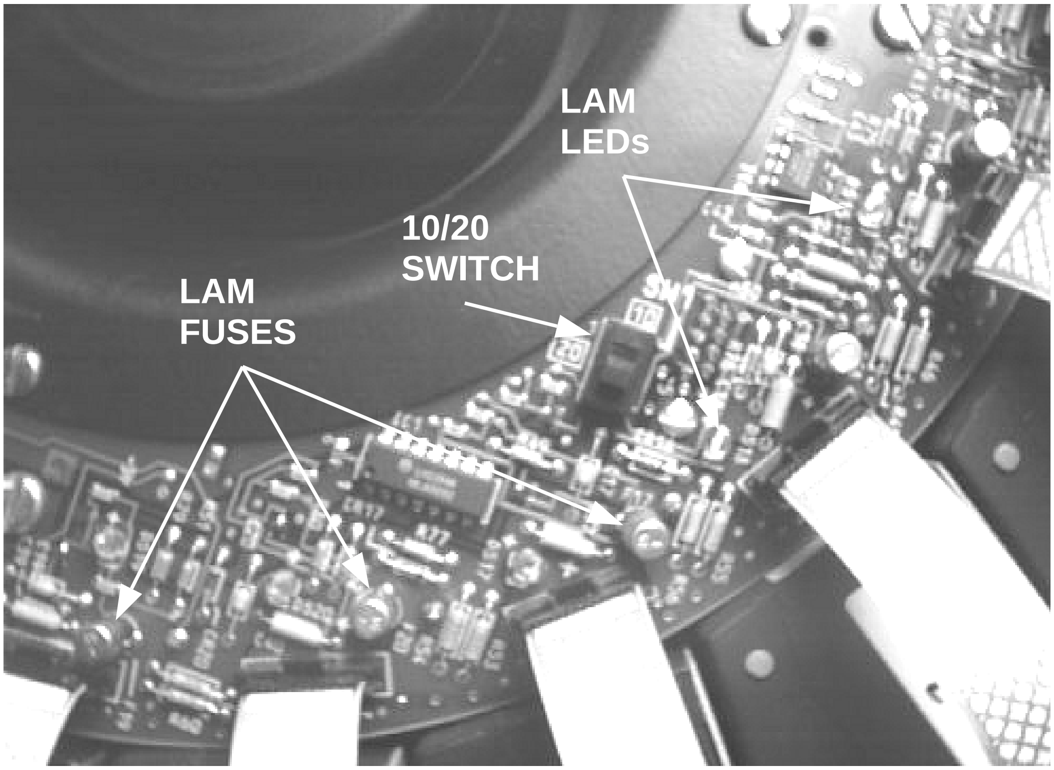


Figure 8-19. Location of LAM Fuses, LEDs, and the 10/20 Switch (on C-Series LACs)

Series II Cell Site, 20-LAM LAC Versus 10-LAM LAC

When Linear Amplifier Circuits (LACs) are shipped from the factory, they are configured as full-power (20-LAM) LACs (see Figure 8-19). If they are to be installed as low-power (10-LAM) LACs, an in-line SMA attenuator must be installed in Series with a coaxial cable in the Linearizer (LZR) and, on C-Series LACs, the 10/20 switch on the front of the circuit AYM board must be changed to the 10 position. To change back to a 20-LAM LAC, the in-line attenuator must be removed and the switch returned to the 20 position. A label (CONVERSION RECORD) is provided on the front face of the Linearizer cabinet on C-Series LACs and should be marked with the date of any 10/20 conversion. A suitable label should also be placed on any A/B-Series LACs which are converted.

NOTE:
Any new C-Series LACs shipped from the factory as replacements will not have attenuators. The attenuators may be obtained from Lucent Technologies as a spare part, Comcode 406825794 or 406822064. Any

new C-Series, half-power LACs ordered will have the attenuator shipped loose as part of J41660CA-1, List 3 or J41660CA-2, List 4.

Series II Cell Site Linearizer Unit ED-2R841-30

The Linearizer unit (LZR) (see Figure 8-20, and Figure 8-23) is located in a shelf below each Linear Amplifier Unit (LAU). The LZR contains circuits that function to reduce intermodulation distortion. The LZR contains a power fault monitor board. This board monitors faults and sends alarms back to the Radio Control Frame (RCF).

The Linearizer Unit (LZR) receives the combined Radio Frequency (RF) input from the Frame Interface Assembly (FIA) and functions to reduce the intermodulation distortion prior to applying the RF input to the Linear Amplifier Unit (LAU). The LZR also has circuits to monitor alarm conditions on the Linear Amplifier (LAF).

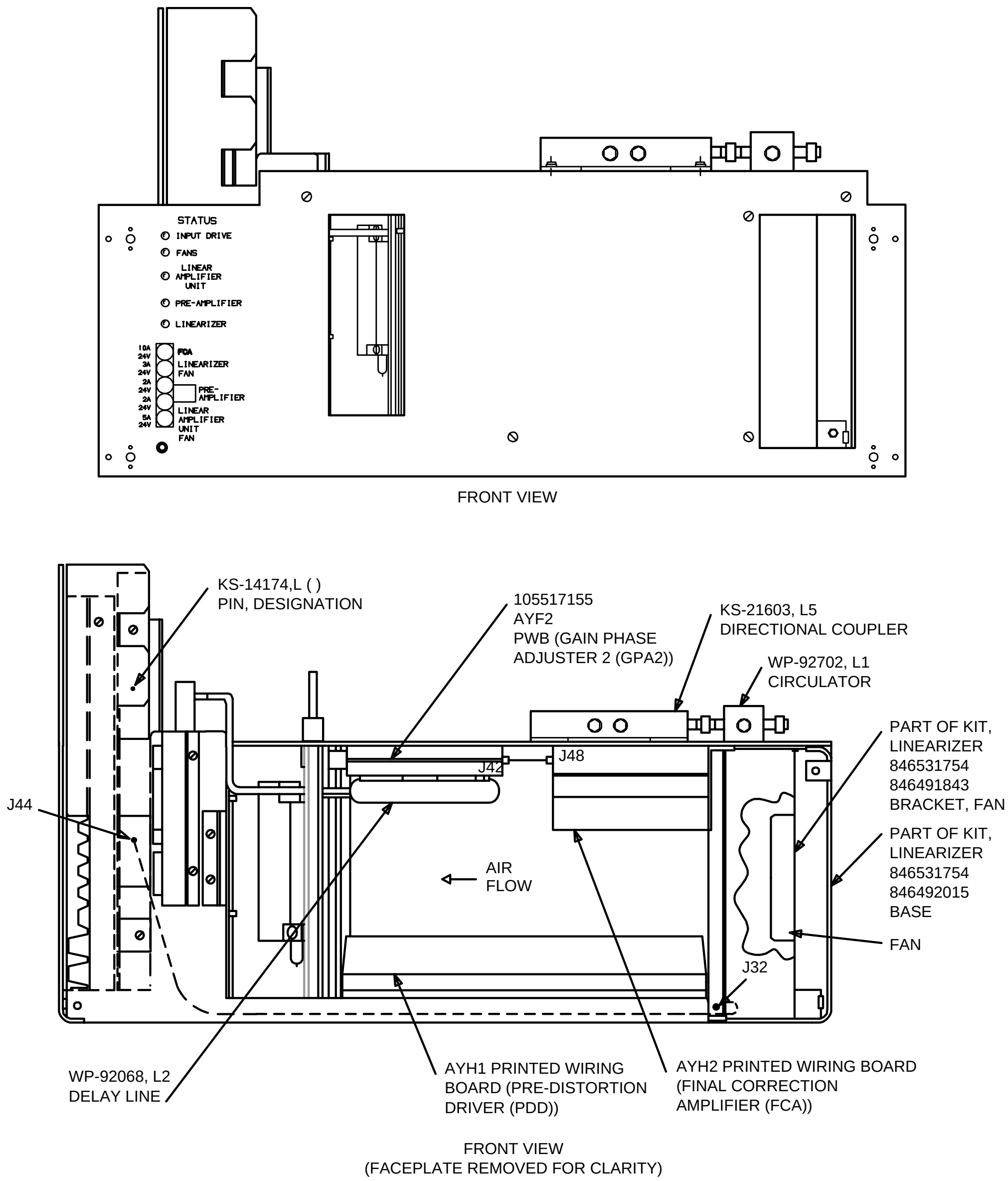


Figure 8-20. Linearizer (LZR) Unit ED-2R841-30

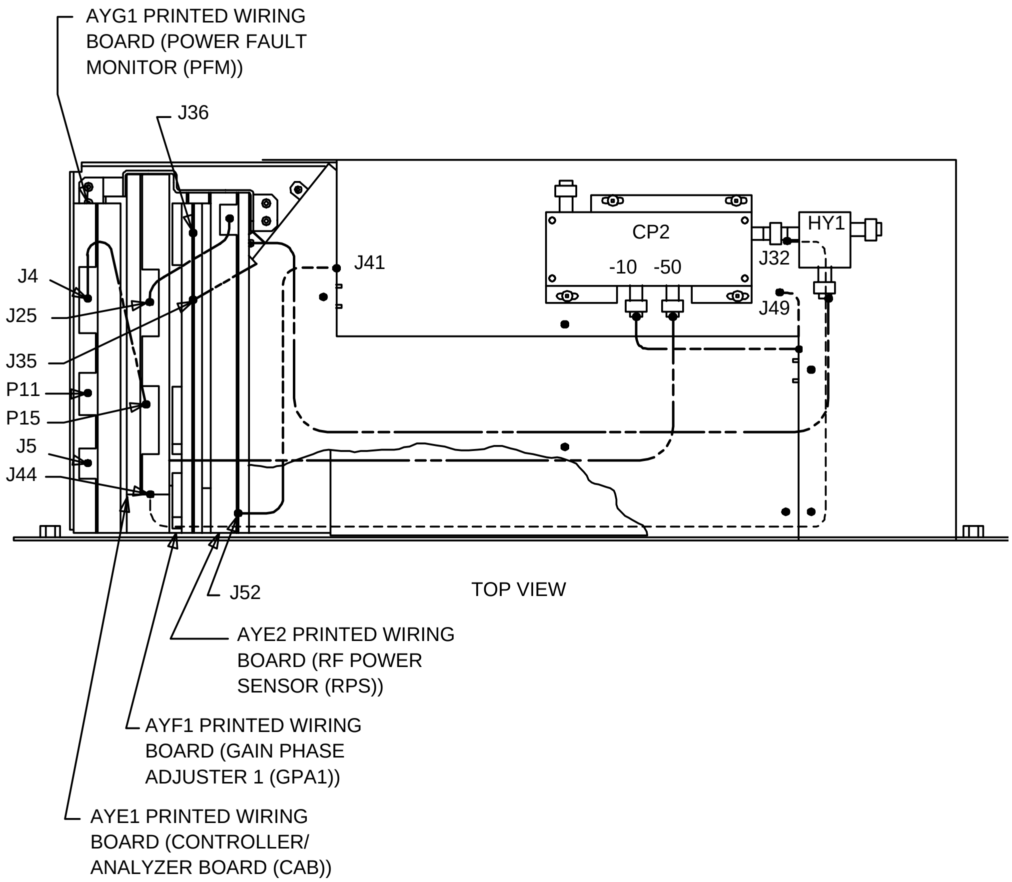
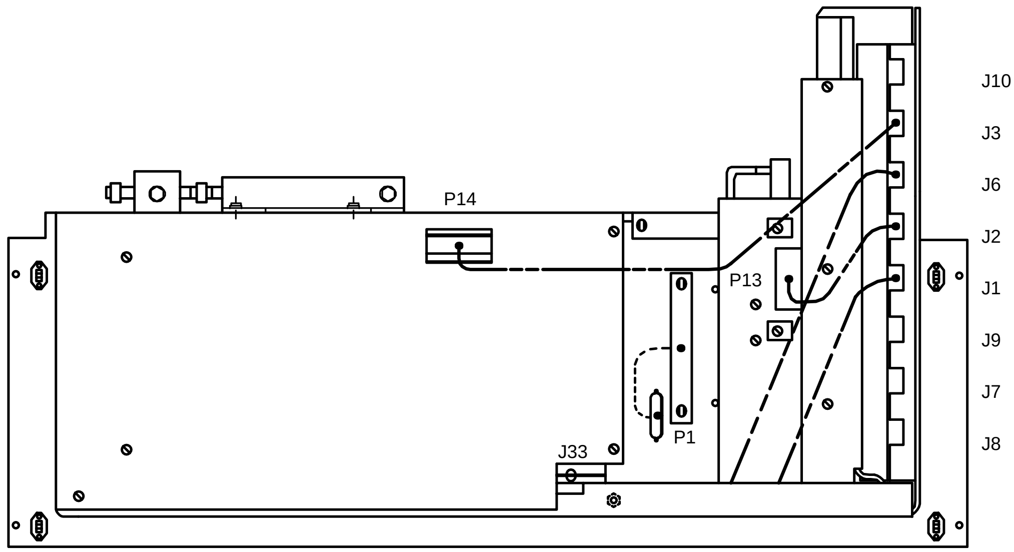


Figure 8-21. Linearizer Unit ED-2R841-30



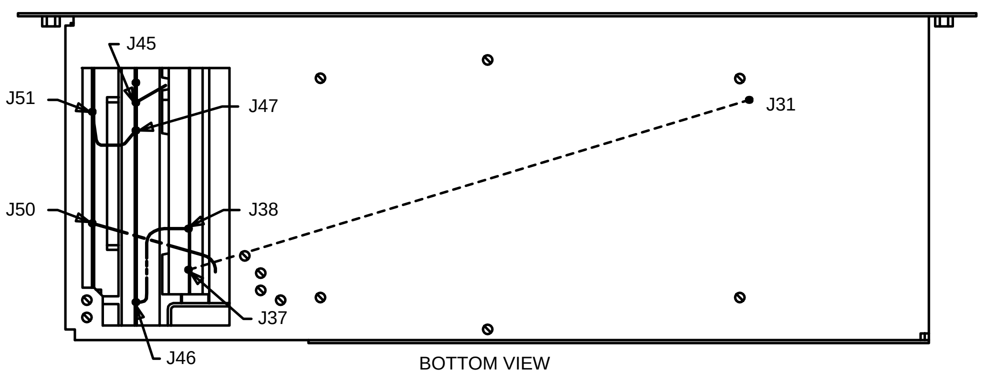


Figure 8-22. Linearizer Unit ED-2R841-30

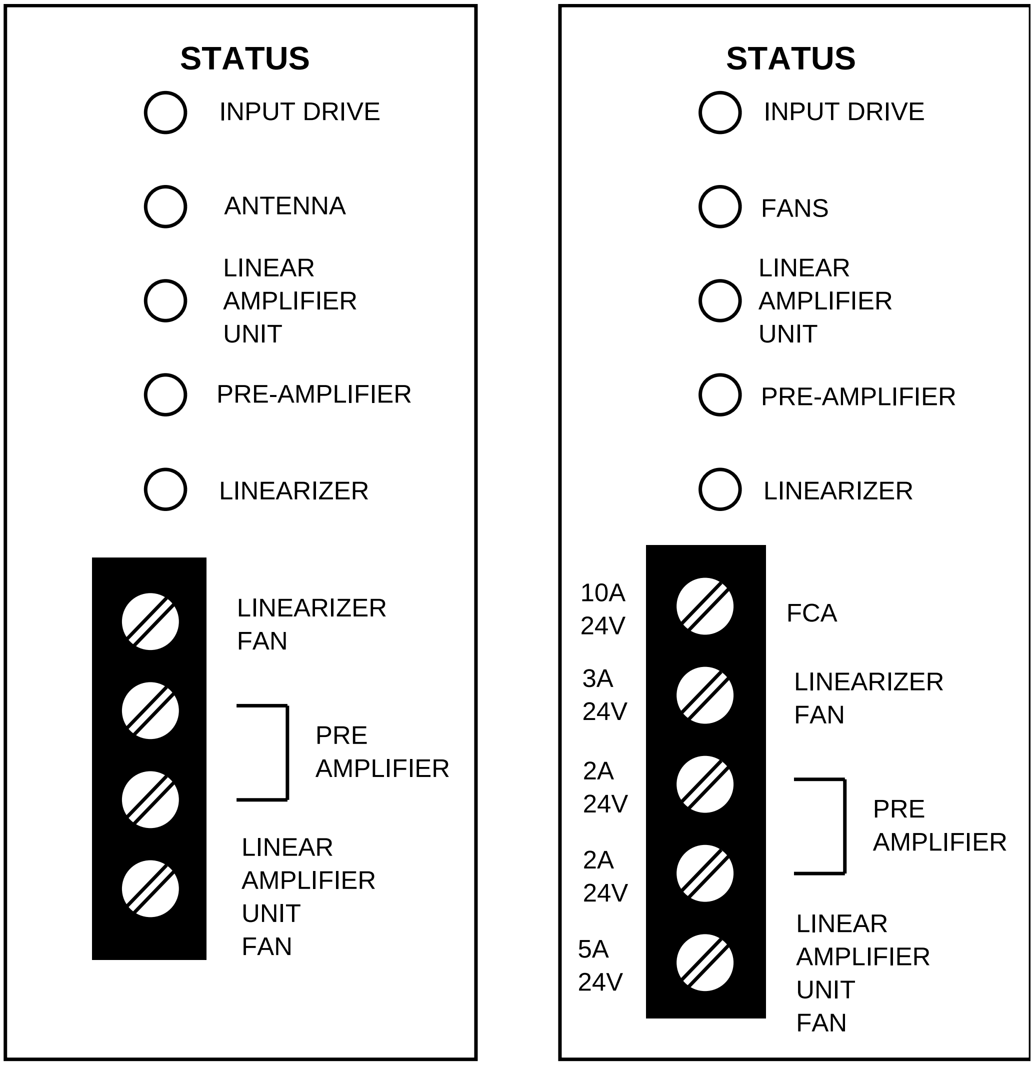


Figure 8-23. Linearizer Faceplate with the Front Grille Removed

Please refer to Lucent Technologies Practice 401-660-125 for a full description of the Modular Linear Amplifier Circuit (MLAC) J-41660CA-3.

Series II Cell Site Frame Interface Assembly ED-2R838-30

The frame interface assembly contains the connectors used to interface the Linear Amplifier Frame (LAF) with the power plant and Radio Channel Frames (RCFs). Also, this assembly contains 20 capacitors used to filter the +24 volt supply.

The Frame Interface Assembly (FIA) (see Figure 8-24) contains a bank of filter capacitors used to filter the DC voltage applied to the Linearizer unit (LZR) and the Linear Amplifier Unit (LAU). In addition, the FIA combines the Radio Frequency (RF) inputs from the Radio Channel Frames (RCFs) through a 3:1 power combiner and applies the combined RF output to an attenuator/ preamplifier. The output of this attenuator/preamplifier is adjusted as required and applied to the LZR. Also, Linear Amplifier Frame (LAF) alarm status request and alarms pass through the FIA.

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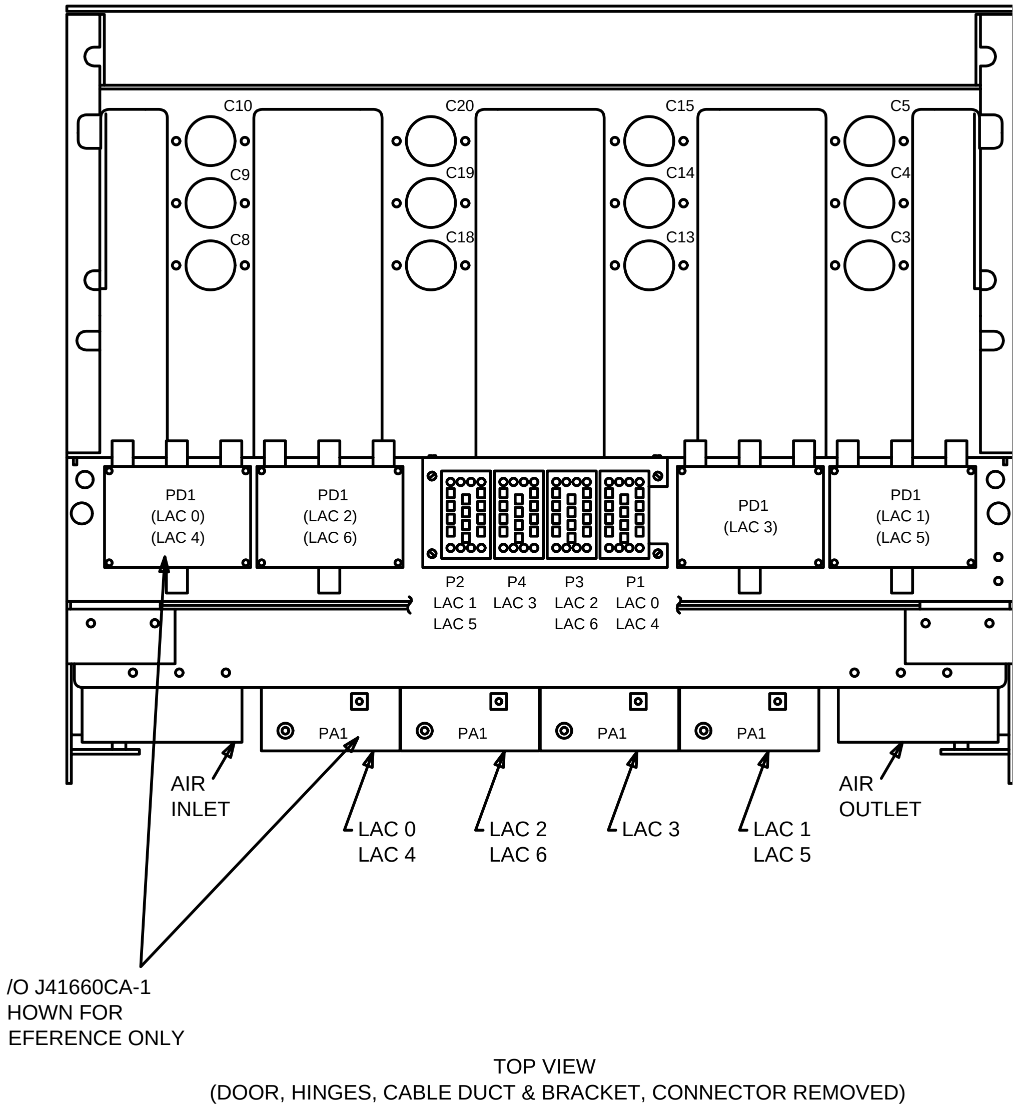

Figure 8-24. Frame Interface Assembly ED-2R838-30

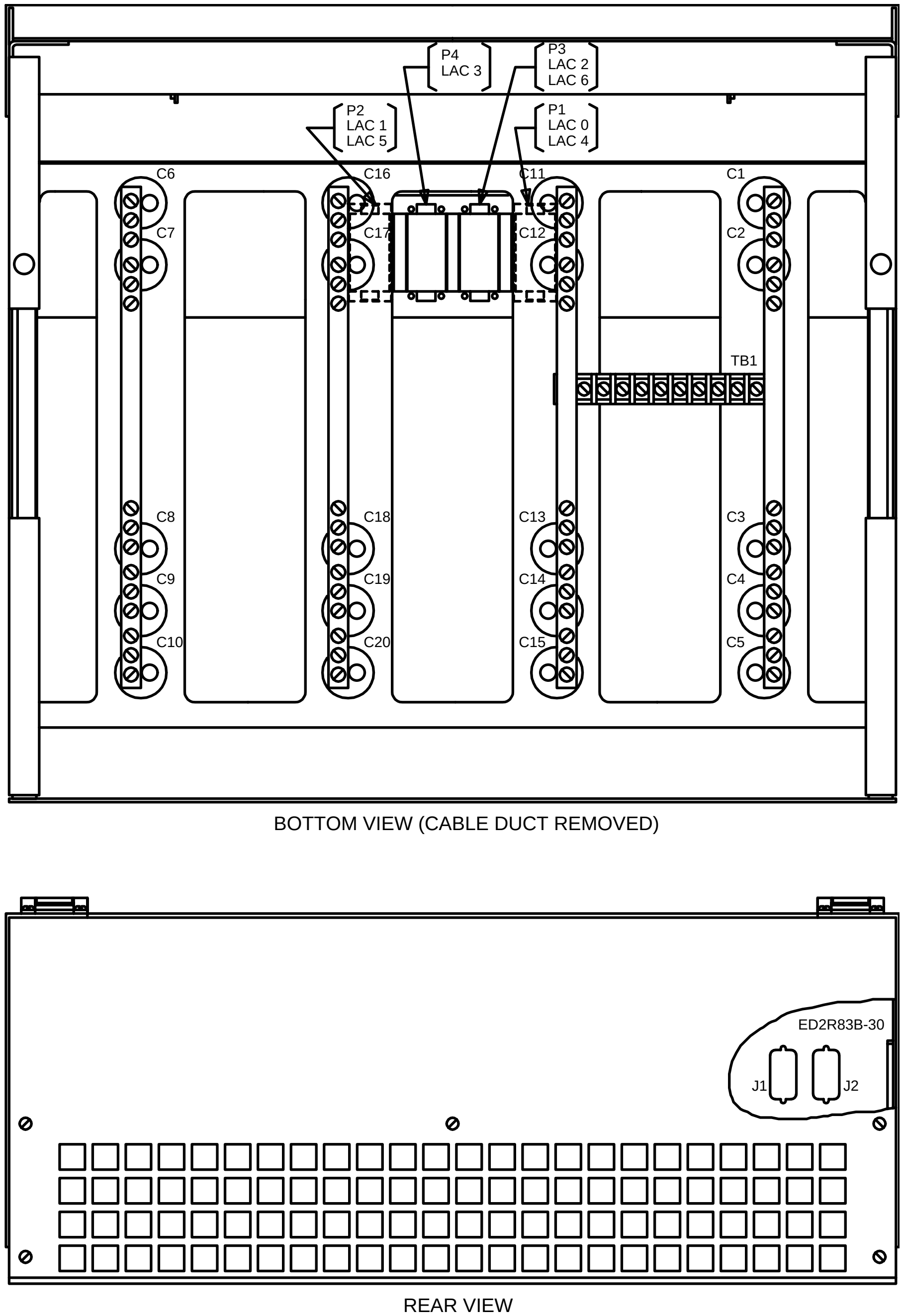

Figure 8-25. Frame Interface Assembly ED-2R838-30

Series II Cell Site Antenna Interface Frame (AIF), Overview

The major hardware units on the Antenna Interface Frame (AIF) are listed below and are described functionally in the following paragraphs.

- Receive, Alarm, and Power Distribution Panel
- Reference Frequency Generator (RFG)
- Radio Test Unit (RTU) Switch
- Receiver Calibration Generator (RCG)
- Receive Filter Panel (RFP)
- Transmit Filter Panel.

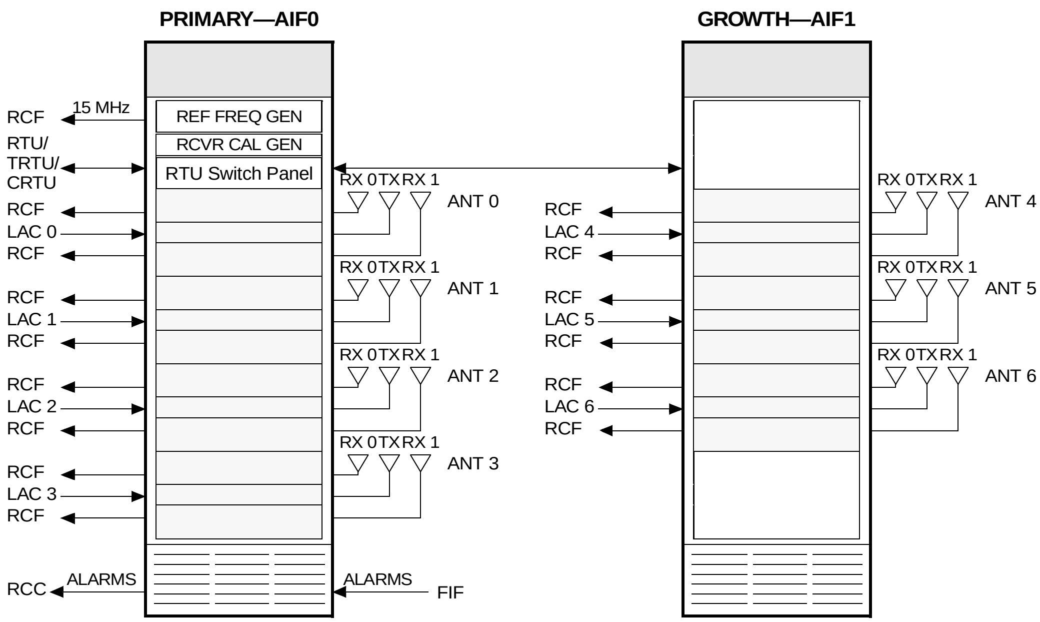

Figure 8-26. Antenna Interface Frame (AIF) Functional Diagram

The Antenna Interface Frame (AIF) has two configurations—a primary frame (J41660E-2) and a growth frame (J41660F-2). The Antenna Interface Frame (AIF) provides the interface and signal filtering circuitry required to complete the

Cell Site Receive (RX) and Transmit (TX) RF paths from the RX and TX antennas to the LAFs and Radio Channel Unit (RCUs) inside the RCFs. This is accomplished through the TX and RX filter panels (TFPs and RFPs) in the AIF.

In addition to the Radio Frequency (RF) filtering and interface circuitry, the AIF contains the test circuitry required for radio diagnostics. A test switch matrix is used to establish the required test paths. A Receiver Calibration Generator (RCG) is used to set a known level for RX path loss calibration. The AIF also contains a highly accurate Cell Site Reference Frequency Generator.

The major assemblies making up each configuration are listed and described below. Note that a duplexer filter panel is available to replace the separate receive and transmit filter panels. The duplexer filter panel has one configuration for the "A" band and another for the "B" band.

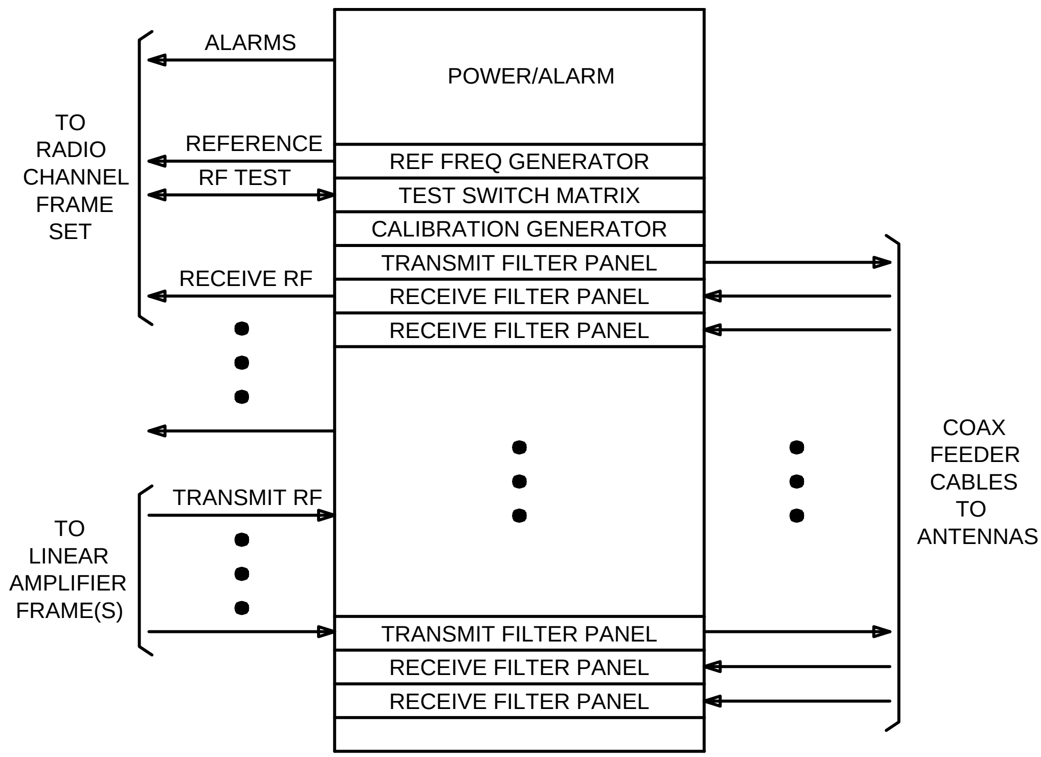

Figure 8-27. Antenna Interface Frame (AIF) Functional Architecture

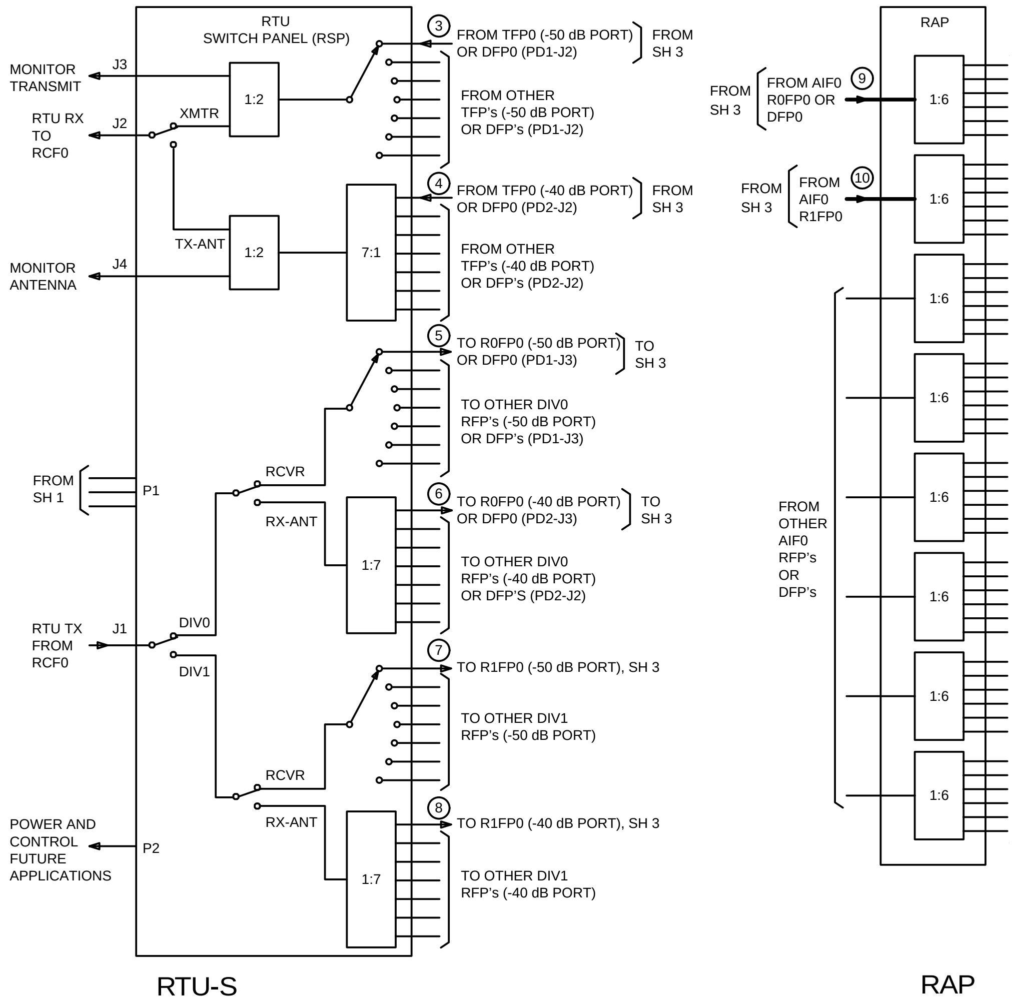

Figure 8-28. Antenna Interface Frame (AIF) Functional Diagram

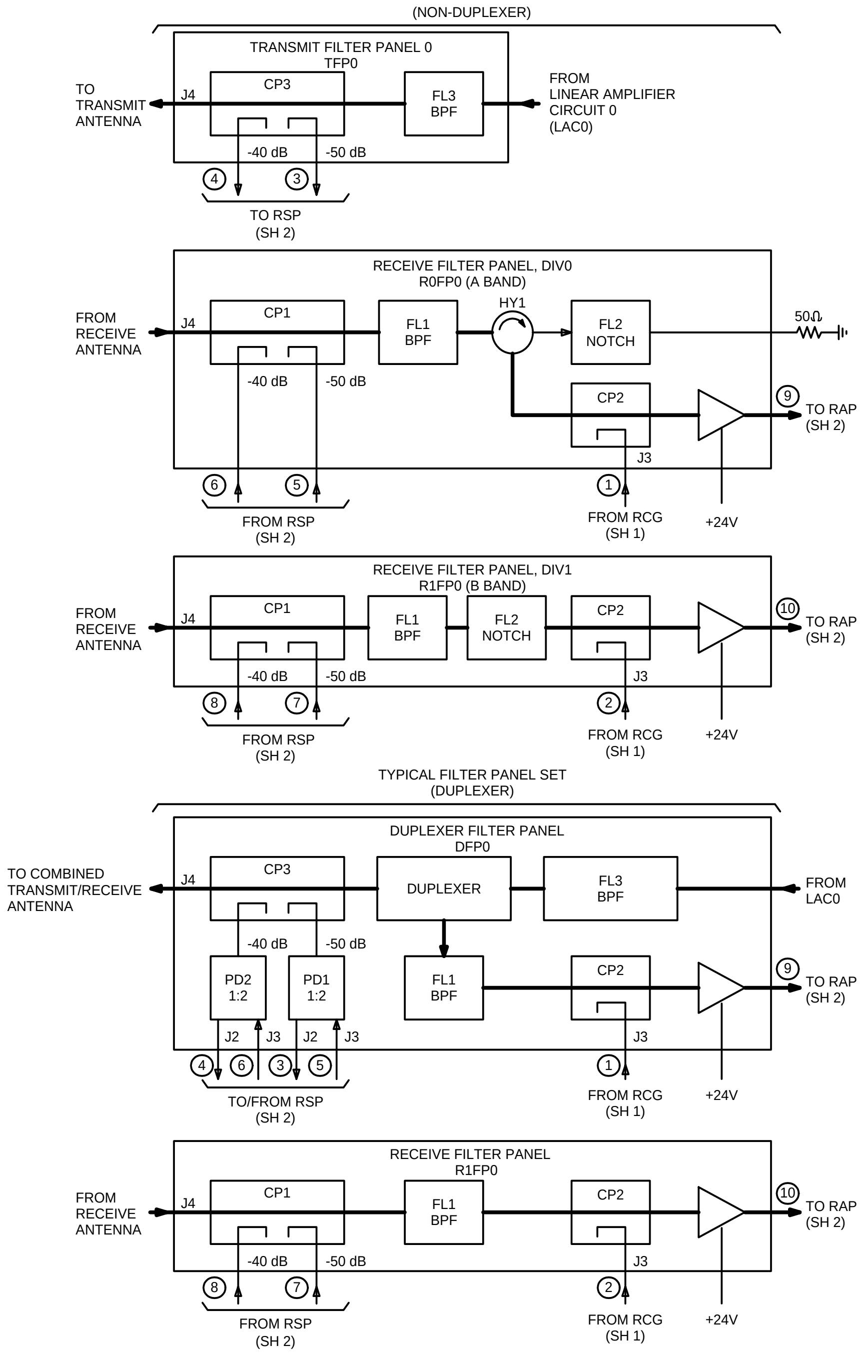

Figure 8-29. Antenna Interface Frame (AIF) Functional Diagram

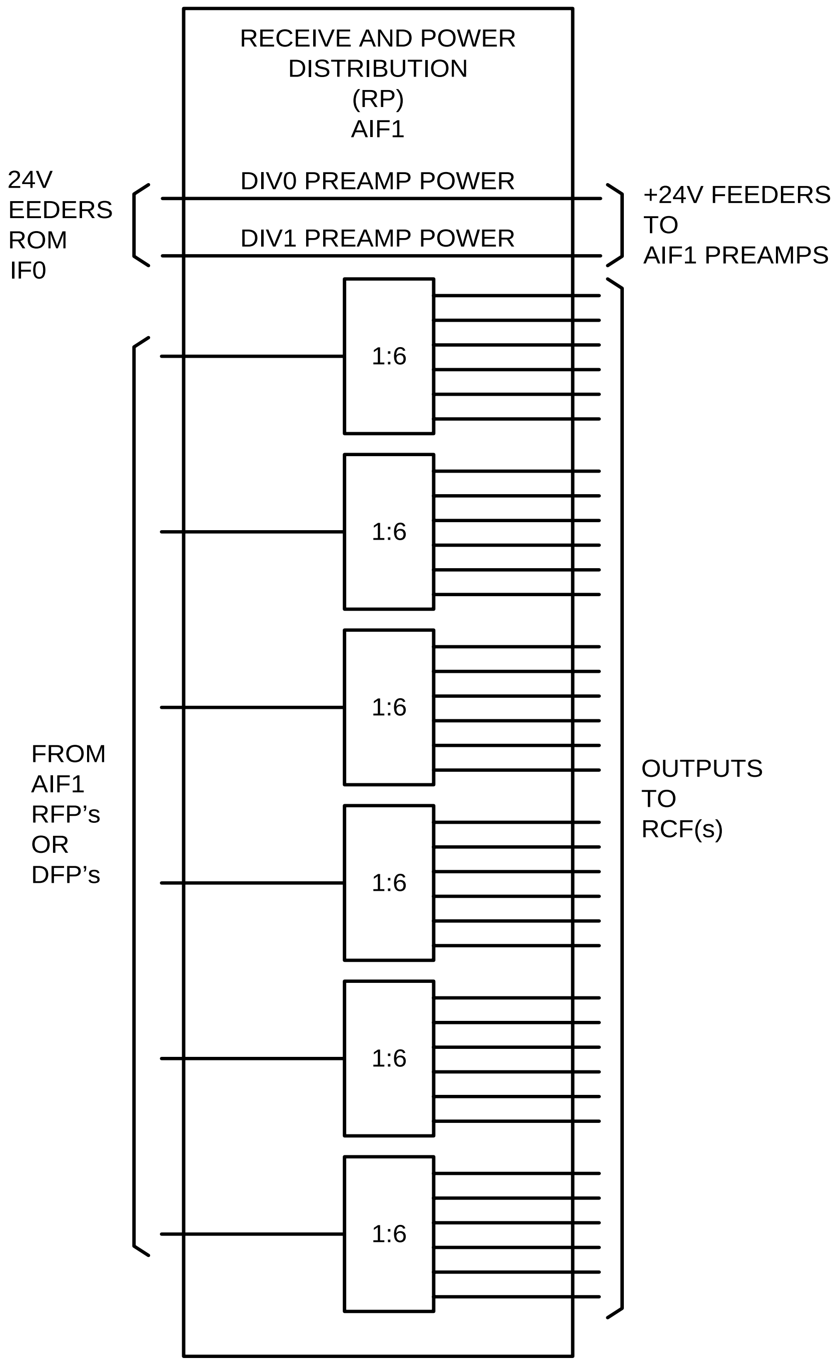

Figure 8-30. Antenna Interface Growth Frame (AIF) Functional Diagram

Series II Cell Site Reference Frequency Generator (RFG) Shelf

The Reference Frequency Generator (RFG) provides a 15-MHz precision reference frequency at a level of +12 dBm ±2 dB. The 15-MHz signal is used as a reference frequency by the Radio Channel Units (RCUs) and the Radio Test Unit (RTU) to produce the desired output frequency. The oscillator circuit is monitored for and indicates when a fault has occurred. When the RFG shelf supports two oscillators, only one oscillator is on line at a time as indicated by Light Emitting Diodes (LEDs).

There are three options available for the RFG shelf, as follows:

1. RFG shelf with one (1) Rubidium oscillator.
2. RFG shelf with two (2) Rubidium oscillators.
3. RFG shelf with one (1) Rubidium oscillator and one (1) crystal oscillator.

Series II Cell Site Receiver Calibration Generator ED-2R845-30

This unit generates the Radio Frequency (RF) test signals used in calibrating the RF path loss within the Cell Site.

The Receiver Calibration Generator (RCG) provides a stable unmodulated calibration signal on Mobile Transmit channel 990. The RCG has a total of 16 Radio Frequency (RF) ports (only 14 are used). These ports are coupled to the inputs of the preamplifiers in the receive paths inside the AIF through 20-dB directional couplers. The calibration signal is used by each Radio Channel Unit (RCU to determine a correction factor required for its Received Signal Strength Indicator (RSSI) output. The correction factor is used to compensate for non frequency dependent losses in each RCU receive path.

The stability of the RCG output frequency is the same as that of the 15-MHz reference frequency. The RCG output frequency is factory preset to channel 990—824.01 MHz. The nominal output power level of each of the 16 RCG ports is -58 dBm ±1.5 dB.

There are four translations entries which affect Receiver Calibration.

- Frequency (Found in the Cell Form)
- Tolerance (Also found in the Cell Form)
- Receive Signal Strength Calibration Diversity 0 (Referred to as the Expected Value, found in the CEQFACE form)
- Receive Signal Strength Diversity 1 (Referred to as the Expected Value, also found in the CEQFACE form).

The RCUs must be reset before these parameters will have an effect. The Receive Signal Strength Calibration parameters for diversity 0 and 1 apply to each face. Changing either of these parameters will only affect the RCUs on that face.

During an RCU restore sequence, the data decoder tunes to the calibration channel (990) and makes signal strength measurements for each antenna diversity. As a result of these measurements, one of the following three things happens:

- If the measurement falls within the tolerance value but is not exactly the same as the expected value, the decoder records the difference between the expected value and the actual measurement. Subsequent measurements made by that radio are adjusted by this value.
- If any of the measurements fall outside of tolerance, no corrections are made to the measured signal strengths. Also, a Receiver Calibration HEH Error message is printed out on the receive-only printer (ROP).
- If the measured value is the same as the expected value, no adjustments are made.

Receiver calibration errors can be the result of incorrect translations, defective RF cabling, faulty RCUs, defective preamps, or basically any problem found between the RCG and the RCUs.

There are two AIF models—AIF0 (primary) and AIF1 (growth). AIF0 contains a Receive, Alarm, and Power Distribution Panel (RAP), an RFG, an RCG, and a Radio Test Unit Switch Panel (RSP). AIF0 can be equipped with one to four sets of filter panels (a single set consists of one TX and two RX filter panels unless it is duplexed).

AIF1 Frame

AIF1 serves as an auxiliary frame to accommodate additional filter panels. It contains a Receive and Power (RP) Distribution Panel and can be equipped with one to three additional filter panel sets.

Integrated Duplexer Filter Panels (DFPs) are optional. When equipped, a DFP assembly can be used to combine a TX filter panel with an RX filter panel and share one combined RX/TX antenna port, thus reducing the required number of antennas from three to two per antenna face. Unless otherwise specified, a DFP combines the RX DIV0 path with the TX path.

AIF0 combined with AIF1 accommodates up to seven antenna faces, typically consisting of seven TX paths and 14 RX paths. Each antenna face requires an RX filter for the diversity 0 (DIV0) RX path, a TX filter for the TX path, and an RX filter for the diversity 1 (DIV1) RX path.

There are some interframe connections between AIF0 and AIF1 to provide the following circuit functions. The RSP in AIF0 switches test signals from the RTU (located in the P-RCF) to and from various RX and TX paths of both AIF0 and AIF1 for system diagnostics. The RAP panel in AIF0 connects the +24 volt DC power supplies to all of the preamplifiers inside the Receiver Filter Panels (RFPs) or DFP(s) of both AIF0 and AIF1. The RCG in AIF0 provides a leveled signal to calibrate all of the RX paths from the AIF equipment all the way to the inputs of the RCUs. There are RF connections from AIF0 to the RCF(s), the LAF(s), the RX antennas and the TX antennas.

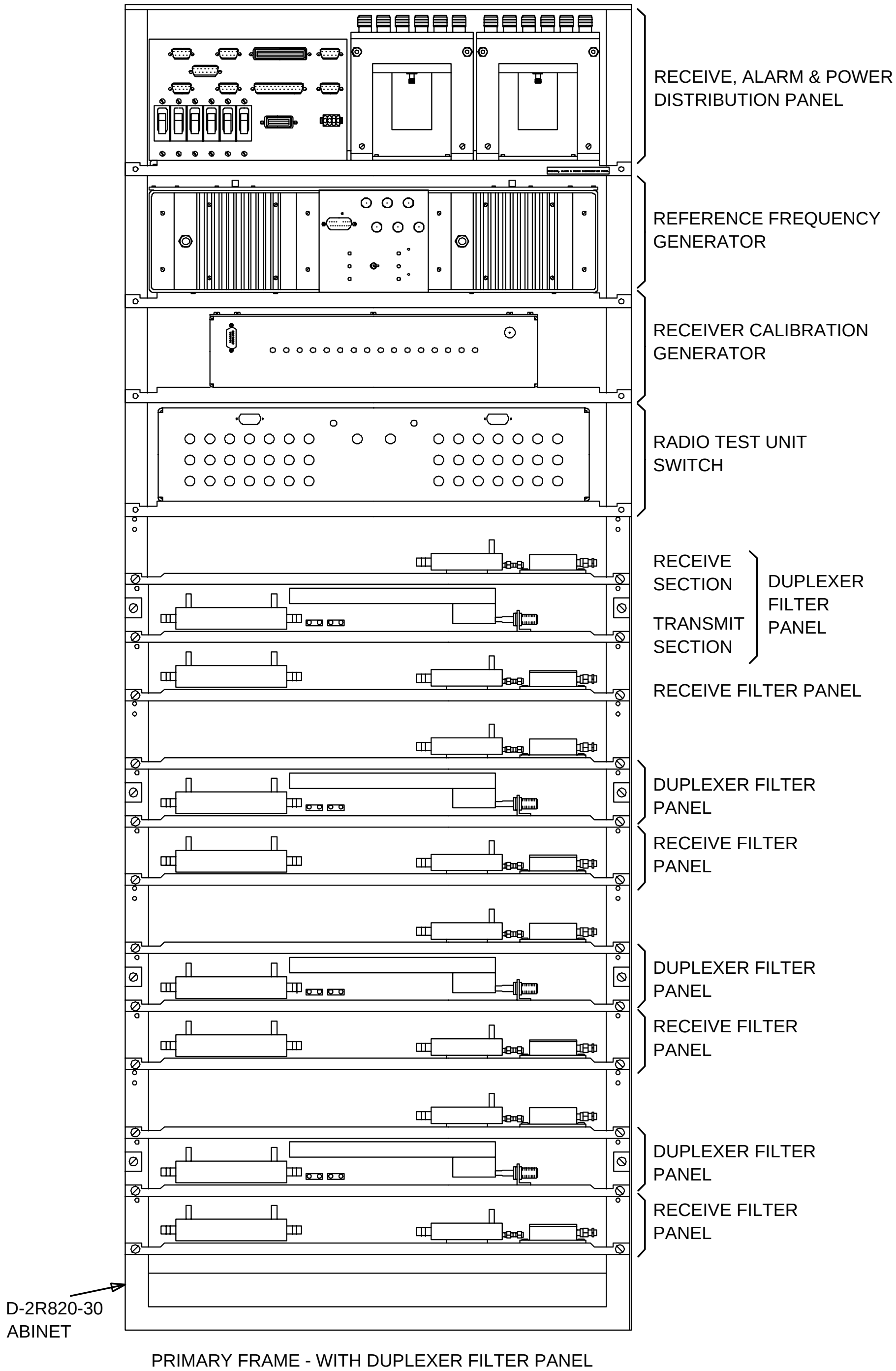

Figure 8-31. Primary Antenna Interface Frame (AIF) J41660E-2

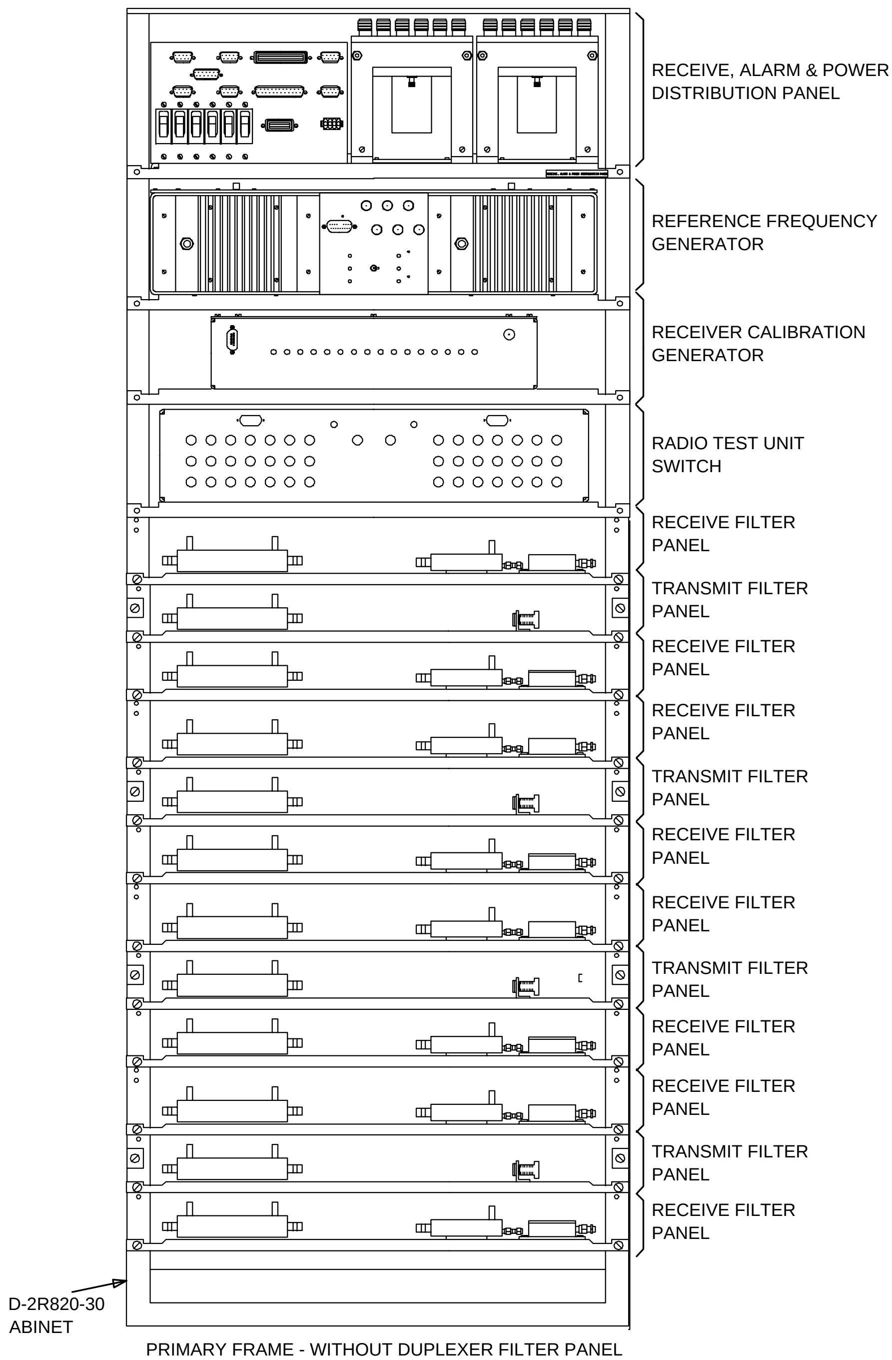

Figure 8-32. Primary Antenna Interface Frame J41660E-2

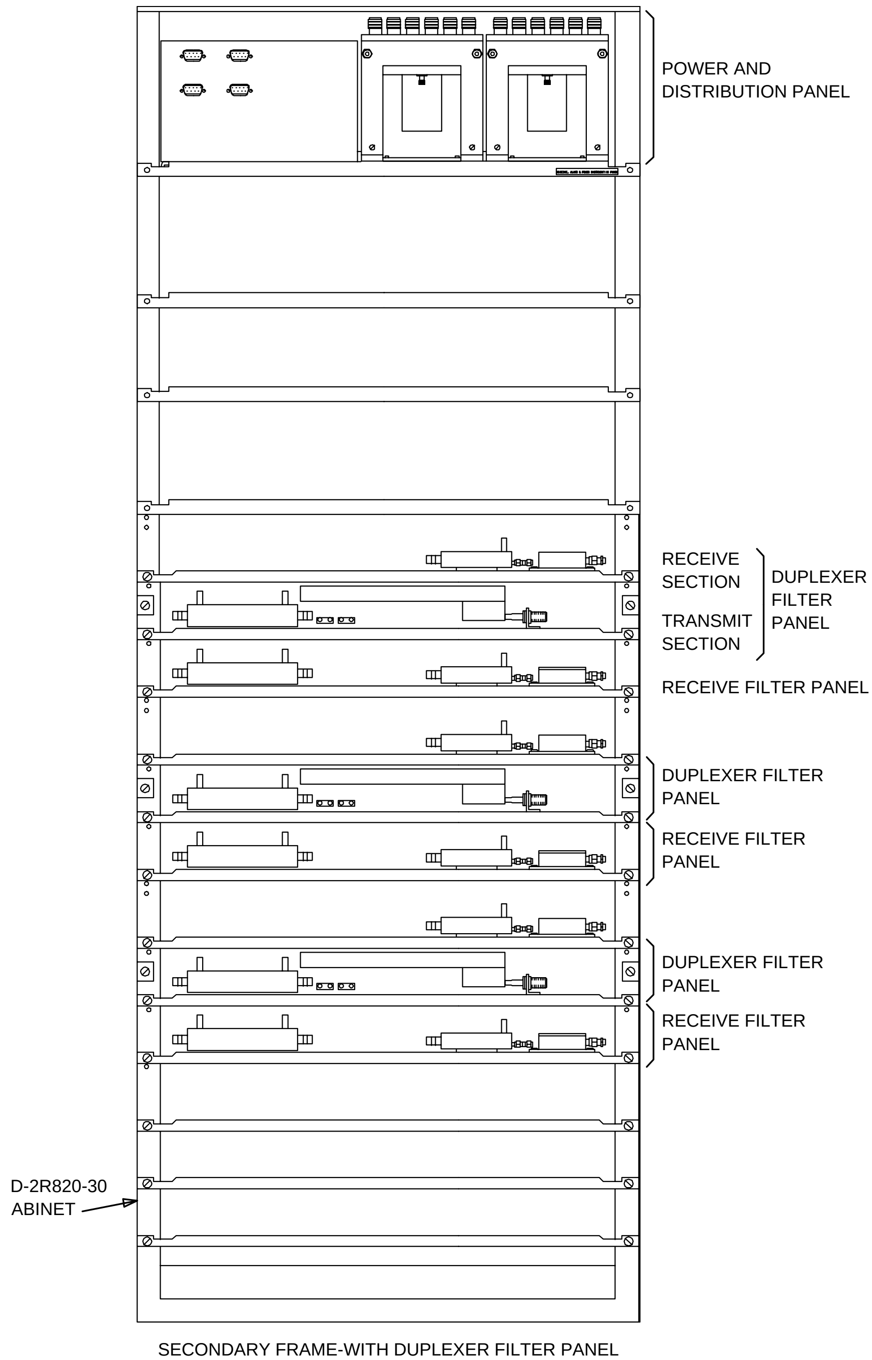

Figure 8-33. Growth Antenna Interface Frame J41660F -2

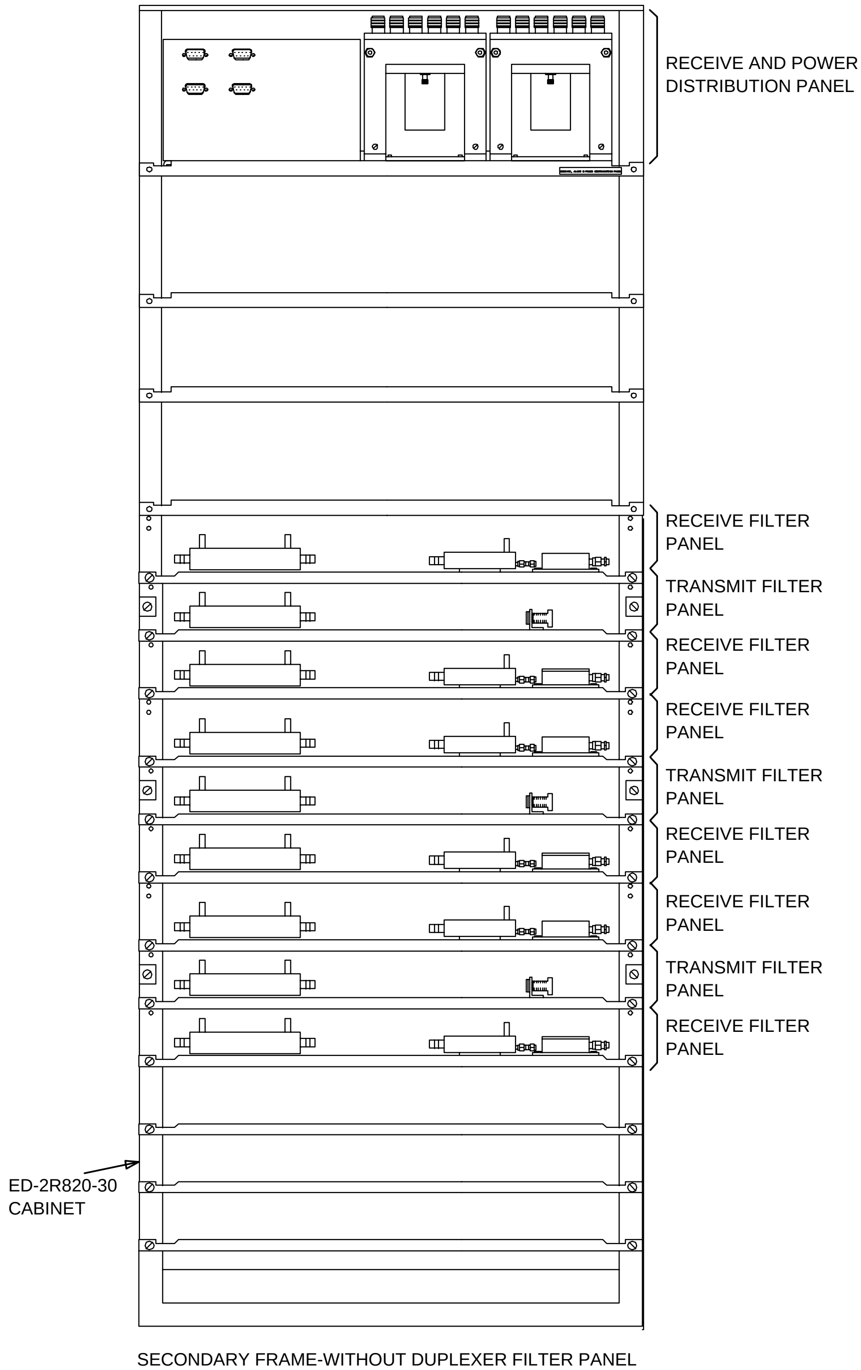

Figure 8-34. Growth Antenna Interface Frame J41660F-2

Series II Cell Site Radio Switch Panel

Series II Cell Site Radio Test Unit (RTU) Switch Panel

This switch panel establishes the functional Radio Frequency (RF) test path used by the Radio Test Unit (RTU) during diagnostic testing. These paths include the following:

- Receiver-Forward Signal Injection
- Receiver-Reflected Signal Injection
- Transmit-Forward Signal Measurement
- Transmit-Reflected Signal Measurement.

The test paths are made through directional couplers containing forward and reflected ports. Under software control, the RTU switch establishes the required paths to test all major functional operations.

The Radio Switch Panel (RSP) provides the RTU (located in RCF0) access to the Cell Site Rx and Tx (Receive and Transmit) paths through a test matrix Radio Frequency (RF) distribution network. The RTU is coupled to the incident and reflected path of every antenna used by the Cell Site through the RSP. RF test signals to and from the RTU test receiver and the transmitter are connected to the RSP. The RSP receives logic control signals from the RTU to switch the RF test signals from the RTU to the Rx and Tx paths under test.

The RTU is used primarily to verify the Rx and Tx paths to and from the transmit and receive antennas of the Cell Site. The RTU contains a test receiver and test generator which serve to simulate a subscriber unit. The test receiver and the test generator can be tuned to any channel. Tuning is accomplished with commands sent over the TDM bus to an Rx/Tx frequency synthesizer within the RTU. The RTU controls the RF switches located in the RSP. The TDM bus is always installed "red stripe up."

During Rx testing on a Cell Site Radio Channel Unit (RCU), the test generator within the RTU is tuned to the channel under test, and the output of the test generator is applied to the appropriate Cell Site receiving antenna. Control is applied to the RSP in AIF0 to select Omni Rx or one face of the directional antenna. RCU transmitter testing is accomplished by connecting the test receiver to the appropriate Tx path and tuning the RTU to the channel under test.

Series II Cell Site Receive, Alarm, and Power Distribution Panel ED 2R851-30

This panel provides an interface between the primary Antenna Interface Frame, AIF0, and other Cell Site equipment for distributing the receive signals, the alarm and control signals, and the +24-volt DC power. The +24-volt DC for the growth AIF1 is supplied from this panel.

The Receive, Alarm, and Power (RAP) distribution panel contains the circuit breakers that feed +24 volts to units on the primary Antenna Interface Frame (AIF) and to the growth frame. This panel also contains power dividers used to distribute received Radio Frequency (RF) to the Radio Channel Frame (RCF) and alarm tie-points for customer alarms. These alarms are fed back to the Alarm/FITS (Factory Installation Test Set) board located on the P-RCF.

The +24 volt DC power from the power plant is applied as FDR0 through CB1 to the RFG, through CB4 to the Receiver Calibration Generator (RCG), and through CB5 to all of the preamplifiers inside the DIV0 Rx filter panels of both AIF0 and AIF1. FDR1 is applied through CB2 to the RFG, through CB3 to the RSP, and through CB6 to the DIV1 Rx filter panels in both AIF0 and AIF1.

The RAP panel provides user alarm connections and alarm signals from the AIFs to the RCF0 alarm circuits. It also provides interface connections between the RTU (inside RCF0) and the RSP (inside AIF0). The antenna select output of the RTU sends logic signals to command the RSP to switch the Radio Frequency (RF) test signals from the RTU to various Rx and Tx (Receive and Transmit) antenna paths under test. The antenna message acknowledge output of the RSP acknowledges the RTU upon successful execution of its commands.

Series II Cell Site Receive and Power Distribution Panel ED-2R853-31

This panel is located in the growth Antenna Interface Frame, AIF1, and provides an interface between AIF1 and other Cell Site equipment for distributing the receive signals and the +24-volt DC received from AIF0.

The outputs of the preamplifiers in the RFPs or DFPs are connected to the respective 1:6 power dividers mounted inside the RAP. The amplified Rx signals are distributed to the RCF(s). All of the unused ports on the 1:6 dividers must be terminated into a 50-ohm resistive load.

The Receive and Power (RP) distribution panel distributes the Rx signals and +24 volt DC within AIF1. The outputs of the preamplifiers in the RFPs or DFP(s) are connected to the 1:6 power dividers mounted inside the RP panel. The amplified Rx signals are distributed to the RCF(s) from these power dividers.

Series II Cell Site Duplexer Filter Panel ED-2R848-31

This filter panel is a combination receive and transmit filter panel with a single Rx/Tx (Receive/Transmit) antenna port. Two configurations of this filter panel are used—one for “A” band and one for “B” band. The group number designates the A or B configuration.

One duplexer filter panel is required for each antenna face and one receive filter panel is required for diversity.

The Duplexer Filter Panel (DFP) is a combined receive and transmit filter panel. Functionally, the receive and transmit circuits are the same as the separate receive and transmit filter panels, except that it provides a combined Rx/TS (Receive/Transmit) antenna port. This allows the Cell Site to use one less antenna. A separate list number is used to designate use with bands A and B.

The Duplexer Filter Panel (DFP) combines a Tx filter panel with an Rx filter panel and has a single Rx/Tx (Receive/Transmit) antenna port. A duplexing technique is applied, enabling the system to use a combined Rx/Tx antenna configuration that reduces the required number of antennas in each antenna face from three to two. The duplexer steers the Rx signals from the combined Tx/Rx antenna to the input of the BPF in the Rx path and directs the Tx signals from the output of the Tx filter to the Tx/Rx combined antenna port. Unless otherwise specified, the duplexer is normally used to combine the DIV0 Rx path with the Tx path.

The connections to the DFP are similar to those of the TFP and RFP, except there is only one antenna port for the combined Tx/Rx antenna function. There is only one dual-port directional coupler (-50 dB and -40 dB) required in the DFP. Two 2:1 combiners are used to provide connections to the RTU for radio test diagnostics. The calibration signal from the Receiver Calibration Generator (RCG) is coupled into the Rx path through a 20-dB directional coupler similar to that of the RFP.

Series II Cell Site Receive Filter Panel ED-2R846-31

This filter panel contains a bandpass and a notch filter, a low-noise receive preamplifier and two couplers used to inject forward and reflected Radio Frequency (RF) test signals. These test signals are used to test the receive path for the Radio Channel Units (RCUs). One filter panel is required for each receive path inside the Antenna Interface Frame (AIF) unless a Duplex Filter Panel is used.

The Receive Filter Panel (RFP) receives the Radio Frequency (RF) from the receive antennas. The RF is first passed through a coupler where test signals may be injected (forward and reflected). The RF is then passed through a bandpass filter and a notch filter. A second coupler, after the filters, provides an injection point for the Radio Channel Unit (RCU) calibration frequency. The receive RF is then applied through a preamplifier to power dividers for distribution into the RCF. The RFP works on both A and B bands.

One Receive Filter Panel (RFP) is required for each receive path inside the AIF unless a Duplexer Filter Panel is used. Typically, each antenna face has two Rx (Receive) paths for diversity 0 and diversity 1. The RFP contains a dual-port (-40 dB and -50 dB) directional coupler, a Band Pass Filter (BPF), a notch filter, a 20-dB directional coupler, and a 44-dB preamplifier.

The received Radio Frequency (RF) signal from the Rx antenna is sent through the dual-port directional coupler to the input of the BPF. The -40 dB and -50 dB coupling ports of this coupler provide the RTU access to the Rx path of the AIF for test purposes. The RTU sends and receives test signals through the RSP to these ports in order to test the Rx path for each Radio Channel Unit (RCU) installed in the RCF(s). Received RF signals from the Rx antenna are filtered and amplified by the RFP before entering the RCU. The BPF (which is different for “A” and “B” band customers) provides the required Rx path filtering characteristics. The output of the BPF is followed by a notch filter.

The calibration signal from the Receiver Calibration Generator (RCG) is coupled into the Rx path through the 20-dB directional coupler at the output of the receive filters. The calibration signal provides a means to determine a correction factor for offsetting the difference in the loss tolerances in the different Rx paths of the system.

The receive and calibration signals are amplified by the preamplifier inside the RFP and sent to the RAP in AIF0 or the RP in AIF1.

A typical AIF0 with four antenna faces has a total of eight RFPs and eight 1:6 power dividers at the RAP, namely Face0 Rx0, Face0 Rx1, Face1 Rx0, Face1 Rx1, Face2 Rx0, Face2 Rx1, Face3 Rx0, and Face3 Rx1. A typical AIF1 with three antenna faces has a total of six RFPs and six 1:6 power dividers at the RP, namely Face4 Rx0, Face4 Rx1, Face5 Rx0, Face5 Rx1, Face6 Rx0, and Face6 Rx1. Each RCF has at least one Rx path connection to one of the six ports of each 1:6 divider. This arrangement enables each RCF to have total access to all of the Rx paths in AIF0 and AIF1. A maximum of six RCFs can be connected to each Rx path to the 1:6 power dividers.

Series II Cell Site Transmit Filter Panel ED-2R847-31

This filter panel contains a transmit filter and a coupler for picking off a portion of the forward and reflected power. These signals are used during Radio Frequency (RF) diagnostic test.

The Transmit Filter Panel (TFP) receives transmitted Radio Frequency (RF) from the LAF and passes it through a transmit filter assembly. The transmitted RF is then fed through a coupler to the transmit antenna. The coupler provides ports for picking off a portion of the forward and reflected RF.

One Transmit Filter Panel (TFP) is required for each antenna face. The TFP contains a dual-port (-40 dB and -50 dB) directional coupler and a band pass transmit filter. Tx (Transmit) signals from the Radio Channel Unit (RCU) are amplified by the LAF before reaching the AIF. The Tx signals from the LAF are filtered by the Tx filter inside the TFP before being transmitted out by the Tx antenna. The filtered Tx signal is then sent through the dual-port coupler before going to the Tx antenna. The -40 dB and -50 dB coupling ports of this coupler provide the RTU access to the Tx path of the system for test purposes. The RTU receives test signals through the RSP to these ports in order to test the Tx path for each RCU installed in the RCF(s). The Tx filter separates out the unwanted signals before transmitting to the Tx antenna.

Table 8-14. Antenna Interface Frame (AIF) Hardware

Item	Max Qty	Code	Eqpt Loc
Antenna Interface Frame 0	1	J41660E-2	
Receive, Alarm, and Power Distribution Panel	1	ED-2R851-30	23
Circuit Breakers (CB1, CB2, CB3, CB4) 3A	4	406026401	
Circuit Breakers (CB5, CB6) 2.5A	2	406085092	
Terminal Strip (TB5, TB6)	2	406131862	
Splitter Mounting Kit	2	846441368	
Power Divider (1:6)	4 (per kit)	KS21604,L12	
RFG shelf with one (1) Rubidium oscillator		407575638	22
RFG shelf with two (2) Rubidium oscillators		407575653	
Provides an RFG shelf with one (1) Rubidium oscillator and one (1) crystal oscillator		407575646	
Receiver Calibration Generator	1	ED-2R845-30	21
Power Divider	1	WP92070,L2	
Signal Generator Circuit Pack	1	ARL3	
Attenuator (AT1, AT3)	2	402910467	
Attenuator (AT2)	1	402910442	
Termination	2	461-1 (meca)	
RTU Switch Panel	1	ED-2R850-30	20
TCI Circuit Pack	1	BBC1	
RCV Circuit Packs	2	BBC2	
Receive Filter Panel (“A” Band)		ED-2R846-31	
Coupler (CP1) 40/50 dB	1	KS21603,L8	
Coupler (CP2) 20 dB	1	KS21603,L7	
Bandpass Receive Filter (FL1)	1	ED-2R815-30	
Notch Receive Filter (FL2)	1	ED-2R816-30	
Item	Max Qty	Code	Eqpt Loc
Circulator (HY1)	1	WP92072,L2	
Preamp (PA1)	1	KS21583,L3	
Adapter	1	406083055	
Termination	1	401-1 (meca)	

Table 8-14. Antenna Interface Frame (AIF) Hardware (Contd)

Item	Max Qty	Code	Eqpt Loc
Receive Filter Panel (“B” Band)		ED-2R846-31	
Coupler (CP1) 40/50 dB	1	KS21603,L8	
Coupler (CP2) 20 dB	1	KS21603,L7	
Bandpass Receive Filter (FL1)	1	ED-2R810-30	
Notch Receive Filter (FL2)	1	WP92064,L1	
Preamp (PA1)	1	KS21583,L3	
Adapter	1	406083055	
Transmit Filter Panel (“A” Band; Installer Mounted)		ED-2R847-31	
Transmit Filter Panel (“B” Band; Installer Mounted)		ED-2R847-31	
Coupler (CP3)	1	KS21603,L8	
Bandpass Filter (“A” Band)	1	ED-2R860-30	
Bandpass Filter (“B” Band)	1	ED-2R860-30	
Duplex Filter Panel (“A” Band)		ED-2R848-30	
Coupler (CP2)	1	KS21603,L7	
Coupler (CP3) 40/50 dB	1	KS21603,L8	
Power Divider/Combiner (PD1, PD2)	2	KS21604,L1	
Bandpass Receive Filter (FL1)	1	ED-2R815-30	
Notch Receive Filter (FL2)	1	ED-2R816-30	
Bandpass Transmit Filter (FL3)	1	ED-2R860-30	
Preamp (PA1)	1	KS21583,L3	
Circulator (HY1)	1	WP92072,L2	
Adapter (ADPTR 1)	1	406083055	
Termination (TRM1)	1	401-1 (meca)	
Duplexer Cable Assembly (DPX1)	1	ED-2R875-30	
Duplex Filter Panel (“B” Band)		ED-2R848-30	
Coupler (CP2)	1	KS21603,L7	
Coupler (CP3) 40/50 dB	1	KS21603,L8	
Power Divider/Combiner (PD1, PD2)	2	KS21604,L1	
Bandpass Receive Filter (FL1)	1	ED-2R810-30	
Notch Receive Filter (FL2)	1	WP92064,L1	
Bandpass Transmit Filter (FL3)	1	ED-2R860-30	

Table 8-14. Antenna Interface Frame (AIF) Hardware (Contd)

Preamp (PA1)	1	KS21583,L3	[redacted]
Adapter	1	406083055	
Duplexer Cable Assembly	1	ED-2R875-30	
* Two terminations are required for a full configuration. Any other configuration requires more than two terminations.			

Special Filters

Outside filters, KS-24020, L3 that were designed and required for the Korean Mobile Telephone (KMT) application can be used as part of the Standard Series II Cell Site AIF0 and AIF1. If KS-24020, L3 is used, then KS-24174, L1 and KS-24022, L2 are not needed.

Transmit notch filters KS24234, L1 to L10, which were developed for the Air-to-Ground Telephone (AGT) application, can also be used as part of the Standard Series II Cell Site. These are mounted on a standard 19-inch bay frame external to the AIF and should be grounded appropriately.

Series II Cell Site Equipment Summary

Table 8-15 provides a summary of Series II Cell Site Equipment.

Table 8-15. SIIe Cell Site, R5.06 or Later

Physical - Frames	**Description**
P-RCF plus 1 or 2G-RCFs 1 or 2 LAFs (up to 7 LACs) 1 Primary AIF 1 Growth AIF	Primary RCF with 1, or 2 Growth Frames 1, or 2 Linear Amplifier Frames
RCF Equipage -	
P-RCF Shelves	Same as in Companion Table
G-RCF Shelves	Standard Series II product with 6 radio shelves
Radios	
Radio Types	RCUs, DRUs, and EDRUs
Locate	1-RCU, optional growth to a maximum number allowed in standard Series II
Setup	1-RCU, optional growth to a maximum number allowed in standard Series II
Voice	1-RCU/DRU/EDRU to a maximum allowed in any combination subject to physically available radio slots (depends on Setup RCU and Locate RCU equipage)
Test	RTU and optional "TRTU"
Communications and Clock	
TDM Buses	1 or 2
DS1 Lines	1 or 2
Data Links	1 or 2
CAT Boards	2 per TDM Bus
Configuration	
Radio Control Complex	Redundant
Reference Frequency Generator	Non-redundant, redundant optional
Receiver Calibration Generator	Optional
Receive Switches	Optional
Voice Sectorization	

Table 8-15. SIIe Cell Site, R5.06 or Later (Contd)

Physical - Frames	**Description**
Voice	Omnidirectional and/or 1 to 6 Sectors
Setup Configurations	
Configurations	Omnidirectional or Directional
AIF Equipage -	
Filter Panels	Simplex or Duplex
Translations Developments -	SIIe Translator

Series II Cell Site, Related Documentation

Table 8-16 below provides a list of supporting documentation. For instructions on how to order this documentation, refer to Lucent Technologies 401-610-000, *Customer Documentation Catalog*.

Table 8-16. Series II Cell Site - Related Documentation

Document Title	**Designation**
Planning Guide	401-610-006
Data Base Update	401-610-036
Input Message Manual	401-610-055
Output Message Manual	401-610-057
System Routine and Corrective Maintenance	401-610-075
ECP/CDN Recovery/Messages Audits Manual	401-610-077
Cell Site Audits Manual	401-610-078
System Recovery	401-610-079
Recommended Spare Parts, Tools, and Test Equipment	401-610-120
Service Measurements	401-610-135
Daily Operations	401-610-151
Multiple System Subscriber Administration (MSSA)	401-612-064
Series II Cell Site Diagnostic Test Descriptions	401-660-101
Series I and II Cell Translations Applications Guide	401-660-106
Cellular Operations Systems Performance Analysis and Cellular Engineering Users Guide	401-660-108
Series IIm T1/E1 Minicell Description, Operation, and Maintenance	401-660-115
AUTOPLEX System Application Schematic	SD2R236, Issue 7
Storage Battery Lead-Acid Type Requirements and Procedures	157-601-701
J86928A Power Plant Maintenance	167-609-309

Table 8-16. Series II Cell Site - Related Documentation (Contd)

Document Title	Designation
J86928A Power Plant Description	167-609-310
J86928A Power Plant Rectifier Description	167-609-311
Cell Site Diagnostic Test Descriptions	401-660-101
Cell Site Antenna Equipment Installation Planning Guide	401-200-300
System Routine and Corrective Maintenance	401-610-175
Cell Site I/O Manual	401-610-107
Recommended Spare Parts, Tools, and Test Equipment	401-610-120
Compact Base Station Description, Operation, and Maintenance	401-660-060
Microcell Implementation, Installation, and Maintenance	401-661-111
Protective Grounding Systems Requirements	802-001-197
Electrical Protection of Radio Stations	876-210-100
Intro to Series II Compact Base Station	**C**ustomer **I**nformation **B**ulletin (CIB)-182
Introduction to Microcell	CIB-191
Radio Channel Frame (Primary) Schematic Drawing	SD-2R263
Radio Channel Frame (Growth) Schematic Drawing	SD-2R264
Linear Amplifier Circuit Schematic Diagram	SD-2R265
Linear Amplifier Frame Schematic Drawing	SD-2R266
Antenna Interface Frame Schematic Drawing	SD-2R268
Series II Cell Site Schematic Drawing	SD-2R271

Radios

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Contents

Introduction

The RCFs contain slots into which cellular equipment and radios are inserted. The P-RCF contains 4 shelves with 12 slots each and 1 shelf with 8 slots, for a total of 56 slots. Each Growth RCF has 6 shelves of 12 slots each for a total of 72 slots. Altogether, an RFS has 200 equipment/radio slots.

Up to two 8-bit TDM buses (TDM bus 0 and TDM bus 1) connect the radio shelves in the primary and Growth RCFs. TDM bus 0 serves 5 radio shelves (56 slots) in the P-RCF and the 4 upper radio shelves (48 slots) in the first Growth RCF for a total of 9 radio shelves (104 slots).

TDM bus 1 serves the 2 bottom radio shelves (24 slots) in the first growth frame and the 6 radio shelves (72 slots) in the second growth frame for a total of 8 radio shelves (96 slots).

Each of the 3 RCFs of an RFS can contain any combination of the following 3 types of radio units.

NOTE:
TDM buses are always installed "red stripe up."

AMPS Radio Units and Personality Types

Radio Channel Unit (RCU)

The RCU is the analog radio used with the Advanced Mobile Phone Service (AMPS) system. The RCU occupies 1 slot on an RCF shelf. 1 RCU provides 1 analog channel. Because an RCU uses a single slot on a radio shelf, an RFS fully-configured with RCUs can house 200 RCUs, including voice, setup, and locate radios, providing 192 analog channels.

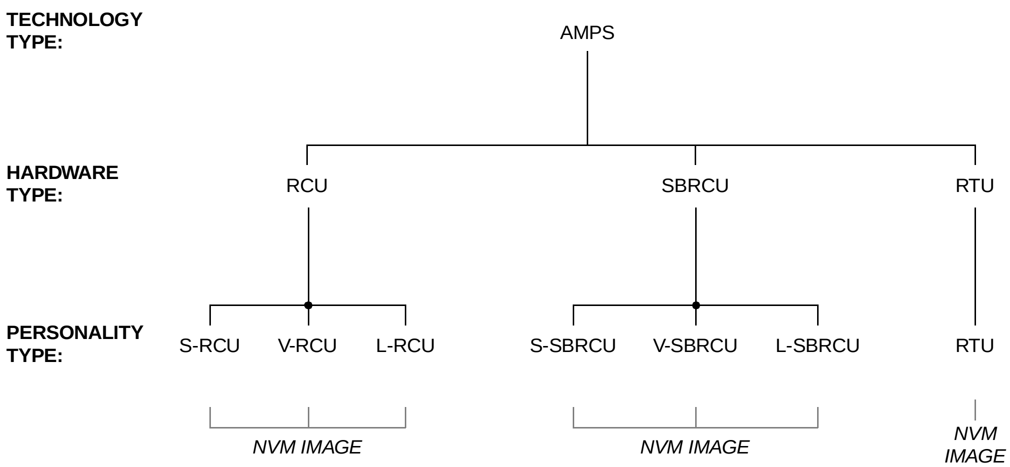


Figure 9-1. AMPS Radio Maintenance Units and Personality Types

For the RCU radio type, there is one non-volatile memory (NVM) image file for the setup radio (S-RCU), analog voice radio (V-RCU), and analog locate radio (L-RCU). At initialization, the RCC downloads the personality type and other specific parameter values to each RCU. There is another NVM image file for the RTU.

For the SBRCU radio type, there is one NVM image file for the S-SBRCU, V-SBRCU, and L-SBRCU. As of ECP Release 8.0, the Cell Site software downloads a new NVM image file to the SBRCU, separate and distinct from the NVM image file downloaded to the RCU.

The Radio Channel Unit (RCU) is a plug-in module containing all RF, baseband, and control circuitry required to perform setup, locate, or voice channel functions. The RCU function, its operating channel, transmit power level, and other specific parameters are downloaded to each radio at initialization by the Time Division Multiplexed (TDM) bus, which is always installed "red stripe up." In addition, RCU call-processing algorithms are contained in nonvolatile memory within each unit and can be updated by the TDM bus, if necessary. The downloadable parameter and nonvolatile memory update features allow remote reconfiguration of the RCU and eliminate the need for many on-site visits.

The RCU also contains a Built-In Self Test (BIST) capability and a multifunction front panel display. BIST routines are automatically executed at initialization and the test results reported to the Radio Control Complex (RCC). The display includes channel number, function, transmitter-on, standby, and failure indications. Also, there is a front panel switch which allows the transmitter to be shut off by a technician independent of automatic control command.

What follows is a brief description of each AMPS radio personality type:

- Analog voice radio: Performs the analog voice function_carries one over-the-air AMPS call.
- Setup radio: Performs the analog setup function_establishes calls via the analog control channel (ACC) with mobile subscribers using AMPS or IS-54B compliant TDMA/AMPS dual-mode mobiles.
- Analog locate radio: Performs the analog locate function. The Analog locate radio assists with AMPS handoffs by measuring the mobile signal strength and verifying the mobile supervisory audio tone (SAT).

Voice RCU (V-RCU)

The receiver section of a Voice Radio Channel Units (V-RCUs) receives Radio Frequency (RF) input from the Cell Site receiving antenna (two inputs for diversity). This input can be supplied from omni receiving antennas or from receiving antennas on one of the faces of the directional antennas.

The Radio Channel Unit (RCU) receiver passes voice audio into its baseband circuits where it is processed and applied through a trunk back to the Mobile Switching Center (MSC). The data output from the receiver is applied to its data decoder circuits where it is decoded and applied to the on-line Cell Site processor. Data transmission on the receive voice channel is referred to as reverse blank-and-burst data. During data transmission by the subscriber unit, the voice channel is blanked for a small interval while a burst of data is sent. The voice receivers also play a part in the handoff function by periodically making signal measurements.

Voice signals to be transmitted are sent from the MSC by a trunk and applied to the RCU where they are processed and applied to the RCU’s transmitter. The modulated transmitter RF output is applied to the Linear Amplifier Unit (LAF) and then through the Antenna Interface Frame (AIF) to the antennas.

Data to be transmitted is applied from the on-line Cell Site processor to the data encoder circuits on the RCU where it is formatted and applied to the transmitter for transmission. Transmitter and receiver tuning is accomplished by a synthesizer which is controlled by a common input. A 15.0-MHz synthesizer reference frequency is applied from the Reference Frequency Generator (RFG) located in the AIF.

An RCU or SBRCU having a voice radio personality may also have a beacon radio personality. Thus, an RCU or SBRCU can serve two functions concurrently: (1) carry an over-the-air AMPS call and (2) provide signal strength measurements for the TDMA mobile-assisted handoff (MAHO) procedure. Since the RF carrier power level remains fixed for beacon radios, the dual-personality RCU or SBRCU is ineligible for dynamic power control.

Setup RCU (S-RCU)

Normally, two Radio Channel Units (RCUs) are designated as Setup Radio Channel Units (S-RCUs). Setup radios perform the receive and transmit functions required to set up a call. Because of the dual function (receiving and transmitting), setup radios provide both paging and accessing functions. Paging refers to the process of calling a cellular subscriber (Cell Site to cellular subscriber). Accessing refers to the process of the cellular subscriber making a call (cellular subscriber to Cell Site). The Radio Frequency (RF) output of the setup radios is amplified by the Linear Amplifier Frame (LAF) and then fed to the transmit antenna through the Antenna Interface Frame (AIF).

With Release 4.3, the Simulcast Setup feature allowed setup radios to transmit signals to all directional voice sectors and receive signals from all directional voice sectors in a Cell Site using a single setup channel frequency. In this configuration, a single setup channel serves the entire Cell Site. This contrasts with directional setup for which each directional voice sector has its own setup channel and its own pair of redundant setup radios. Simulcast setup also contrasts with omnidirectional setup which requires an omnidirectional antenna and associated Linear Amplifier Circuit (LAC).

Locate RCU (L-RCU)

Some Radio Channel Units (RCUs) are designated as "Locate"RCUs (L-RCUs). L-RCUs perform the locate function required to determine if a handoff is needed. Signal measurements are made periodically by the locate receivers within Cell Sites adjacent to the Cell Site serving the subscriber’s unit. When it is determined that an adjacent Cell Site can serve the subscriber better, a handoff is made to that adjacent Cell Site.

Any of the RCUs may be designated a locating radio. Frequency control data is applied to the receiver’s frequency synthesizer to tune the locating radio to the channel being monitored. A reference frequency is supplied to the receiver’s synthesizer from the Reference Frequency Generator (RFG) located in the Antenna Interface Frame (AIF).

Diversity receiving antennas are used for all omnidirectional and directional antenna configurations. This means that each Cell Site RCU has two receiving Radio Frequency (RF) inputs, referred to as 0 and 1.

Received signals from the Cell Site receiving antennas are applied to the switch/combiner board in the Primary Radio Channel Frame (P-RCF). The P-RCF is wired to receive two omni receive inputs and two receive inputs from each directional face. Use of these RF inputs depends upon the antenna configuration options employed at the Cell Site. RF switches within the switch/combiner board provide individual RF selection for each RCU. This means that up to two omni receive inputs or directional receive inputs can be selected and applied to each setup RCU and that the locating RCUs may receive up to either two omni receive inputs or two directional receive inputs from any one of the directional faces. In addition to the switchable antenna configuration provided by the switch/combiner board, a fixed antenna configuration is also used.

Radio Test Unit (RTU)

The Radio Test Unit (RTU) provides Radio Frequency (RF) testing of all Radio Channel Units (RCU)s. Under software control, diagnostic test paths are established to test and measure all major RF functional operations. The RTU contains a test receiver and test generator which serve to simulate a subscriber's unit. The test receiver can be tuned to any subscriber's receive channel, and the test generator can be tuned to any subscriber's transmit channel. Tuning is accomplished by the RF test frequency control input to a transmit/receive frequency synthesizer within the RTU. The reference frequency, supplied from the internal Reference Frequency Generator (RFG), provides the synthesizer reference. The RTU can be switched into a self-test mode to make a loop-around test.

During receiver testing on an RCU, test data is encoded and applied from the RTU. The test generator within the RTU is tuned to the channel under test, and the output of the test generator is applied to the appropriate Cell Site receiving antenna's directional coupler. Control is applied to the Radio Test Unit Switch Panel (RSP) in the Antenna Interface Frame (AIF) to select the correct antenna. The test generator can inject the test signal (as selected by the RTU) into either the forward or reflected port of a directional coupler associated with the RCU under test.

Test data injected into the reflected port of the directional coupler is seen by the receiver under test as a normal incoming signal. The receive signal and data are evaluated and the results sent to the Mobile Switching Center (MSC). Test signals injected into the forward port of the directional coupler are seen by the receiver under test as a reflected input. Receiving antenna efficiency can be measured by comparing (obtaining a ratio of) receive signal strength resulting from reflected and forward signal injection.

TDMA Radio Units and Personality Types

The two types of TDMA digital radios are briefly explained below.

Digital Radio Unit (DRU)

The DRU is the digital radio used with the Time-Division Multiple Access (TDMA) system. The DRU occupies 2 slots on an RCF shelf. The DRU supports 3 full-duplex Digital Traffic Channels (DTCs) on one 30-kHz bandwidth RF channel via Time-Division Multiplexing. Given that the DRU occupies 2 slots, the number of DRUs that can be housed in the P-RCF is half the number of RCUs, which is 28 DRUs. For the 2 Growth RCFs, the number of DRUs that can be housed is also half the number of RCUs, that is, 36 DRUs apiece. Altogether, an RFS fully-configured with DRUs can house 99 DRUs, including voice and locate radios. The software can support 256 DTCs. (Call setup is done by the DCCH with no setup radios required). The DRU is tested using a TDMA Radio Test Unit (TRTU).

Enhanced Digital Radio Unit (EDRU)

The EDRU is an enhanced version of the DRU that is fully backward compatible with the DRU. The EDRU improves (i.e., enhances) many of the features offered by the DRU. Additionally, the EDRU provides new features and capabilities that the DRU cannot offer. The EDRU occupies 1 slot on an RCF shelf. That is, two EDRUs can be installed for each DRU. Like the DRU, the EDRU supports 3 DTCs. Each of the 3 channels can carry either Control information or Traffic (C/T). Because the EDRU, like the RCU, occupies only 1 slot on a radio shelf, the Primary RCF has enough radio slots for 56 EDRUs, and the Growth RCFs have enough radio slots for 72 EDRUs apiece.

However, a 430AB power converter unit is required to support a maximum of 8 EDRUs per shelf. Additionally, due to software limitations, the maximum number of EDRUs supported are:

- RCF0: 23 EDRUs
- RCF1: 40 EDRUs
- RCF2: 16 EDRUs
- Total: 79 EDRUs The total number of EDRUs per cell should not exceed 79, including voice and locate radios. Call setup is done by the DCCH with no setup radios required. The EDRU is tested using a TRTU.

Digital Radio Personality Types

The following paragraphs provide a brief description of each TDMA radio personality type:

Digital Voice Radio

Performs the digital traffic channel function_carries up to three over-the-air TDMA calls.

Digital Control Channel (DCCH) Radio

Performs the digital setup and short message service functions_ establishes calls via the DCCH with mobile subscribers using IS-136 compliant TDMA/AMPS dual-mode mobiles. The DCCH is carried on user channel 1. Typically, there is one DCCH per physical antenna face, or sector, in a TDMA system.

Digital Beacon Radio

Performs the digital beacon channel function_transmits at a fixed level at all times to provide signal strength measurements for the TDMA MAHO procedure. Typically, there is one beacon radio per physical antenna face in a TDMA system.

Digital Locate Radio

Performs the digital locate channel function_assists with handoffs when the established TDMA call can be better served by an adjacent sector or cell by measuring the signal strength and verifying the digital verification color code (DVCC) of the IS-54B or IS-136 compliant TDMA/AMPS dual-mode mobile targeted for handoff. The digital locate radio is instrumental in the DVCC verification procedure.

For the DRU radio type, there is one NVM image file for the digital control channel radio (D-DRU), digital voice radio (V-DRU), and digital beacon radio (B-DRU). At initialization, the RCC downloads the personality type and other specific parameter values to each DRU. There is another NVM image file for the digital locate radio (L-DRU), and still another for the TRTU.

A DRU or EDRU provides a basic modulation efficiency of three user channels per 30-kHz of bandwidth. The three user channels are designated user channel 1, user channel 2, and user channel 3. Each user channel is assigned one trunk (DS0) on the T1 line and one duplex timeslot on the RCF internal TDM bus, which is always installed "red stripe up."

A D-DRU or D-EDRU may also carry digital traffic and beacon channels. Thus, a D-DRU or D-EDRU can serve three functions concurrently: (1) perform the digital setup function_establish calls via the DCCH with mobile subscribers using IS-136 compliant TDMA/AMPS dual-mode mobiles, (2) carry one or two over-the-air TDMA calls, and (3) provide signal strength measurements for the TDMA MAHO procedure. Since the RF carrier power level remains fixed for DCCH radios, the D-DRU or D-EDRU is ineligible for dynamic power control.

The EDRU, unlike the DRU, will be able to carry more than one DCCH. That is, in a future release, an EDRU will be able to carry one, two, or three DCCHs.

A B-DRU or B-EDRU may also carry digital traffic channels. Thus, a B-DRU or B-EDRU can serve two functions concurrently:

(1) provide signal strength measurements for the TDMA MAHO procedure and

(2) carry one, two, or even three over-the-air TDMA calls. (A digital beacon channel may double as a digital traffic channel.) Since the RF carrier power level remains fixed for beacon radios, the B-DRU or B-EDRU is ineligible for dynamic power control.

A V-DRU or V-EDRU may only carry digital traffic channels. A V-DRU or V-EDRU can carry one, two, or three digital traffic channels.

An L-DRU may only carry digital locate channels. An L-DRU can carry one, two, or three digital locate channels.

DRU - Detailed Description

The Digital Radio Unit (DRU) is the digital radio used with the Time-Division Multiple Access (TDMA) system. The DRU is entirely digital, self contained, comes with all the software needed to support TDMA, and does not need any additional equipment to support call processing.

The DRU plugs into the same connectors as the Radio Channel Unit (RCU) that is used with AMPS Systems. However, whereas the RCU occupies 1 slot in a Radio Channel Frame (RCF), the DRU occupies 2 slots in an RCF. Then again, the RCU provides only 1 analog channel, whereas the DRU supports 3 full-duplex Digital Traffic Channels (DTCs) on one 30-kHz bandwidth RF channel via Time-Division Multiplexing. The DRU can support control information (DCCH) on 1 of its channels and (voice) Traffic on the other 2 channels. If the Cell Site supports the Digital Control CHannel (DCCH) feature, the DCCH will perform the setup function for digital calls and no setup radios will be required. (Setup radios will still be required for analog calls).

The DRU's dimensions are nominally 8 inches high by 3 inches wide by 14 inches deep. Although the DRU is twice as wide as the RCU and occupies 2 slots as compared with 1 slot for the RCU, DRUs and RCUs can sit side-by-side on the same RCF shelf.

The combination of DRUs and RCUs allowed on a 12-slot RCF shelf is as follows:

(2 x Number of DRUs) + (Number of RCUs) = 12 slots

The Radio Test Unit (RTU) shelf of an RCF contains 8 available slots. Therefore, the combination of DRUs and RCUs allowed on the 8-slot RCF is as follows:

(2 x Number of DRUs) + (Number of RCUs) = 8 slots

The placement of DRUs on a radio shelf in constrained as follows. While the DRU uses 2 RCU slots, it makes contact with only 1 backplane slot. That slot is the one on the left if one is viewing the equipment from the front. To place the maximum number of DRUs on a shelf, the DRU must be installed so that it makes contact with the even-numbered RCU slot. On an RCU shelf, for example, the valid locations for 6 DRUs would be RCU slots 0-1, 2-3, 4-5, 6-7, 8-9, and 10-11. The connections would be at slots 0, 2, 4, 6, 8, and 10.

On RCF shelves containing 12 RCU slots, +5 Volts DC power is provided by 1 of 2 units; The 415 AA DC/DC unit and the 415 AC DC/DC unit. The power converter used depends on the combination of RCU and DRU/EDRU units on the shelf.

Table 9-1. 415 AA/AC DC/DC Power Unit

415AA DC/DC power supply		415 AC DC/DC power unit	
DRUs/EDRUs	RCUs	DRUs/EDRUs	RCUs
1 DRU/EDRU	10 RCUs	4 DRUs/EDRUs	4 RCUs
2 DRUs/EDRUs	8 RCUs	5 DRUs/EDRUs	2 RCUs
3 DRUs/EDRUs	6 RCUss	6 DRUs/EDRUs	0 RCUs

An important feature that increases the flexibility of the system and protects your investment in the DRU is the ability to download the DRU's software/firmware from the Mobile Switching Center (MSC). This makes it quick and easy to accommodate future revisions in the IS-54A standard and reduces down-time for upgrades.

The DRU consists of 2 modules. One is the Signal Processing Module (SPM), which contains 3 circuit boards. The other is the Transceiver Circuit Module (TCM), which contains one circuit board. The DRU is tested using a TDMA Radio Test Unit (TRTU). The DRU faceplate provides a channel display and LED status indicators.

The DRU is also used to support the Digital Control CHannel (DCCH) feature. For information regarding how the DRU is used to support the DCCH, please see the appropriate section in this document.

EDRU - Detailed Description

The Enhanced Digital Radio Unit (EDRU) is an enhanced version of the Digital Radio Unit (DRU) that is used with Time Division Multiple Access (TDMA) systems. The EDRU is fully back-compatible with the DRU and can perform all the functions of a DRU. When the EDRU is used to perform the same functions that a DRU performs, it uses the same commands.

Like the DRU, the EDRU supports 3 full-duplex Digital Traffic Channels (DTCs) on one RF channel via Time-Division Multiplexing. However, the EDRU occupies only 1 radio slot, whereas the DRU occupies 2. The EDRU's dimensions are nominally those of the Radio Channel Unit (RCU):

Height: 7.67 inches.

Width: 1.5 inches.

Depth: 14.15 inches, including the connector and face plate that extends from the EDRU.

Depth: 13.86 inches, excluding the connector and face plate that extends from the EDRU.

RCUs, DRUs, and EDRUs can sit side-by-side on the same RCF shelf.

If the Cell Site supports the Digital Control CHannel (DCCH) feature, the DCCH will perform the setup function for digital calls and no setup radios will be required. (Setup radios will still be required for analog calls).

The Time Division Multiple Access (TDMA) Systems that support Enhanced Digital Radio Unit (EDRU) Implementation are the Series II, IIm (mini), IImm (micro-cell), IIe (enhanced), Compact Base Station (CBS), and Personal Communications Services (PCS) TDMA Minicell.

The EDRU complies with the standards that define control, traffic, and data operations for both cellular and PCS TDMA systems. Unless explicitly stated otherwise, the EDRU contains all features specified in this document for both cellular and PCS operations. The EDRU is software-configurable as the 2 radio types that follow:

1. Control/Traffic radio (C/T-EDRU) When the EDRU is configured as a C/T-EDRU it supports DCCH or DTC func-tionality in any combination for any of the 3 full-duplex channels it provides. The C/T-EDRU supports DTC structure for the forward and reverse digital traffic channels as defined in the standards for TDMA frame format, time-slot format, data rate, and timing relationships. The C/T-EDRU supports the following config-urations for DTC and DCCH on the same RF carrier.

Table 9-2. C/T EDRU Configurations

C/T EDRU Configurations			
Configuration	Time Slot 1	Time Slot 2	Time Slot 3
1	DTC	DTC	DTC
2	DCCH	DTC	DTC

- Digital Verification Color Code (DVCC) detection
- Receive Signal Strength Indicator (RSSI) Estimates. In addition, the EDRU can perform any of these functions for PCS systems if external frequency conversion is provided.

2. Locate Radio (L-EDRU)

The Locate Radio performs the following:

- Diagnostics and Functional Tests

- Power level measurements

Series II Cell Site, Enhanced Digital Radio Unit (EDRU) Components

The two modules in the Enhanced Digital Radio Unit (EDRU), and the functions they perform, are outlined below:

1. Transceiver Circuit Module (TCM):
   a. The EDRU's TCM uses a transmitter to:
      - Up-convert baseband signals from the Signal Processing Module (SPM) to digitally modulated Radio Frequency (RF) signals
      - Send the digitally modulated RF signals to the RF output ports

      The transmitter's 4 components are:

      — Up-Converter

      — Amplifiers

      — Filters

      — Power Control Circuits

   b. The EDRU's TCM uses a receiver to:
      - Down-convert digitally modulated RF signals from the RF input ports to baseband signals.
      - Send the baseband signals to the demodulator (SPM).

      The receiver's 4 major components are:

      — Down-Converter

      — Amplifiers

      — Filters

      — Gain Control Circuits

   The TCM contains the EDRU RF circuitry and uses the power converter voltages below:

      - +12 VDC-RF
      - -12 VDC power converter voltages.

2. Signal Processing Module (SPM): Contains the EDRU's digital circuitry. The major components in the SPM are the Digital Signal Processors (DSPs) that perform the necessary functions by exe-cuting the code stored in the firmware. The functions of the SPM are:

- Communicating with the Radio Channel Complex (RCC) via the Time Division Multiplex (TDM) bus, which is always installed "red stripe up." The EDRU provides the capability to transmit uplink (EDRU to RCC) messages and to receive downlink (RCC to EDRU) messages over the TDM bus.
- Supervising TCM Operations
- Speech Coding and De coding
- Channel Coding and Decoding
- Interleaving and De-Interleaving
- Formatting and Deformatting
- Modulating and Demodulating
- Providing Equalization
- Providing Echo Cancellation
- Providing Receive Signal Strength Indicator (RSSI) Estimates.

The three functions listed below are performed differently for Digital Traffic Channels (DTCs) and Digital Control CHannels (DCCHs).

1. Channel Coding/Decoding
2. Interleaving/De-Interleaving
3. Formatting/Deformatting Features. The SPM contains the EDRU Digital Circuitry, and it uses the power converter voltages below:
   - +12 VDC
   - -12 VDC
   - +5 VDC

To prevent noise from disturbing the RF circuitry, no digital circuitry in the entire system is permitted to use the +12 VDC-RF power converter voltage, which is different from the +12 VDC.

The EDRU heat dissipation does not exceed 43.9 W.

Series II Cell Site, Enhanced Digital Radio Unit (EDRU) Interfaces

The Series II Cell Site, Enhanced Digital Radio Unit (EDRU) Backplane Connection features Fastech backplane connectors in the Radio Channel Frame (RCF) that provide the Enhanced Digital Radio Unit (EDRU) with the 4 following interfaces:

1. Radio Frequency (RF)
   - To provide receive diversity, the EDRU has 2 external RF input (receive) ports via backplane connections.
   - The EDRU has 1 external RF output (transmit) port via a backplane con-nection.

2. Reference Frequency
   - The EDRU has 1 external reference frequency input port via a backplane connection.
3. DC Power

   The EDRU operates appropriately when all its supply voltages are within 5% of their nominal values. The maximum EDRU current drain on supply voltages of the 4 interfaces is as follows:
   - Current drain for +12 VDC-RF source is 1.0 A
   - Current drain for -12 VDC source is 0.2 A
   - Current drain for +12 VDC source is 0.2 A
   - Current drain for +5 VDC source is 5.0 A
4. Digital Signal

The EDRU has an external TDM bus interface to connect to the TDM bus via the backplane. The TDM bus is always installed "red stripe up."

In the Series II and Series IIe Cell Sites, the EDRU is connected to either TDM bus 0 or TDM bus 1, depending on where the EDRU is installed in the frame. Each TDM bus has 2 sides, an "A side"and a "B side,"for redundancy. Only 1 side is active at any given time. TDM buses are always installed "red stripe up."

In other systems, that are not Series II or Series IIe Cell Sites, the EDRU is connected to only 1 TDM bus. That TDM bus also has an "A side"and a "B side."

The interfaces specified here are for the 2 sides of whichever TDM bus is serving the EDRU. The EDRU uses the active TDM bus to communicate with the RCC.

Environmental Features:

- Internal Cabinet Temperature: From 0x C to 65x C.
- Humidity: From 5% relative humidity to the lesser of 95% relative humidity or 0.024 g water vapor per gram of dry air over the internal cabinet temperature range.
- Altitude: From 200 feet below sea level to 10,000 feet above sea level.

Enhanced Digital Radio Unit (EDRU) Reliability, Federal Communications Commission (FCC), and Safety Features

The following lists the EDRU reliability, FCC and safety features:

- The reliability of the Enhanced Digital Radio Unit (EDRU) is less than 2500 FIT, equating to a MTBF of 400,000 hours.
- The useful lifetime of the EDRU is 7 years.
- The EDRU complies with the applicable features in Part 2, Part 15, and Part 22 of the FCC regulations.
- The EDRU in conjunction with the up-bander complies with the applicable fea-tures in Part 24 of the FCC regulations.
- The EDRU is UL-1950 approved.

DRU/EDRU Power Supply

On RCF shelves containing 12 RCU slots, +5 Volts DC power is provided by 1 of 2 units; The 415 AA DC/DC unit and the 415 AC DC/DC unit. The power converter used depends on the combination of RCU and DRU/EDRU units on the shelf. For the purposes of the table below, the DRU and EDRU are equivalent. An important feature that increases the flexibility of the system and protects your investment in the DRU is the ability to download the DRU's software/firmware from the.

Table 9-3. 415 AA/AC DC/DC Power Unit

415AA DC/DC power supply		415 AC DC/DC power unit	
DRUs/EDRUs	RCUs	DRUs/EDRUs	RCUs
1 DRU/EDRU	10 RCUs	4 DRUs/EDRUs	4 RCUs
2 DRUs/EDRUs	8 RCUs	5 DRUs/EDRUs	2 RCUs
3 DRUs/EDRUs	6 RCUss	6 DRUs/EDRUs	0 RCUs

An important feature that increases the flexibility of the system and protects your investment in the DRU is the ability to download the DRU's software/firmware from the Mobile Switching Center (MSC). This makes it quick and easy to accommodate future revisions in the IS-54A standard and reduces down-time for upgrades.

The DRU consists of 2 modules. One is the Signal Processing Module (SPM), which contains 3 circuit boards. The other is the Transceiver Circuit Module (TCM), which contains one circuit board. The DRU is tested using a TDMA Radio Test Unit (TRTU). The DRU faceplate provides a channel display and LED status indicators.

The DRU is also used to support the Digital Control CHannel (DCCH) feature.

Directional Setup and Beacon Channels

Only a Radio Channel Unit (RCU) can be used for analog setup, but a DRU/EDRU may be used for digital setup. When the directional setup option is chosen, the entire LAC and antenna system previously used for omnidirectional setup may be eliminated. Directional setup radios use the same antennas as do the voice radios. When there is directional setup in a cell, the mobile-assisted handoff feature of the DMMS transceivers scans the directional setup channels or the beacon channels to determine a candidate list of faces to hand off to.

Omnidirectional setup is an option to the service provider. However, after Release 5.0, if omnidirectional setup is implemented in a Cell Site with directional voice sectors, then beacon channels must be provided to support the mobile-assisted handoff capability for DMMSs. With no directional setup in a Cell Site, the DMMSs scan the beacon radio frequencies for that Cell Site. A beacon channel is provided by a designated voice radio which transmits its carrier at a constant power level. Each antenna sector in a Cell Site must be allocated one beacon channel. Beacon channels are provided at the request of the service provider and are required only when the Cell Site has directional voice with omni setup, or when the Cell Site is equipped entirely with analog RCUs and the neighboring Cell Site is equipped with digital channels.

Other setup options are simulcast setup or DCCH setup.

Setup radios are installed in the top radio shelves of the P-RCF. Normally, at start-up, two setup radios (one active and one standby) are used.

TDMA Radio Test Unit (TRTU)

The TDMA Radio Test Unit (TRTU) is a plug-in unit required in the P-RCF to test the Digital Radio Units (DRUs) and other DRU-related equipment. It is one of several test units in the Primary Radio Channel Frame (P-RCF). The RTU tests the analog Radio Control Units (RCUs).

The TRTU is composed of two functional groups

1. the Transceiver Functional Group and the
2. Signal Processing Functional Group.

The Transceiver Functional Group tests RF-related functions. The Signal Processing Functional Group tests baseband speech processing, speech, channel and message coding, equalization, and communication. The TRTU exchanges messages with other equipment in the P-RCF via a TDM bus, which is always installed "red stripe up."

The RTU Control Board (RCB) is used to multiplex the communication between the RTU and TRTU and the RTU Switch Panel (RSP). The RSP allows the appropriate test unit, TRTU or RTU, to test the DRU or RCU, respectively. There is a cabling kit to route the RF signals to and from the appropriate test unit. Frames ordered from the factory come with the option built in. For frames already in the field, there is a package available for field installation.

Test Enhanced Digital Radio Unit (T-EDRU), Feature IDentification (FID) #2775

Cell Sites that can use the Test Enhanced Digital Radio Unit (T-EDRU)

This chapter covers the "Test Enhanced Digital Radio Unit (T-EDRU)"feature, which has Feature IDentification (FID) #2775. The Test Enhanced Digital Radio Unit (T-EDRU) is a more advanced alternative to the older TDMA Radio Test Unit (TRTU) for testing EDRUs, but not DRUs. The T-EDRU may be used in all Series II Classic, Series IIe, Series IIm, Series IImm and PCS TDMA Minicell Products that are equipped with EDRUs only. The functionality on the TDMA Radio Test Unit (TRTU), which is used to test DRUs and EDRUs, is identically replicated on the Test Enhanced Digital Radio Unit (T-EDRU). However, the Test Enhanced Digital Radio Unit (T-EDRU) takes up half the space of the TRTU and is used to test EDRUs only.

The Test Enhanced Digital Radio Unit (T-EDRU) is identical in terms of hardware and physical size to the Enhanced Digital Radio Unit (EDRU). The only difference between it and the Enhanced Digital Radio Unit (EDRU) is that a different Non-Volatile Memory (NVM) software/firmware image is downloaded into it from the Radio Control Complex (RCC) over the Time-Division Multiplexed (TDM) bus, which is always installed "red stripe up."

Table 9-4. Placement and Use of the Test Enhanced Digital Radio Unit (T-EDRU)

Dimensions and Placement		
	TRTU	T-EDRU
Height	8.00 inches	8.00 inches
Depth	14.15 inches	14.15 inches
Width	3.00 inches	3.00 inches
Test Capability	TRTU (Tests DRUs and EDRUs)	T-EDRU (Tests EDRUs only)
SBRCU slots used	4 SBRCU slots	2 SBRCU slots
RCU slots used	2 RCU slots	1 RCU slot

The Test Enhanced Digital Radio Unit (T-EDRU) and the TDMA Radio Test Unit (TRTU) are not supported in the same base station at the same time. Only one TDMA test radio, either the TDMA Radio Test Unit (TRTU) or the Test Enhanced Digital Radio Unit (T-EDRU) is required per base station. One Test Enhanced Digital Radio Unit (T-EDRU) is enough to test the Enhanced Digital Radio Units (EDRUs) in one or more radio frames, equipped with EDRUs only, within a single cell site. Like the TDMA Radio Test Unit (TRTU), the Test Enhanced Digital Radio Unit (T-EDRU) is located in the radio test slot of the Primary Radio Channel Frame (P-RCF) at the cell site. Because only 1 Test Radio is used per cell site, if it fails, all diagnostic testing that requires the Test Radio must be suspended.

The Test Enhanced Digital Radio Unit (T-EDRU) is placed in the 2 lower numbered Time-Division Multiplexed (TDM) bus addresses currently used by the

TDMA Radio Test Unit (TRTU) for all Series II products and the TDMA PCS Minicell. TDM buses are always installed "red stripe up."

Only in the case of the Series IImm can a Control/Traffic Enhanced Digital Radio Unit (C/T-EDRU) or a Locate EDRU (L-EDRU) be allowed to occupy and operate in the 2 higher numbered Time-Division Multiplexed (TDM) bus addresses, which are also the 2 available Single Board Radio Channel Unit (SBRCU) slots next to the Test Enhanced Digital Radio Unit (T-EDRU). This capability is not supported on other products. The 2 slots for the Control/Traffic in the Series II mm have been designed to support receive and transmit functions to these backplane slots. Also, the amplification scheme in the Series IImm products allow for the addition of another radio.

Testing Supported by the Test Enhanced Digital Radio Unit (T-EDRU)

The Test Enhanced Digital Radio Unit (T-EDRU) is functionally backward compatible with the TDMA Radio Test Unit (TRTU). Additionally, it supports all functional, diagnostic, and measurement testing of the following:

- Enhanced Digital Radio Units (EDRUs) (In Any Configuration)
- Radio Frequency (RF) Switches
- Transmit Antennas
- Receive Antennas
- Lightwave Microcell Transceiver (LMT)
- Lightwave Microcell Transceiver (LMT) Optical Link.

Functional tests are performed when a radio is in service. Diagnostic and measurement tests are performed when a radio is out of service.

Test Enhanced Digital Radio Unit (T-EDRU) Self-Test

As part of Lucent’s maintenance strategy, the Test Enhanced Digital Radio Unit (T-EDRU) tests itself before it tests the other radios. The self-diagnostics performed by the Test Enhanced Digital Radio Unit (T-EDRU) include measuring the following:

- Transmit Power Level
- Received Signal Strength Indicator (RSSI) Integrity
- Time Alignment
- Radio Frequency (RF) Signals on the Switchable Shelf

Test Enhanced Digital Radio Unit (T-EDRU) Connectivity

The Test Enhanced Digital Radio Unit (T-EDRU) simulates a mobile station in order to test the TDMA radios and any other TDMA related equipment in the cell site. Failures are treated the same as a TDMA Radio Test Unit (TRTU). The Test Enhanced Digital Radio Unit (T-EDRU) provides a control lead and an RS-422 interface to the Radio Test Unit (RTU) Communications Board (RCB). The Radio Test Unit (RTU) Communications Board (RCB) is used to provide Radio Frequency (RF) connectivity to the Radio Test Unit (RTU) switch panel.

Radio Control Complex (RCC) Generic Maintenance Software Capability

Generic maintenance software in the Radio Control Complex (RCC) can:

- Control the Test Enhanced Digital Radio Unit (T-EDRU) transmit and receive antenna switches.
- Transmit Radio Frequency (RF) signals to TDMA radios located on switchable shelves to test the receive paths through the antenna switches.
- Transmit Radio Frequency (RF) signals directly to TDMA radios, then to the receive antennas, for performing return loss measurements.
- Measure digital voice radios for transmit and receive power level testing.
- Perform transmit power level/RSSI integrity self tests.
- Perform a voice band signal processing/transmission level adjustment test in the Test Enhanced Digital Radio Unit (T-EDRU) using a tone sent to the Test Enhanced Digital Radio Unit (T-EDRU) over the Time-Division Multiplexed (TDM) bus, transmitted and received within the Test Enhanced Digital Radio Unit (T-EDRU), and returned to the Time-Division Multiplexed (TDM) bus, which is always installed "red stripe up."
- Perform new functions associated with digital radios and the fiber optic transmis-sion system.
- Perform internal Test Enhanced Digital Radio Unit (T-EDRU) loop-back tests.

Test Enhanced Digital Radio Unit (T-EDRU) Transmit Testing

The Test Enhanced Digital Radio Unit (T-EDRU), like the TDMA Radio Test Unit (TRTU), tests TDMA signals in both the transmit and receive directions. For tests in the transmit direction, a radio in the Radio Control Frame injects signals into the forward transmission path. A directional coupler couples attenuated Radio Frequency (RF) signals proportional to the incident and reflected power in the antenna path back to the Test Enhanced Digital Radio Unit (T-EDRU) for measurement. The Test Enhanced Digital Radio Unit (T-EDRU) reports the measurements back to the Radio Control Complex (RCC) for processing and analysis. The Radio Frequency (RF) connectivity of the Test Enhanced Digital Radio Unit (T-EDRU) supports functional, diagnostic, and measurement testing.

Test Enhanced Digital Radio Unit (T-EDRU) Transmit Testing

For tests of performance in the receive direction, the Test Enhanced Digital Radio Unit (T-EDRU) functions as a transmitter and injects an Radio Frequency (RF) signal through a face selector switch into a directional coupler and finally to the antenna. A radio in the radio frame then measures the Radio Frequency (RF) signal strength it receives and passes the measurements to the Radio Control Complex (RCC) for processing and analysis. When the Enhanced Digital Radio Unit (EDRU) is in receive mode, the Test Enhanced Digital Radio Unit (T-EDRU) supports functional, diagnostic, and measurement testing.

Test Enhanced Digital Radio Unit (T-EDRU) Testing of C/T-EDRU, L-EDRU, and DCCH

The Test Enhanced Digital Radio Unit (T-EDRU) supports all functional, diagnostic, and measurement testing of the Control/Traffic (C/T-EDRU) and the Locate EDRU (L-EDRU).

When it performs Digital Control CHannel (DCCH) functional testing, the Test Enhanced Digital Radio Unit (T-EDRU) transmits on one time slot only. Not transmitting on the other time slots minimizes the interference during Digital Control CHannel (DCCH) testing.

Test Enhanced Digital Radio Unit (T-EDRU) Bit-Error Rate (BER)

The Bit-Error Rate (BER) of the Test Enhanced Digital Radio Unit (T-EDRU) with diversity on does not exceed 1% under the following conditions:

- The carrier to noise ratio is 30 dB or higher.
- The delay interval is zero
- The Radio Frequency (RF) input signal is static, and its power level is within the dynamic range of the receiver.

Test Enhanced Digital Radio Unit (T-EDRU) Power Requirements

The Radio Control Complex (RCC) software handles the difference in power outputs when a Test Enhanced Digital Radio Unit (T-EDRU) is substituted for a TDMA Radio Test Unit (TRTU). The Test Enhanced Digital Radio Unit (T-EDRU) and Enhanced Digital Radio Unit (EDRU) are designed to operate at attenuation 0 setting at a nominal power level of +10 dBm with a minimum adjustable range using the faceplate potentiometer of +/- 3 db over environmental conditions. The maximum transmit power from the Test Enhanced Digital Radio Unit (T-EDRU) could be as great as +15 dBm before calibration by a technician. A technician is required to adjust the potentiometer on the front panel of the Test Enhanced Digital Radio Unit (T-EDRU) to ensure it is set to +10 dBm at attenuation 0 when installed. The power output level of the Test Enhanced Digital Radio Unit (T-EDRU) is +10 dBm instead of +4 dBm as it was in the TDMA Radio Test Unit

(TRTU). Code in the Radio Control Complex (RCC) subtracts 6 dB from all Radio Frequency (RF) signals transmitted by the Test Enhanced Digital Radio Unit (T-EDRU).

MSC and TI OA&M for the Test Enhanced Digital Radio Unit (T-EDRU)

The Mobile Switching Center (MSC) can perform the same functions on the Test Enhanced Digital Radio Unit (T-EDRU) that it performs on the TDMA Radio Test Unit (TRTU). The system operator can check the status of the Test Enhanced Digital Radio Unit (T-EDRU), remove it from service, perform diagnostics on it, and return it back to service using the same Technician Interface (TI) commands that are used for the TDMA Radio Test Unit (TRTU). Operation, Administration, and Maintenance (OA&M) operations that can be performed on the Test Enhanced Digital Radio Unit (T-EDRU) include:

- Checking status
- Removing (Take out of service manually)
- Take out of service automatically for routine diagnostics.
- Restore (Bring back to service and reset all parameters used to control it) Aside from the wide range of testing that the Test Enhanced Digital Radio Unit (T-EDRU) brings to the service provider, it allows the Series IImm to add another Enhanced Digital Radio Unit (EDRU) to its Primary Radio Channel Frame (P-RCF) to increase control or traffic channel capacity.

Test Enhanced Digital Radio Unit (T-EDRU) Activation Not Required

The Test Enhanced Digital Radio Unit (T-EDRU) is not activated by a Feature Activation File (FAF). The Test Enhanced Digital Radio Unit (T-EDRU) is activated by simply replacing a TDMA Radio Test Unit (TRTU) with a Test Enhanced Digital Radio Unit (T-EDRU). That is, placing the Test Enhanced Digital Radio Unit (T-EDRU) in the test radio slot in the Primary Radio Channel Frame (P-RCF).

RC/V Configuration of Test Enhanced Digital Radio Unit (T-EDRU)

Recent Change & Verify (RC/V) allows the technician to equip and configure the Test Enhanced Digital Radio Unit (T-EDRU) in the same way that the TDMA Radio Test Unit (TRTU) is configured.

CDMA Radio Maintenance Units and Personality Types

For each CDMA cluster (one CCC managing up to seven CCUs), there is one NVM image file for the CCC, another for the pilot/sync/access (P/S/A) CE personality, another for the page CE personality, another for the traffic CE personality, and still another for the orthogonal-channel noise simulator (OCNS) CE personality. At initialization, the CCC downloads the personality-type image files and other specific parameter values into active memory of the CCUs_the CCC downloads exactly one personality-type image file to each CCU CE. There is another NVM image file for the BBA, another for the CRTUi, and still another for the SCT.

The CCU contains two on-board CEs. Thus, a CCC can manage up to 14 CEs.

For the cellular band class (850 MHz), the TIA IS-95A standard defines two common carriers: the primary CDMA carrier, which is centered on RF channel 283 for System A (A band) and 384 for System B (B band), and the secondary CDMA carrier, which is centered on RF channel 691 for System A (A’ band) and 777 for System B (B’ band). Each CDMA omni cell or cell sector must be assigned at least one common carrier. For the PCS band class (1900 MHz), candidates for common CDMA carriers range from channel numbers 25 to 1175 in increments of 25.

Each common CDMA carrier (primary, secondary) on an antenna face has one CE configured as the P/S/A CE and another configured as the page CE. The two CEs may be on the same CCU or on different CCUs within the same CDMA cluster.

The following paragraphs provide a brief description of each CDMA CE personality type:

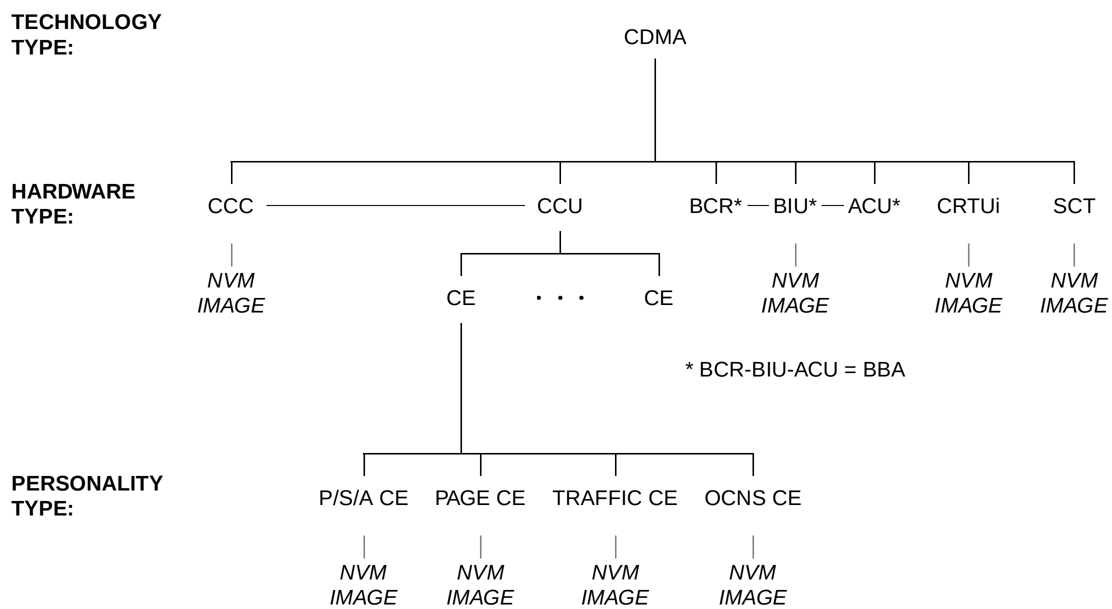


Figure 9-2. CDMA Radio Maintenance Units and Personality Types

Pilot/Sync/Access Channel Element (CE)

The CE Performs part of the CDMA call setup function_establishes calls with mobile subscribers using IS-95A or IS-95B compliant CDMA/AMPS dual-mode mobiles.

The pilot channel is an unmodulated, direct-sequence spread-spectrum signal transmitted continuously by each sector of a CDMA cell. It allows the mobile to acquire the timing of the forward control channels and provides a coherent carrier phase reference for demodulating the sync and paging channels.

The sync channel provides time-of-day and frame synchronization to the mobile. The mobile uses this channel to acquire cell and sector-specific information.

The access channel is a CDMA reverse channel used for short signaling message exchange such as mobile registration, mobile call origination, and response to pages. The access channel is a slotted random access channel used by mobiles to communicate to the Cell Site.

Page CE

Performs part of the CDMA call setup function_transmits control information to idle mobiles during mobile powerup and when a mobile is acquiring a new Cell Site. It conveys pages to the mobiles.

Traffic CE

Performs the CDMA traffic channel function_carries one over-the-air CDMA call. A traffic channel, which is a communication path between a mobile station and a

Cell Site, carries user and signaling information. The term traffic channel implies a forward and reverse pair.

Orthogonal-channel Noise Simulator CE

Simulates a specified number of mobile users operating in a specified sector on a specified carrier. OCNS allows generation of a simulated user load on the CDMA forward channels in order to assist in verifying the capacity of the CDMA system.

Antenna Hardware Configurations

10

Contents

Introduction

The Series II Cell Site accommodates up to seven antenna faces, thus permitting implementation of omnidirectional, 3-sector (120 degrees per sector), 6-sector (60 degrees per sector), or other special antenna configurations. Each antenna face has an antenna set, which typically consists of one transmit antenna and two (diversity) receive antennas.

There are two basic antenna types:

1. **Omnidirectional** antennas—antennas having an omnidirectional pattern.

   Omnidirectional antennas are approximately 14 feet high and 3 inches in diameter. They are typically mounted at the corners of a 3-sided platform at the top of a free-standing steel mast.

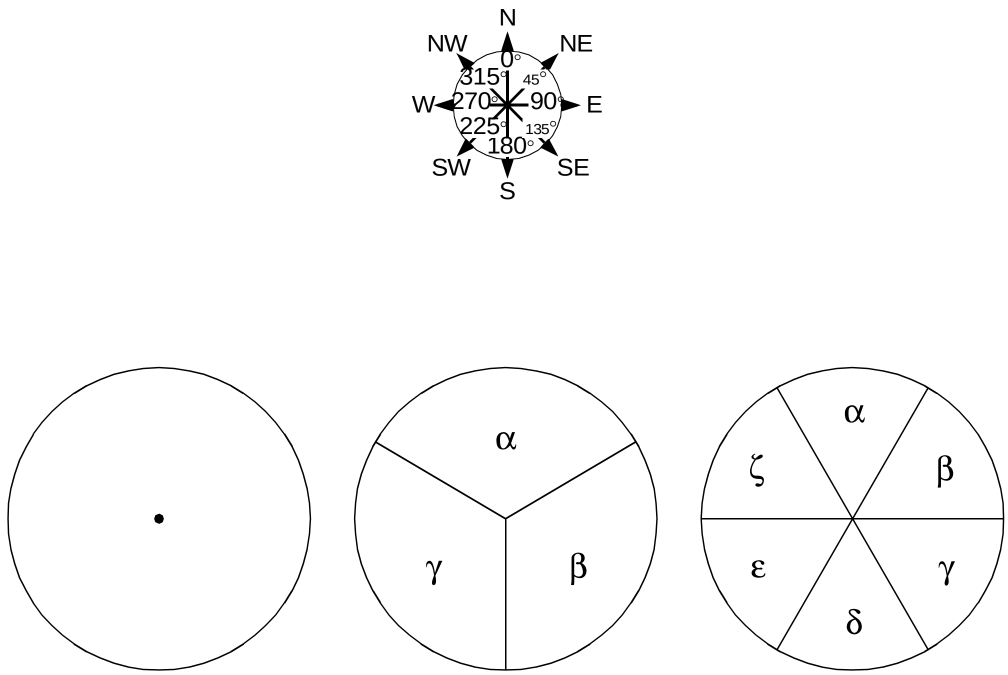
2. **Directional** antennas—antennas having a unidirectional pattern.

   Directional antennas usually have higher gain than omnidirectional antennas.

   There are two basic directional antenna types: the 120-degree directional antenna, which covers a 120-degree sector in a given cell, and the 60-degree directional antenna, which covers a 60-degree sector in a given cell.

   The directional antennas are mounted on each side (face) of a 3-sided or 6-sided platform at the top of a free-standing steel mast.

Omni cells are Cell Sites using omnidirectional antennas. *Sector cells* are Cell Sites using directional antennas. An omni-configured system costs significantly less per customer (mobile user) than a sectored installation.



OMNI Directional Antenna Configuration

ALL-Directional, 3-Sector Antenna Configuration

ALL-Directional, 6-Sector Antenna Configuration

ANT Face DESG	Greek Symbol	Sector Number
ALPHA	α	1
BETA	β	2
GAMMA	γ	3
DELTA	δ	4
EPSILON	ε	5
ZETA	ζ	6

Figure 10-1. Series II Cell Site Antenna Configurations

In addition to the two basic antenna types listed above, there is a new 2-branch intelligent antenna type. The 2-branch intelligent antenna will be the third type of antenna discussed.

Fixed Antenna Connection Configuration

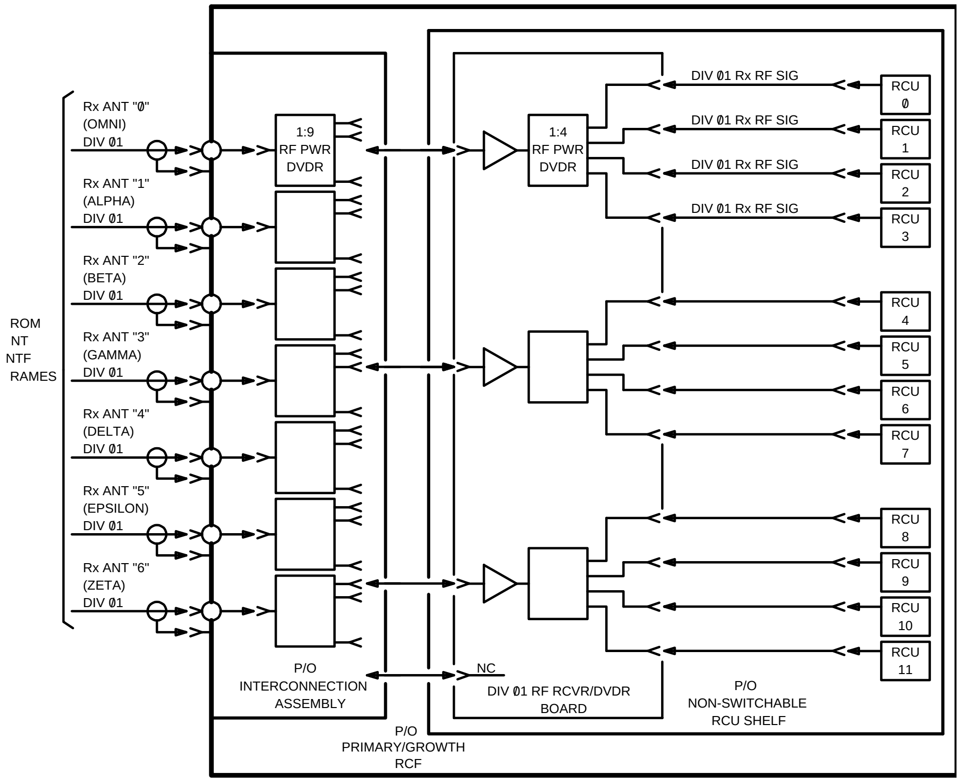
Shelves equipped for the fixed antenna connection option (see Figure 10-2) can be used in frames where all the Radio Channel Units (RCUs) are connected to an omni antenna or connected to directive antennas, or in frames that have some RCUs connected to omni antennas and some connected to directive antennas. On shelves with the fixed antenna connection configuration, power combiners and dividers interface 3 radio groups of 4 radios each.

For the transmit direction, the grouping on each shelf is by 4:1 RF power combiners located on a BBN2 circuit board. The output of each combiner is cabled to the Interconnection Panel Assembly where it is connected to 9:1 power combiners for transmission to the LAFs. In this arrangement, the 9:1 combiners can accommodate up to nine groups of four RCUs for a total of 36; they can also handle up to seven antennas, which can be directive, omni, or a combination of the two.

There is a test port on each 9:1 combiner through which the power level in each channel signal can be measured with either a Radio Frequency (RF) power meter having a tunable front end or a spectrum analyzer. The coupling loss between the main output and the test port is 20 ± 0.5 dB.

For the Simulcast Setup feature with macrocell only (a macrocell is a Series II antenna sector), the transmit path (see Figure 10-3) uses a 1:6 divider in Series with a nominal 2-dB RF pad. The 1:6 divider is used to split the setup radio signals to each sector antenna. The combined loss of the RF pad and 1:6 splitter is almost the same as the loss of the 9:1 combiners that feed signals to the LACs.

The two setup radios used for Simulcast must be located in positions that are each powered by a different power unit and served by the same shelf 4:1 combiner.



A. FIXED ANTENNA CONNECTION

Figure 10-2. Interconnection Panel Assembly

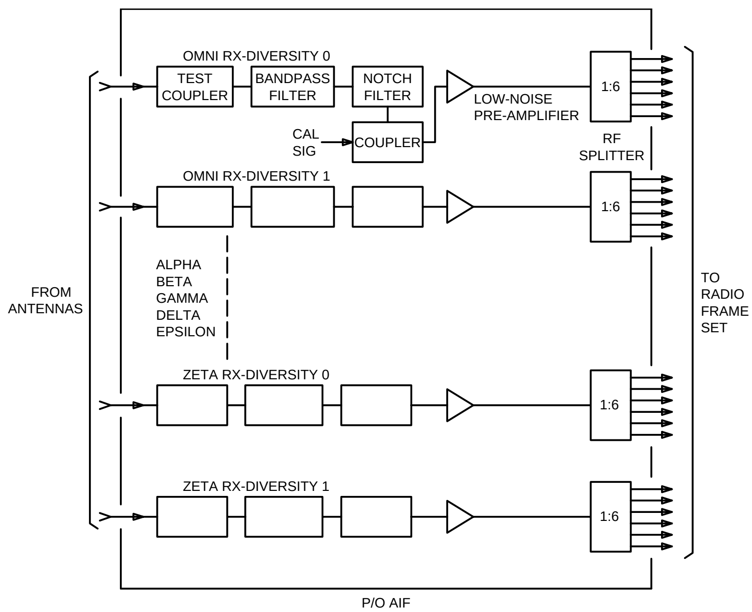


Figure 10-3. Antenna Interface

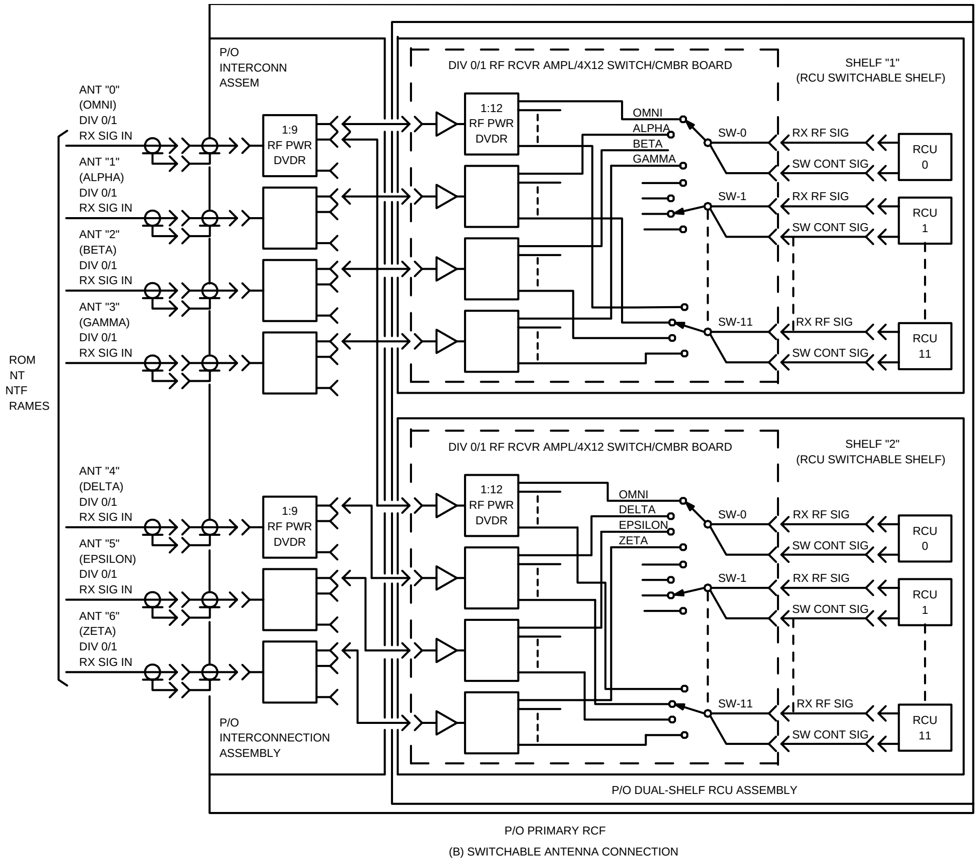


Figure 10-4. Primary RCF Switch Antenna Connector

3-Sector Directive Plus Omni Antenna Switching Configuration

This description pertains to setup and locate radios only. In this configuration, the switchable antenna connection option is used for the receive path (see Figure 10-4). With the switchable antenna connection option, each Radio Channel Unit (RCU) on the shelf can switch receive paths to any one of 4 available antennas. Receive inputs from the AIFs are coupled through 1:9 RF power dividers in the Interconnection Panel Assembly to 1:12 power dividers on a BBM1 circuit board on the RCU shelf. One board is used for each of the two diversities. Each board has 12 single-pole, four-position Radio Frequency (RF) switches. Each switch is associated with and controlled by an RCU.

The control lines to the switches in the two receive diversity paths associated with the same RCU are connected in parallel and, therefore, controlled simultaneously.

Fixed antenna connections are used in the transmit path.

6-Sector Directive Plus Omni Antenna Switching with Dual-Radio Solution

This description pertains to setup and locate radios only. In this configuration (see Figure 10-4), the hardware on the two shelves is the same as it is in the 3-sector configuration; the differences are in the way the connections are made to the AIFs. Fixed antenna connections are used for the transmit paths, and the switchable antenna connection option is used for each of the two diversities in the receive paths.

Inputs from the Omni antenna and directive antennas 1 through 6 are coupled through 1:9 RF power dividers on the Interconnection Panel Assembly to BBM1 circuit boards on the Radio Channel Unit (RCU) shelves. One BBM is used for each of the two diversities. The BBM1 boards on shelf 1 are connected to the interface circuits of the Omni antenna and to directive antennas 1 through 3; the boards on shelf 2 are connected to the Omni antenna and to directive antennas 4 through 6.

3- or 6-Sector Directional Antenna Switching with Simulcast Setup

In this configuration (see Figure 10-5), the hardware on the two shelves is the same as it is in the omni setup 3- or 6-sector configurations; the difference is that an omni antenna is not required for the setup radios. For 3-sector configurations, the “simulated omni” signal is connected from a 6:1 combiner in AIF0 to a connector in the RCF Interconnection Panel Assembly and through a 2-dB pad to the BBM1 board. For 4-, 5-, or 6-sector configurations, the 2-dB pad is replaced by a 1:2 divider. The combination of a 6:1 combiner and 2-dB pad and a 6:1 combiner and 1:2 divider are roughly equivalent to the loss of the 1:9 divider they replace. The simulated omni signal is sent to the upper Switchable Radio Shelf or, through the 1:2 divider, to both the upper and lower Switchable Radio Shelves.

The 6:1 combiner output signal simulates the omnidirectional setup antenna signal of an omnidirectional setup/directional voice Cell Site, thereby eliminating the need for an omnidirectional antenna dedicated to the setup function.

All-Omnidirectional Configuration

The basic all-omnidirectional configuration (see Figure 10-6) consists of one voice channel transmit antenna, one optional setup transmit antenna to handle transmission and paging signals over the entire cell,* and two receive antennas. The receive antennas feed all Cell Site voice channel radios, setup radios, and analog locate radios.

In an all-omnidirectional configuration, up to seven voice channel transmit antennas are possible via the multiple-LAC feature. The multiple-LAC feature allows up to seven LACs and seven transmit antennas to be associated with one antenna face. The maximum number of transmit antennas at a Series II Cell Site is 7.

* The basic all-omnidirectional configuration described here requires omnidirectional setup. There are three setup configuration options—omnidirectional setup, directional setup, and simulcast setup.

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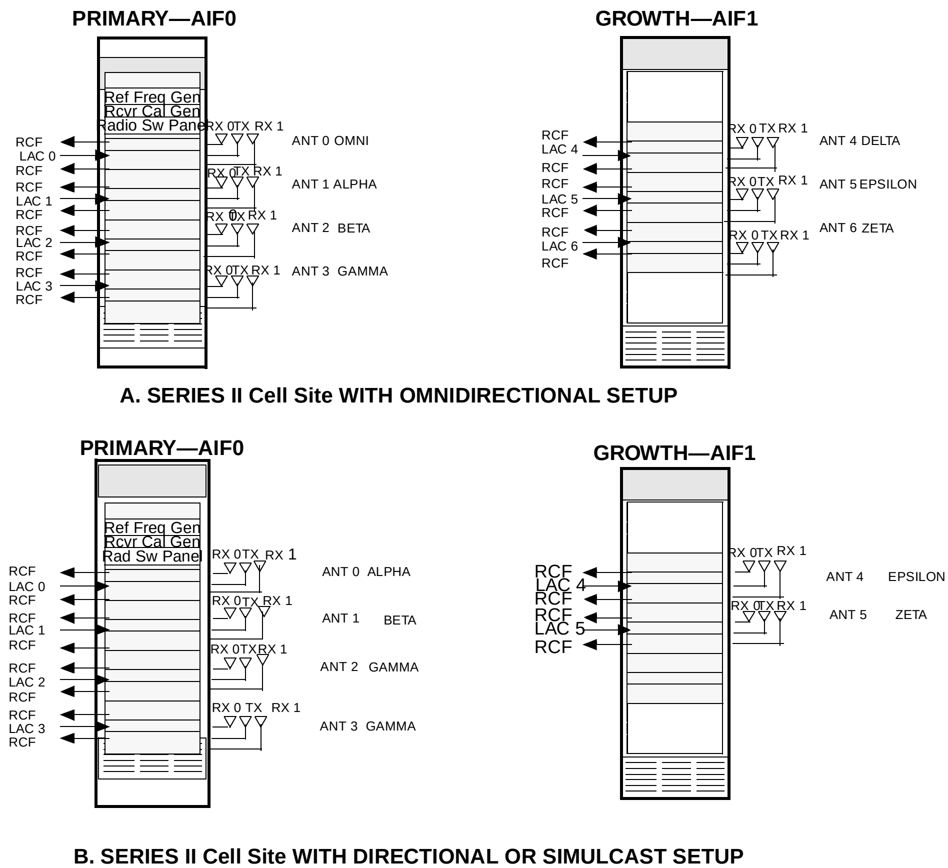


Figure 10-5. Mapping of Antenna Faces to Antenna Sets for the Various Setup Options

All-Directional Configuration

In general, it will be necessary ultimately to sector omni cells to minimize interference and provide increased system performance quality. Sectoring (see Figure 10-5) is normally done with 120-degree directional antennas, where three transmit antennas are used to cover the full 360 degrees. Sectoring may also be done with 60-degree directional antennas, where six transmit antennas are used to cover the full 360 degrees.

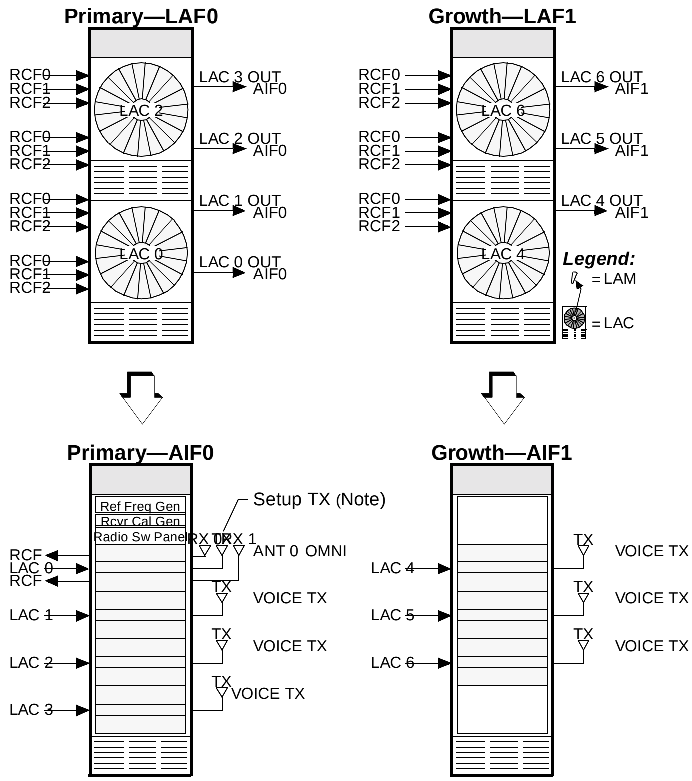


Figure 10-6. Omnidirectional Cell Site Having Seven Transmit Antennas

The basic all-directional configuration consists of:

1. Three sets of 3-sector (120-degree) directional antennas or six sets of 6-sector (60-degree) directional antennas,
2. One optional omnidirectional setup transmit antenna to handle transmission and paging signals over the entire cell, and
3. Two optional omnidirectional setup receive antennas. Each physical antenna face has one or two directional transmit antennas and two directional receive antennas.

Thus, when a cell is sectored, there are at least nine 120-degree directional antennas or 18 60-degree directional antennas, plus the optional three omnidirectional setup antennas to complete the configuration—for a maximum of 21 antennas at a Series II Cell Site.

If *duplexers* are used on each antenna face, the maximum number of antennas is reduced to 14. A duplexer is a combined receive and transmit filter panel that connects to a single antenna. Functionally, the receive and transmit circuits are the same as the separate receive and transmit filter panels, except that the duplexer provides a combined receive/transmit antenna port. Thus, the duplexer permits multiplexing of one of the receive paths—usually diversity 0—with the transmit path of an antenna face, thereby reducing the required number of antennas from three to two per face.

A 3-sector cell has three physical antenna faces, which are functionally designated alpha, beta, and gamma. Usually, the antenna face whose center line is pointing north is called alpha. The antenna face clockwise from alpha is called beta, and the antenna face clockwise from beta is called gamma.

A 6-sector cell has six physical antenna faces, which are functionally designated alpha, beta, gamma, delta, epsilon, and zeta. The antenna face clockwise from gamma is called delta, the antenna face clockwise from delta is called epsilon, and the antenna face clockwise from epsilon is called zeta.

Figure 10-1 shows how the antenna faces map to antenna sets for the omnidirectional, directional, and simulcast setup options. Notice that antenna 0 does not necessarily mean antenna omni; antenna 0 may also mean antenna alpha—at a Cell Site having directional or simulcast setup.

The Cell Site RCC identifies the transmit and receive antennas associated with an antenna face by the Radio Test Unit Switch Panel (RSP) switch positions used to test them. The RSP cable connections to transmit antennas 0 through 6 are fixed, but the RSP cable connections to receive antennas 0 through 6 for diversity 0 and diversity 1 are *not* fixed and depend upon whether antenna 0 means antenna omni or antenna alpha. The RSP cable connections at a Series II Cell Site when antenna 0 means antenna omni (applicable to Cell Sites having omnidirectional setup). The RSP cable connections at a Series II Cell Site when antenna 0 means antenna alpha (applicable to Cell Sites having).

Radio Transmission and Reception

The Cell Site receives digital-voice signals via a T1 line, modulates and up-converts the signals to RF, and then transmits the RF output signals over the air interface to a mobile station. In the mobile-transmit direction, the Cell Site receives RF input signals from a mobile station via the receive antennas (two inputs for diversity), then filters, amplifies, and recovers the original mobile data for transmission over a T1 line to the MSC.

Two-branch spatial diversity on reception is achieved by providing two receive antennas physically separated by about 3 to 4 meters so that their received signals are not correlated. When one antenna receives a multipath fade, the other antenna probably will not.

RF Transmitter Interfaces

There are two distinct RF transmitter interface configurations: the all-omnidirectional antenna configuration and the all-directional (120- or 60-degree) antenna configuration. The RF output can be transmitted through an omni-transmit antenna or through a transmit antenna on one of the physical antenna faces of the directional antennas. The low-power RF transmissions from multiple radios are combined and amplified by a LAC and sent through a transmit filter panel to the transmit antenna (see Figure 10-7).

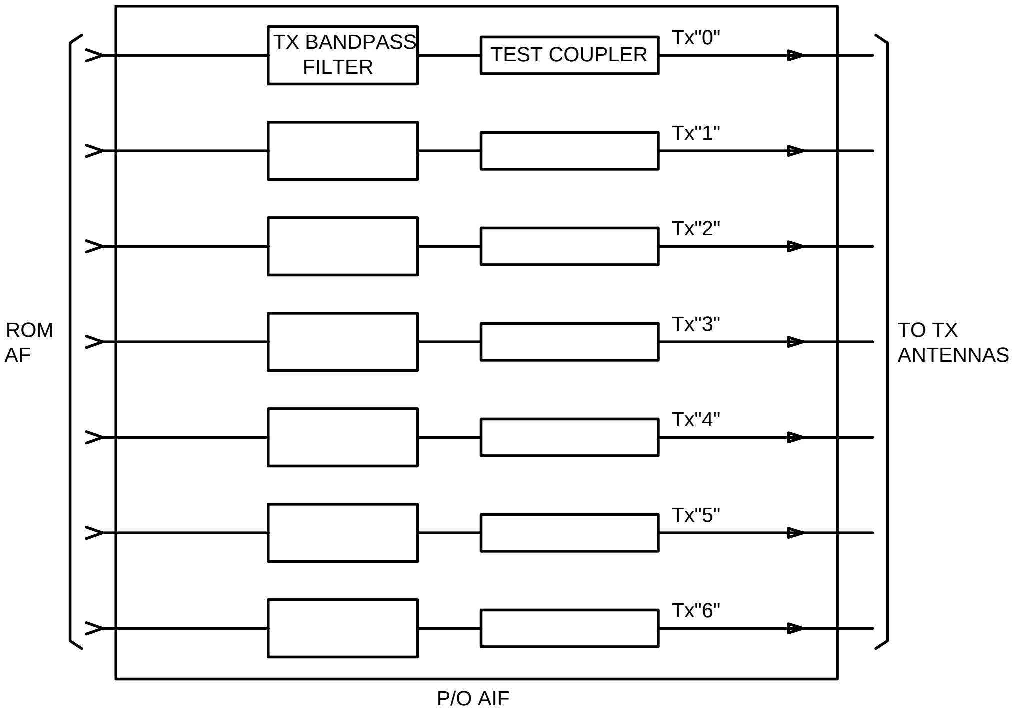


Figure 10-7. Antenna Coupler

RF Receiver Interfaces

There are two distinct RF receiver interface configurations: the all-omnidirectional antenna configuration and the all-directional (120- and 60-degree) antenna configuration. The RF input can be received through a pair of omni-receive antennas or through a pair of receive antennas on one of the physical antenna faces of the directional antennas. The RF input signals pass through receive filter panels to RF power dividers, where the signals are divided and cabled to the diversity 0 and diversity 1 receiver sections (identical receivers) of the radios.

2 Branch Intelligent Antenna, Feature IDentification (FID) #3145

What “2 Branch” means in 2 Branch Intelligent Antennas

This chapter covers the “2 Branch Intelligent Antennas” feature, which has Feature IDentification (FID) #3145. The “2 Branch Intelligent Antennas” feature was developed to deliver better voice quality on the transmission link between the mobile and the base station. “2 branch” refers to the 2 existing paths, 1 path from each of the 2 diversity receive antennas, to the Enhanced Digital Radio Unit’s (EDRU) or the Dual Radio Module (DRM). While a four branch reverse link system would have yielded a greater improvement in voice quality, it would have required extensive redesign of the existing Series II architecture. Therefore, the 2 branch system, which required no redesign, was implemented.

How the Enhanced Digital Radio Unit (EDRU) is used to support 2 Branch Intelligent Antennas

The 2 Branch Intelligent Antennas feature is implemented in the Enhanced Digital Radio Unit's (EDRU's) software. However, the 2 Branch Intelligent Antennas Feature does not add a new Non-Volatile Memory (NVM) image. Both of the existing Enhanced Digital Radio Unit's (EDRU's) Non-Volatile Memory (NVM) images (packet pipe & non-packet pipe) incorporate the new software. The Enhanced Digital Radio Unit's (EDRU) is used in the Series II Classic, Series IIe, Series IIm, Series IImm, and PCS TDMA Minicell products. The 2 Branch Intelligent Antennas Feature is not intended for and does not work with Lucent's analog products. No extra Radio Frequency (RF) hardware is required to implement this feature and it does not impact the existing base station's Radio Frequency (RF) footprint, antennas, size, or power.

What "Intelligent" means in 2 Branch Intelligent Antennas

"Intelligent Antennas" refers to an entire system comprised of a radiating structure with antennas for transmit and receive, which are connected via Radio Frequency (RF) cables to a Digital Signal Processor (DSP) (within the Enhanced Digital Radio Unit's (EDRU) which has the ability to execute intelligent algorithms that process the Radio Frequency (RF) signals to improve system performance.

The Adaptive Interference Rejection Technique

The 2 Branch Intelligent Antennas Feature uses the "Adaptive Interference Rejection," technique, also known as digital beamforming, for optimally combining the 2 diversity receive antennas. Adaptive Interference Rejection captures the Radio Frequency (RF) signals from the antenna elements and converting them into 2 streams of binary I and Q signals, which together represent the amplitudes and phases of the signals received by the antenna. The adaptive interference rejection is carried out by weighting these digital signals, thereby adjusting their amplitudes and phases, such that when they are added together, it maximizes the Signal-to-Noise Ratio (SINR) for the desired signal. A typical digital adaptive interference rejection system consists of an array of antenna elements, independent receivers for the individual antenna elements, and one or more digital signal processors. This feature is a software enhancement only and makes use of the existing 2 branch architecture for receive diversity built into the Enhanced Digital Radio Unit's (EDRU). This feature works for only the reverse link in the Enhanced Digital Radio Unit's (EDRU). All processing is done at baseband.

Performance with 2 Branch Intelligent Antennas

The 2 Branch Intelligent Antennas Feature provides better voice quality in an interference dominated environment on the reverse link (Mobile to Base Station) only. The 2 Branch Intelligent Antennas feature yields a 3 dB performance enhancement in the reverse link C/I in an interference limited environment when compared to the existing maximal ratio combining technique used in the differential detection and trellis equalization paths. On average, co-channel interference is expected to decrease by a nominal 3 dB compared to the classic diversity scheme in the Enhanced Digital Radio Unit's (EDRU) in an interference limited environment. The level of improvement depends on the distribution of co-channel users in neighboring cells. This feature allows each 30 kHz TDMA channel, through software processing, to reduce/eliminate the effects of co-channel interference within the field of view of the Enhanced Digital Radio Unit's (EDRU). Baseband processing is able to combine the spatially separated diversities for interference rejection.

The 2 Branch Intelligent Antennas Feature equals the performance of the existing maximal ratio combining technique when used in a noise limited environment. The feature does not increase the existing capacity or range of the base station in a noise limited environment. A tower top Low Noise Amplifier (LNA), however, provides range extension on the reverse link in a noise limited environment. Using this feature together with a tower top Low Noise Amplifier (LNA) would yield interference rejection and range extension on the reverse link. However, the purpose of this feature is to improve voice quality in an interference limited environment, not a noise limited environment. Activation of this feature does not degrade the existing performance of the Enhanced Digital Radio Unit's (EDRU) in a noise limited environment.

Digital Locate under 2 Branch Intelligent Antennas

The 2 Branch Intelligent Antennas Feature should not be implemented on the digital locate radio. Locate radios are used to determine if a call will be placed on a certain channel. Selection criteria should be based on the best channel in a noise limited environment. Calls should not be placed on channels with a lot of interference.

2 Branch Intelligent Antennas Testing

Testing of the 2 Branch Intelligent Antennas on the Enhanced Digital Radio Unit's (EDRU) feature is done in maximal ratio combining mode. Current testing in the Enhanced Digital Radio Unit's (EDRU) only tests one branch of the dual diversity receive paths at a time. To eliminate the development of a new testing routine with minimal gains, the Enhanced Digital Radio Unit's (EDRU) should be switched back to maximal ratio combining mode and tested one branch at a time.

2 Branch Intelligent Antennas Phased Release

The 2 Branch Intelligent Antennas Feature is a phased release. Phase 1 implements this feature on the digital traffic radio and incorporates the adaptive interference rejection technique into the differential detection path of the Digital Signal Processor (DSP).

2 Branch Intelligent Antennas Feature Activation

The 2 Branch Intelligent Antennas Feature is activated on a per Cell Site Feature Activation File with Qualifiers (QFAF) basis. The feature is enabled from the Mobile Switching Center (MSC) by a translation to select adaptive interference mode or maximal ratio combining mode on a cell by cell basis. All Enhanced Digital Radio Unit’s (EDRUs) at the cell site have the feature turned on or off on a cell by cell basis using RC/V.

Cell Site Hardware Functions and Interconnections

11

Contents

Introduction

The Series II Cell Site (See Figure 11-1) includes controllers, radios, wideband linear amplifiers, antennas, and associated equipment for setting up and completing cellular calls. It can support AMPS, TDMA, and CDMA simultaneously through the same wideband linear amplifier and antennas.

Hardware elements common to AMPS, TDMA, and CDMA are the linear amplifier frames (LAFs), the antenna interface frames (AIFs), and the hardware units resident in the RCF (See Figure 11-2). The hardware units resident in the radio channel frames (RCFs) are described in the following paragraphs.

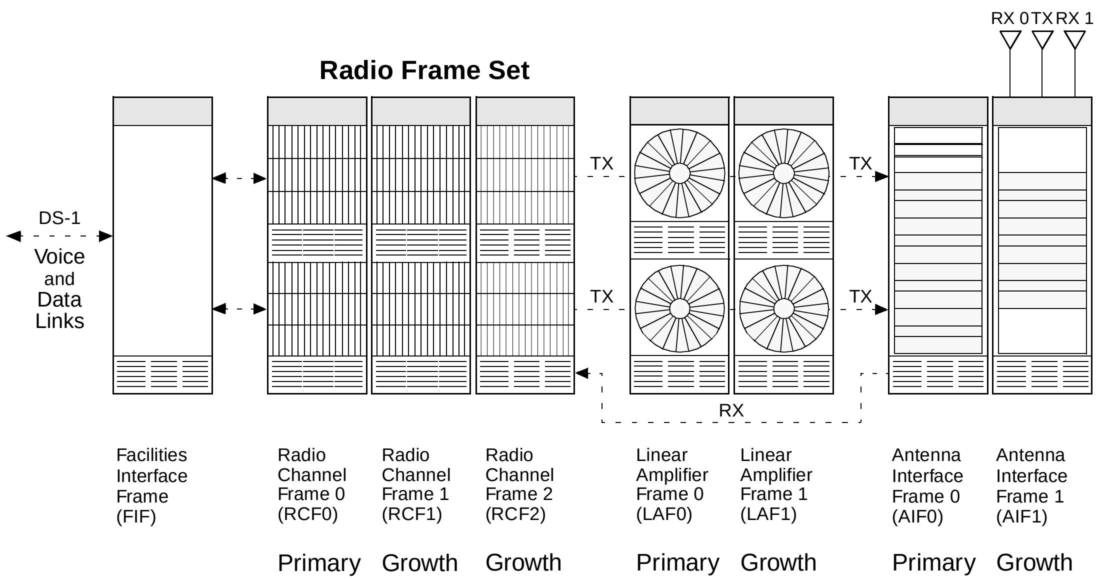


Figure 11-1. Series II Cell Site Architecture

Radio Control Complex (RCC)

The RCC (See Figure 11-2) provides control of the Cell Site equipment and performs call processing in conjunction with the ECP complex. Specifically, the RCC performs the following tasks:

- Manages radio resources and speech trunks
- Gathers statistical information about the operation of the cell for network management
- Maintains the service status of hardware and software entities within the cell

- Monitors subordinate hardware devices for detected faults
- Performs diagnostic tests on the Cell Site equipment

The Radio Control Complex (RCC) controls the entire Radio Frame Set (RFS). The RCC is fully redundant and uses two identical processors, called RCC 0 and RCC 1, as shown in Figure 11-2. Normally, one processor is active and one is standby. Each processor contains a memory, Network Control Interfaces (NCIs) to control the TDM buses, a Communications Processor Interface (CPI), an alarm interface, and a system bus which connects all circuit packs. An update bus interconnects the two processors within the RCC. Series II processors have improved speed and memory capacity. The TDM buses are always installed "red stripe up."

The RCC also provides the interface to pass Cell Site alarms to the MSC. These alarms include hardware alarms/power alarms, fire and intrusion alarms, and environmental alarms. Alarms are monitored by the alarm interface circuits located in the RCC shelf of the primary Radio Control Frame (RCF). They include the following:

- 12 internal frame alarms
- 18 user-assigned alarms
- 12 frame alarms from each growth frame
- 6 circuit alarms from the Antenna Interface Frame (AIF)
- Status alarms from each Linear Amplifier Circuit (LAC) in the Linear amplifier Frame (LAFs)

All the user-assigned and the AIF alarms are connected to the primary RCF by one connector. The status of the alarms originating in the LACs is scanned periodically and alarm data is transmitted to the P-RCF by a dedicated connector.

Digital Signal (DS1) Units

DS1 units perform serial-to-parallel and parallel-to-serial data conversion between the T1 lines and the one or two time-division multiplexed (TDM) buses that connect the primary RCF to the growth RCFs. The DS1 units provide the T1 (1544 kbit/s) connectivity to the DCS. The TDM buses are always installed "red stripe up."

Digital Facilities Interface (DFI) Units

The DFI unit performs serial-to-parallel and parallel-to-serial data conversion between the T1 lines and the one or two TDM buses that connect the primary RCF to the growth RCFs. A DFI may reside in any slot reserved for the DS1.

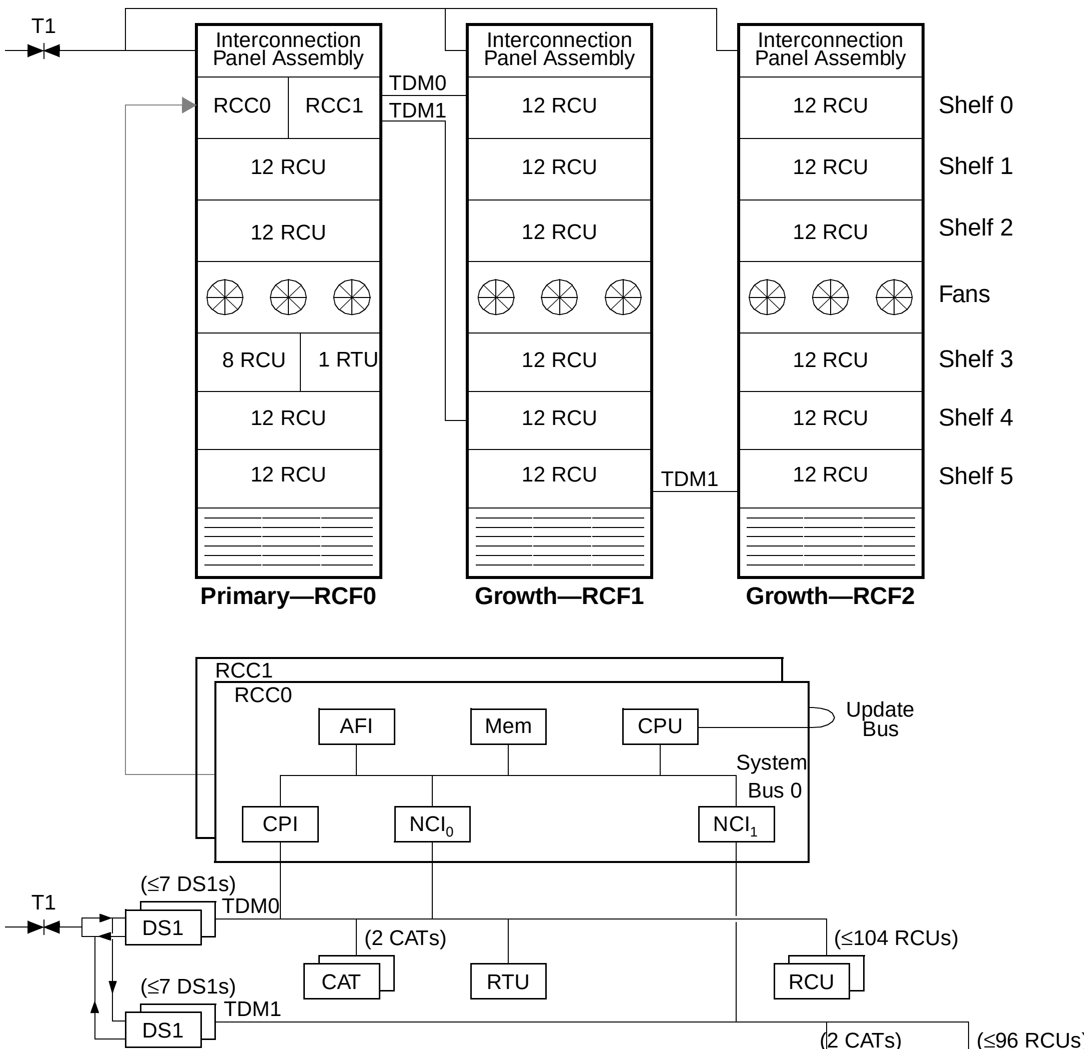
Unlike the DS1, which can terminate only one T1 line, the DFI can terminate up to two T1 lines, although only one termination is currently supported. In addition, the DFI can be configured to terminate E1 (2048 kbit/s) lines.

Clock And Tone (CAT) Units

The CAT unit generates the clock signals for the one or two TDM buses that connect the primary RCF to the growth RCFs. The TDM buses are always installed "red stripe up."

Radio Frame Set

A radio frame set consists of a primary RCF and up to two growth RCFs. A radio frame set is capable of accommodating up to 14 DS1 or DFI units, four CAT units, 200 AMPS radio channel units (RCUs) or single-board RCUs (SBRCUs) (includes setup, locate, and voice radios), and one AMPS radio test unit (RTU).



Note: Cat units are redundant for both TDM0 and TDM1.

Figure 11-2. Radio Frame Set Architecture and Bus Structure

A radio frame set can also accommodate TDMA digital radio units (DRUs, EDRUs) and a TDMA radio test unit (TRTU). A radio frame set can hold up to 96 DRUs. The maximum number of EDRUs that can be installed in a radio frame set has yet to be determined.

Any combination of RCUs, SBRCUs, DRUs, and EDRUs can reside in the primary RCF or in a growth RCF with the following constraint: no more than five EDRUs are allowed in the same radio shelf due to DC power limitations. All four radio types can sit side-by-side in the same radio shelf. The TRTU, when installed, sits right next to the RTU in the radio test shelf. The DRU occupies two adjoining RCU slots, the EDRU occupies one RCU slot, and the TRTU occupies two adjoining RTU slots.

CDMA radios are installed in their own growth RCF, which is designed to house 12 CDMA radios—two (redundant) radios per shelf. (One CDMA radio is active and one is standby). CDMA radios cannot be installed in the primary RCF, nor can they be intermixed with RCUs, SBRCUs, DRUs, or EDRUs in the same growth RCF. Since there can be up to two growth RCFs in a radio frame set, the Series II Cell Site can accommodate up to 24 CDMA radios.

A radio frame set consists of at most three RCF frames: a primary RCF and one or two growth RCFs. One or both of the growth RCFs may be CDMA growth frames.

The plug-in units, or circuit boards, are physically located by shelf and slot numbers. Slot numbers are indicated at various points along the horizontal run.

A Radio Frame Set (RFS) consists of at least a primary Radio Channel Frame (RCF 0) and a maximum of two "growth" RCFs (RCF 1 and RCF 2). All RCFs contain 6 radio shelves, shelves 0 through 5. The entire RFS is controlled by the Radio Control Complex (RCC), which is located in the uppermost shelf (Shelf 0) of the P-RCF.

In the P-RCF, shelves 1, 2, 4, and 5 can each support 12 Radio Channel Units (RCUs). Shelf 3 of the P-RCF contains the TDMA Radio Test Unit (TRTU), required to test the radio units, and therefore can only house up to 8 RCUs. Altogether, RCF 0 can house 56 RCUs or Enhanced Digital Radio Units (EDRUs) (which, like the RCU use only 1 radio slot apiece) (12 x 4 + 8); or RCF 0 can house 28 Digital Radio Units (DRUs), which use 2 radio slots apiece.

Each of the Growth RCFs is capable of accommodating up to a total of 12 RCUs or EDRUs on each of its 6 radio shelves, or 72 RCUs or EDRUs apiece (12 x 6); or a Growth RCF can house 36 DRUs.

TDM bus 0 connects all the radio shelves in RCF 0 and the 4 upper shelves, 0 thru 4, in RCF 1. That makes the number of radio slots covered by TDM bus 0 equal to 104. That many slots could house 104 RCUs or EDRUs or 52 DRUs.

TDM bus 1 Connects the 2 lowest radio shelves in RCF 1 and all the radio shelves in RCF 2. That makes the number of radio slots covered by TDM bus 1 equal to 96. That many slots could house 96 RCUs or EDRUs or 48 DRUs.

The TDM buses are always installed "red stripe up."

The number of radios and/or radio channels that TDM buses 0 and 1 support may or may not be equal to the number of radio units that physically fit into those shelves that are covered by either of the buses.

RCF Architecture and Bus Structure

The RCC (See Figure 11-2), which resides on the uppermost shelf (shelf 0) of the primary RCF, consists of two identical controllers. One controller is active (on-line) and one is standby (off-line).

System bus

Each RCC controller makes use of a dedicated system bus over which all of the units that make up the controller communicate. The two system buses (0 and 1) are embedded in the RCC backplane.

Update bus

An update bus interconnects the two RCC controllers. It is over this bus that the standby controller obtains information from the active controller so that it is constantly informed of the status of the operating parameters. This mode of operation allows an immediate switch from the active-controller side to the mate-controller side with a minimum of lost control information in the event of a controller failure. The update bus is embedded in the RCC backplane.

TDM buses

There are two TDM buses in the primary and growth RCFs (See Figure 11-3): TDM bus 0 (TDM0) and TDM bus 1 (TDM1). The TDM buses provide the transfer paths for both digital-voice and signaling data (call processing or operation and maintenance messages) within the RCFs. The TDM buses communicate with the ECP over BX.25 data links (signaling channels).

The TDM buses are always installed "red stripe up."

The TDM buses interconnect the RCC with the other units in the primary and growth RCFs. The interconnections are accomplished via AYD4 paddleboards (circuit boards) that mount onto the wiring side of certain backplane pinfields. Each of these paddleboards has a connector that provides termination to flat ribbon cable, thus providing the means to complete the necessary interconnections. In addition, all TDM buses are terminated via AYD3 termination paddleboards that mount onto the wiring side of certain backplane pinfields.

NOTE:
All TDM bus inter-shelf and inter-frame bus cables should be installed with the pin 1 edge upward. The pin 1 edge is denoted by a red colored stripe. An upside-down TDM bus cable can reduce the effective signal ground between shelves and frames and distort the TDMSYNC1 signal, which provides a reference signal used to lock the T1/E1 span to the TDM bus.

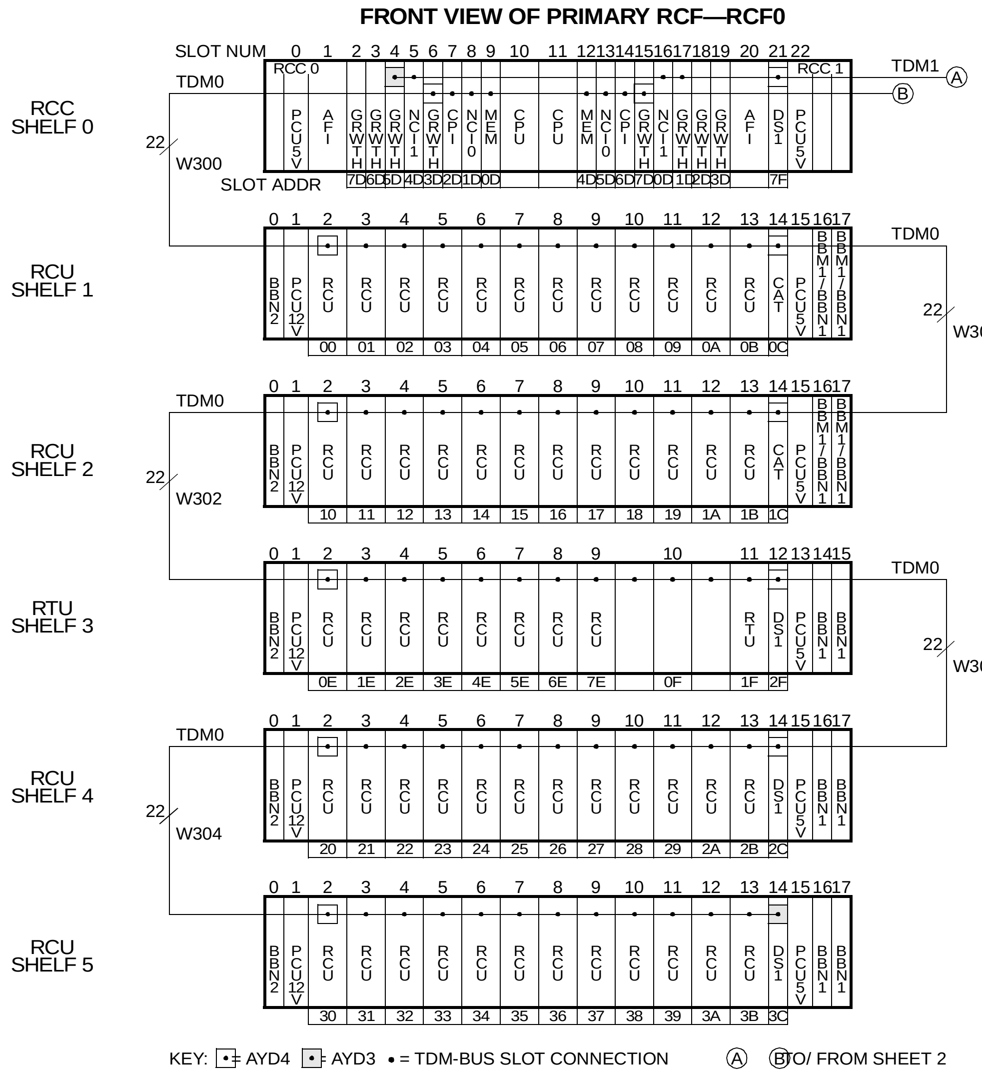


Figure 11-3. Physical View of TDM Buses (Sheet 1 of 3)

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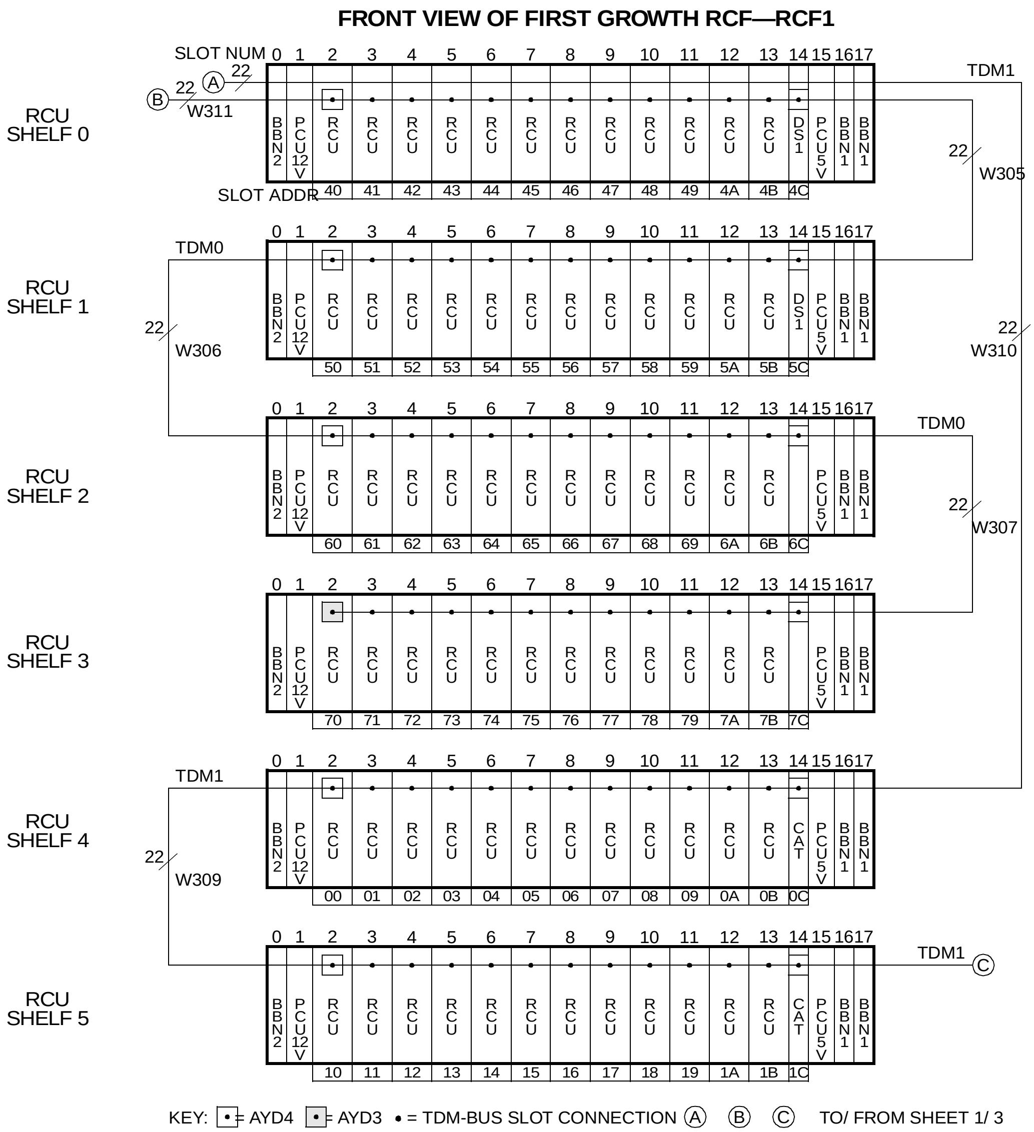


Figure 11-4. Physical View of TDM Buses (Sheet 2 of 3)

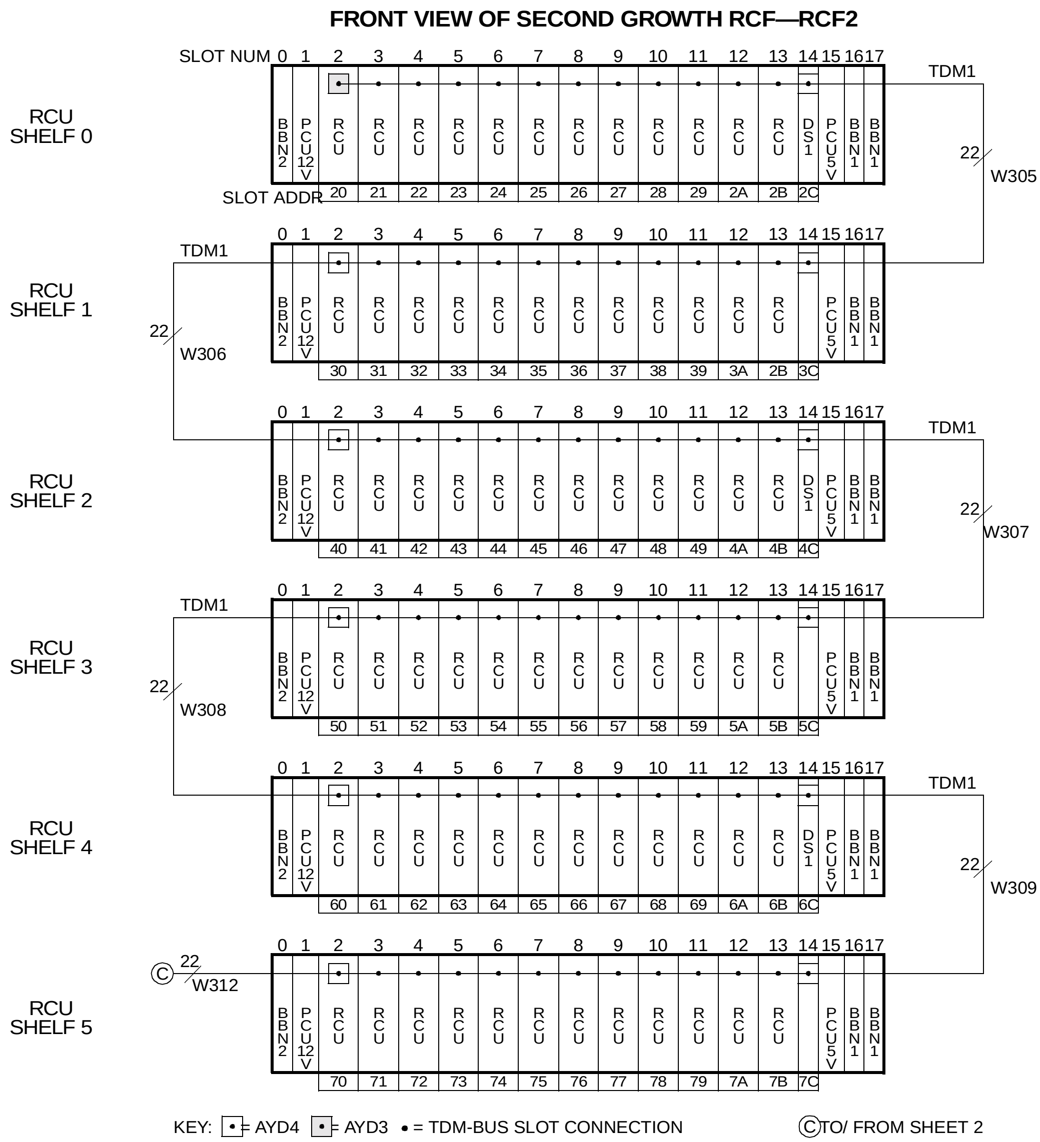


Figure 11-5. Physical View of TDM Buses (Sheet 3 of 3)

If the radio frame set consists of only the primary RCF, AYD3 termination paddleboards (instead of AYD4 paddleboards) are installed on the wiring side of RCF0 shelf 0, slots 15 and 21.

If the radio frame set consists of only the primary RCF and a growth RCF and assuming that shelf 4 and/or shelf 5 of RCF1 is populated with radio equipment, an AYD3 termination paddleboard is installed on the wiring side of RCF1 shelf 5, slot 14. In addition, to generate clock signals for TDM1, redundant CAT units are installed in RCF1 shelf 4, slot 14, and RCF1 shelf 5, slot 14.

Each controller contains the following set of plug-in units:

- One CPU - The core processor (CPU) unit is a 32-bit Motorola MC68020 processing element.
- One MEM - The 8-megabyte memory (MEM) unit provides the volatile main memory resource for the CPU.

  Applications in Release 9.0 and later require 8-megabytes of memory (as opposed to 4-megabytes of memory). The 8-megabytes of memory must be realized by installing one 8-megabyte TN1710 memory unit in RCC0 and one in RCC1. (A memory board has no pin connections to the TDM bus.)

- One AFI - The alarms and FITS* interface (AFI) unit monitors alarm sensors and reports adverse conditions to the CPU.
- One or Two CPIs - The communications processor interface (CPI) unit provides BX.25 communication between the CPU and the ECP. One CPI is required for TDM0, and one CPI is optional for TDM1.
- One or Two NCIs - The network control interface (NCI) unit provides the communication interface between the CPU on the system bus and the TDM-bus client units on the TDM buses. One NCI is required for each TDM bus.

The TDM buses are always installed "red stripe up."

* FITS, for Factory Installation and Test System, is a Lucent Technologies test set that can connect to a special connector accessible through the faceplate of the AFI. At initial frame installation, FITS is used to download Cell Site translations and initiate diagnostic tests.

Data Link and Voice Path Connections

All data link and voice path connections (See Figure 11-6) between the MSC and its associated Cell Sites are based on the connection topology specified in the *translations* (system-configuration parameters). The Cell Site radios are connected to their appropriate DS1s or DFIs and T1 trunks (64-kbit/s channels or DS0s) in accordance with the translations.

Cell Site translations can be set or changed from the ECP or OMP; initially, they are maintained in the ECP's application data bases and then downloaded to the Cell Site RCC. Refer to the *Data Base Update Manual* (401-610-036) for a complete listing of Cell Site translations.

The figure shows a data link connection path between the MSC and a Cell Site RCC:

CDN ‹ CSN ‹ DFI* ‹ TSIU ‹ DFI ‹ FIF ‹ DS1 ‹ CPI ‹ CPU

A Cell Site data link is a static (dedicated) connection path from end to end. All hardware, T1 trunks, and TDM bus timeslots in the path are assigned statically ("nailed up") in accordance with the translations.

The figure also shows a digital-voice connection path between the PSTN and a Cell Site radio:

PSTN ‹ DFI ‹ TSIU ‹ DFI ‹ FIF ‹ DS1 ‹ RCU

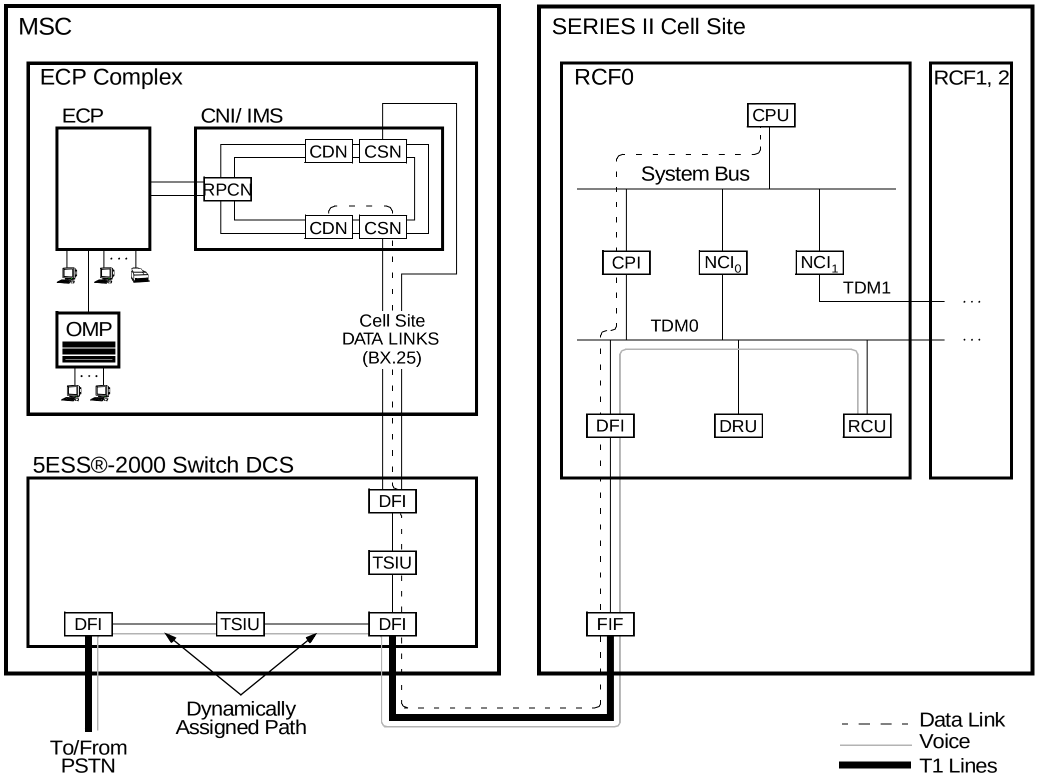
A digital-voice connection path is static except for the connection between the PSTN and the Cell Site T1 trunk (that is, the connection through the DCS). That connection is set up and torn down dynamically by the call processing and data base node (CDN); it is NOT specified in the translations. The CDN receives a call setup message from the PSTN or Cell Site via a DCS or Cell Site data link. The CDN decides how to complete the call and then sends the appropriate messages to the DCS and the targeted Cell Site to set up the call.

T1/E1 Communications

The digital-voice and signaling communications between the MSC and the RCC at the Cell Site are based on a T1/DS1 or E1/CEPT† line interface. The T1 line interface is the lowest level in the hierarchy of the North American T-carrier digital transmission facility.

* The DFI at the switch is physically different but functionally equivalent to the DFI at the Cell Site.

† CEPT stands for Conference of European Postal and Telecommunications Administrations. CEPT, CEPT-1, and E1 are equivalent terms.



DEFINITIONS:

CDN	Call processing and Data base Node (Cabinet)
CNI	Common Network Interface
CPI	Communications Processor Interface (Board)
CPU	Core Processor (Board)
CSN	Cell Site Node (Cabinet)
DCS	Digital Cellular Switch
DFI	Digital Facilities Interface (Board)
DRU	Digital Radio Unit (Board—TDMA Radio)
ECP	Executive Cellular Processor
FIF	Facilities Interface Frame (Cabinet)
IMS	Interprocess Message Switch
MSC	Mobile Switching Center
NCI	Network Control Interface (Board)
OMP	Operations and Management Platform
PSTN	Public Switched Telephone Network
RCF	Radio Channel Frame
RCU	Radio Channel Unit (Board—AMPS Radio)
RPCN	Ring Peripheral Controller Node (Cabinet)
SM	Switching Module (Cabinet)

Figure 11-6. Data Link and Voice Paths—Example

The DS1 and DFI hardware units are the carrier line interface circuits at the Cell Site. The DS1 can terminate one T1 line. The DFI can terminate two T1 lines *or two E1* lines, although only one termination is currently supported. That is, of the two line interface ports on the DFI—port 0 and port 1, only port 0 is currently used to terminate a carrier line.

A Cell Site may connect to T1 lines or E1 lines but not a mixture of both. The DS1 and DFI can support the all-T1 Cell Site configuration. Only DFIs can support the all-E1 Cell Site configuration.

T1 Line Interface

As shown in Figure 11-7, a T1/DS1 frame consists of twenty-four 8-bit timeslots, or channels, plus one *F* bit (for detection of frame boundaries and the transport of additional information), resulting in a 193-bit frame. The 193-bit frame, which is repeated every 125 ms—8000 times per second, yields a line rate of 1544 kbit/s. Each channel, referred to as a *DS0*, operates at a 64-kbit/s rate.

A T1 line is a balanced, full-duplex digital transmission line: one twisted pair to transmit data and one twisted pair to receive data. It must be terminated at both ends in its characteristic impedance, that is, 120 ohms. A T1 line can accommodate 24 digital-voice communication channels or a combination of digital-voice and signaling channels.

E1 Line Interface

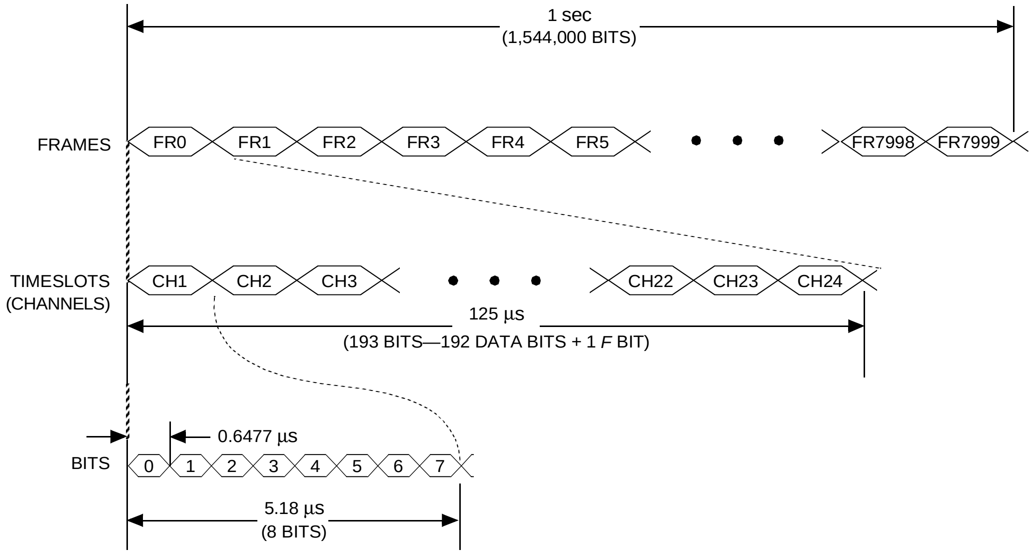
As shown in Figure 11-8, an E1/CEPT frame consists of thirty-two 8-bit timeslots, or channels, of which one channel, timeslot 0 (TS0), is reserved for framing and alarm information. The 256-bit frame, which is repeated every 125 ms—8000 times per second, yields a line rate of 2048 kbit/s. Each channel operates at a 64-kbit/s rate.

An E1 line is a balanced or unbalanced, full-duplex digital transmission line: one twisted pair or coaxial cable to transmit data and one twisted pair or coaxial cable to receive data. It must be terminated at both ends in its characteristic impedance, that is, 120 ohms for twisted pair and 75 ohms for coaxial cable. An E1 line can accommodate 31 digital-voice communication channels or a combination of digital-voice and signaling channels.

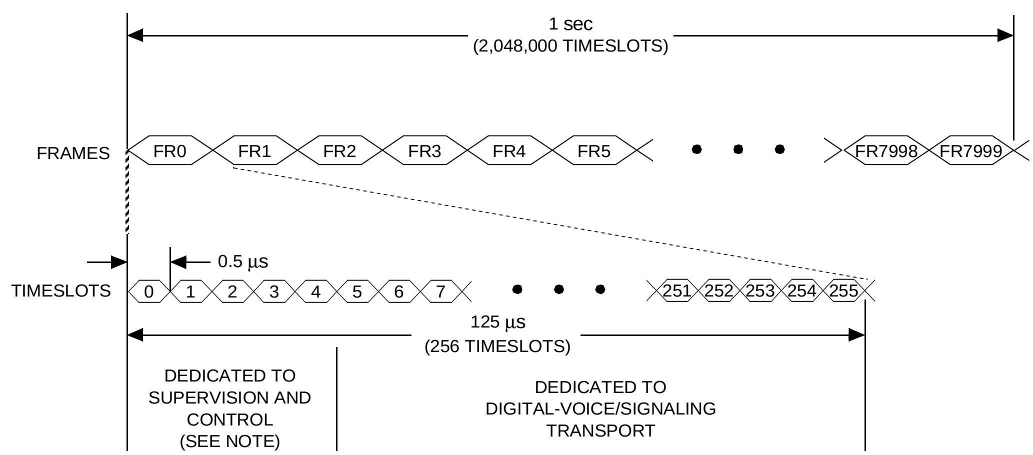
Line Interface Connections at the Cell

The T1 line interface at the cell is 120-ohm twisted pair. The E1 line interface at the cell is optionally configurable for 120-ohm twisted pair *or* 75-ohm coaxial cable, but not both.

The channel service units (CSUs) in the FIF provide the electrical interface between the T1 lines and the DS1s/DFIs in the RCF. Two 14-pin, D-type female connectors provide the 120-ohm twisted-pair connector interface at the primary or growth RCF.



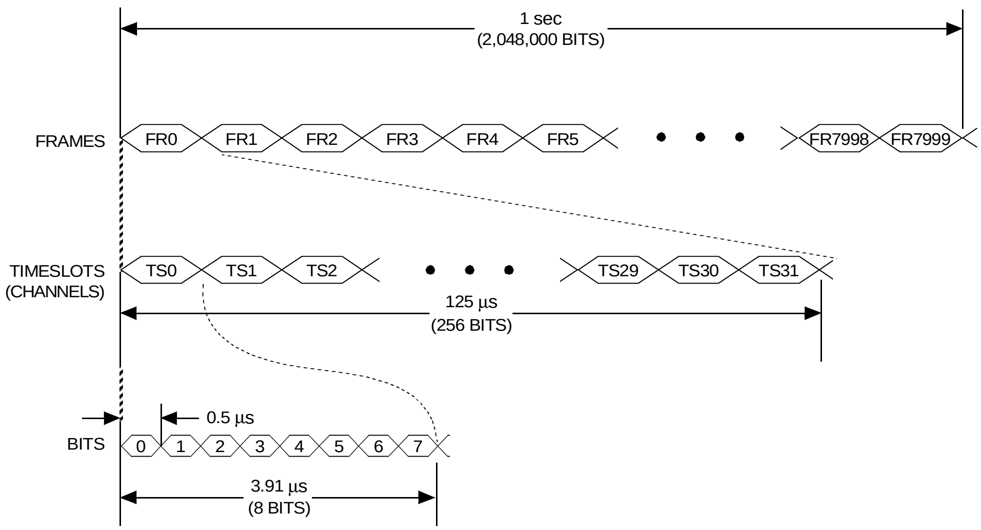
A. T1/DS1 TRANSMISSION FORMAT



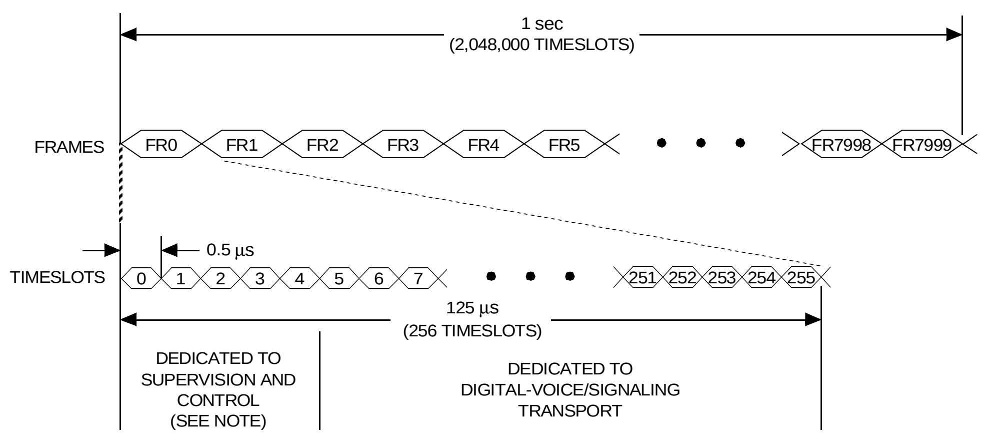
NOTE: FOR TDM0 AND TDM1, 251 TIMESLOTS ON HIGHWAY A AND HIGHWAY B (502 TIMESLOTS TOTAL) ARE AVAILABLE FOR DIGITAL-VOICE AND SIGNALING TRANSPORT.

B. TDM BUS TRANSMISSION FORMAT

Figure 11-7. T1/DS1 Transmission Format and RCF TDM Bus Transmission Format



A. E1/CEPT TRANSMISSION FORMAT



NOTE: FOR TDM0 AND TDM1, 251 TIMESLOTS ON HIGHWAY A AND HIGHWAY B (502 TIMESLOTS TOTAL) ARE AVAILABLE FOR DIGITAL-VOICE AND SIGNALING TRANSPORT.

B. TDM BUS TRANSMISSION FORMAT

Figure 11-8. E1/CEPT Transmission Format and RCF TDM Bus Transmission Format

Customer-provided network termination units (NTUs)* provide the electrical interface between the E1 lines and the DFIs in the RCF. The same two 14-pin, D-type receptacle described above provide the 120-ohm twisted-pair connector interface at the primary or growth RCF. An additional piece of equipment, referred to as a *balun* (for balanced/unbalanced), is needed to accommodate the 75-ohm coaxial-cable interface. A balun is an impedance-matching device used to connect balanced twisted-pair cabling with unbalanced coaxial cable. Coaxial cables from the NTU connect to BNC connectors on the balun, and twisted-pair cabling from the balun connects to the two 14-pin connectors on the primary or growth RCF.

* To realize the NTU function, Lucent Technologies is currently testing an E-SMART® plug-in card developed by Kentrox Industries. The E-SMART card would replace the T-SMART® card in the T-SMART CSU. (The T-SMART CSU is one of two types of CSUs that may be installed in the FIF.) More information on this feature will be supplied when it becomes available.

Data Link Configurations

One BX.25 data link, or signaling channel, is required between the RCC and the ECP; two data links are needed to achieve increased reliability. The latter is best accommodated via two carrier lines connected to two separate DS1s/DFIs, with one BX.25 data link in each line. This arrangement ensures that no single point failure will reduce service capability by more than 50 percent.

Data link configurations are established using the ECP **DNLD: CELL a,DLOPTS** command. This command is used to establish any one of the following data link configurations:

One DS1/DFI Unit and One Data Link

The DS1/DFI is in shelf 3, slot 12, of the primary RCF (logical unit *DS1 0* as seen at the ECP); the data link is carried in channel 24 of the attached carrier line.

One DS1/DFI Unit and Two Data Links

The DS1/DFI is in shelf 3, slot 12, of the primary RCF (*DS1 0* as seen at the ECP); the primary data link (DL 0) is carried in channel 24 of the attached carrier line, and the secondary data link (DL 1) is carried in channel 13 of the attached carrier line.

Two DS1/DFI Units and Two Data Links

One DS1/DFI is in shelf 3, slot 12, of the primary RCF (*DS1 0* as seen at the ECP), and one is in shelf 4, slot 14, of the primary RCF (*DS1 1* as seen at the ECP); DL 0 is carried in channel 24 of the carrier line attached to DS1 0; DL 1 is carried in channel 24 of the carrier line attached to DS1 1.

In the current RC/V implementation, the physical unit mappings for logical units DS1 0 and DS1 1 are fixed (as stated above) and cannot be changed by the user.

For a Cell Site configured with two data links, both data links are active. DL 0 carries call-processing messages, and DL 1 carries maintenance and locate request messages. If one data link fails or is placed out-of-service, the other data link must carry all of the message traffic between the RCC and the ECP; call-processing messages have priority over maintenance and locate request messages.

Remote Data Link Reconfiguration

Release 4.3 supports two ways to update data link parameters: by Factory Installation Test System (FITS) and by cell data links (that is, from the Mobile Switching Center (MSC)). While changing data link parameters from the MSC, the cell remains in service. However, at least one Core Processor Unit (CPU) must have the correct current data link options to keep the Cell Site in service. The new data link parameters are downloaded to the inactive (mate) CPU. A Radio Control Complex (RCC), that is, Cell Site Controller side switch is then made, and the parameters are copied from the new active, updated CPU to the new mate CPU.

External Interfaces to the Series II Cell Site

Voice Trunks from the Digital Cellular Switch (DCS)

Cell data links from the Interprocess Message Switch (IMS) ring are connected to the TDM buses by integrated Digital Cross-Connect (DSX-1) interfaces. Data links from the Mobile Switching Center (MSC) are connected to TDM bus 0.

The TDM buses are always installed "red stripe up."

The TDM buses provide the paths for control and data transfer within the RFS. Within the RFS there may be up to 200 RCUs (195 can be used for voice), 1 RTU, 14 Digital Service 1 (DS1) or Digital Facilities Interface (DFI) boards, 4 Clock And Tone (CAT) boards, and the number of RF switch modules, transmit combiners, receive dividers, and power supply boards required to handle the RFS configuration used.

Time Division Multiplexed Buses

All external interfaces (that is, T1 or E1 lines from the MSC) are connected to the RCF TDM buses via the DS1/DFI interfaces. (Data links from the MSC are connected to TDM0 via DS1 0 and DS1 1). The TDM buses provide the paths for control and data transfer within the primary RCF and any attached growth RCF(s).

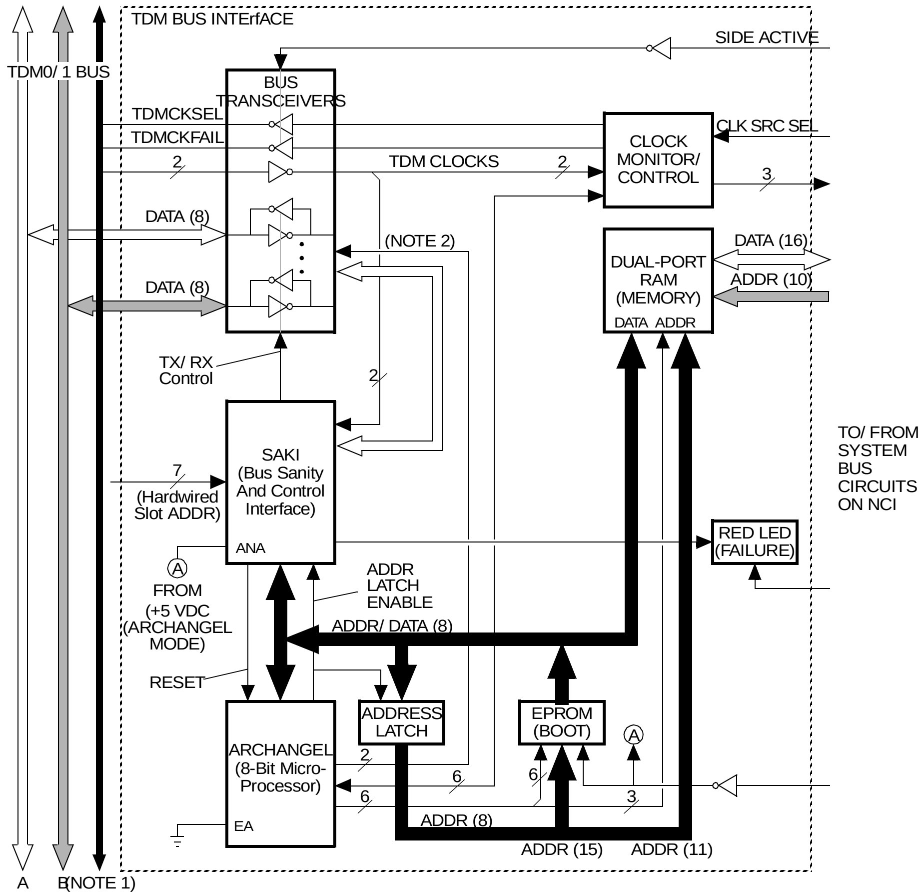
The TDM buses are always installed "red stripe up."

TDM Bus Operation

The TDM buses, TDM0 and TDM1, are independently synchronized to individual carrier lines connected to the cell; those lines are specified by Cell Site system software. The DS1/DFI serving a synchronization line continually extracts a frame-sync signal (8 kHz) from the carrier line and passes it to the active CAT unit. Using the 8-kHz signal as the sync reference, the active CAT generates two system clocks for the TDM bus: a 2048-kHz timeslot clock and an 8-kHz framing clock. Each TDM bus operates at 2048 kHz with a frame rate of 8 kHz.

A TDM bus consists of two 8-bit highways (highway A and highway B); each highway provides 256 timeslots. (Each highway requires eight wires and carries eight bits per timeslot.) For both TDM0 and TDM1, the first five timeslots on highway A and highway B—timeslots 0 through 4—are dedicated for control, and the rest are used to carry user information. At any given time, only one of the highways (highway A or highway B) is actively used to carry control information. Timeslots 0 through 4 are referred to as the *TDM bus control channel*.

The TDM buses are always installed "red stripe up."



NOTES:

1. TDM CLOCK AND CONTROL BUS.
2. THE 8-BIT MICROPROCESSOR (ARCHANGEL) CONTROLS WHICH TDM BUS (A OR B) CONNECTS TO THE SAKI.

Figure 11-9. TDM-Bus Interface Circuitry for the NCI—TDM Bus Archangel

The updating of *firmware* (software stored in updatable non-volatile memory—NVM) to TDM-bus client units is accomplished through the TDM bus, specifically, through the TDM bus control channel. TDM-bus client units having updatable non-volatile memory are the RCU, SBRCU, RTU, DRU, EDRU, TRTU, CCC, BIU, SCT, and CRTUi.

TDM buses are always installed "red stripe up."

The CPU and CPI also have updatable non-volatile memory; the updating of CPU or CPI firmware is accomplished through the system bus.

For the AMPS and TDMA access technologies, one *full-duplex* timeslot on the TDM bus, that is, one timeslot for transmission and one for reception, can carry one digital-voice channel. (The TDM bus interface for the RCU or SBRCU is a single full-duplex timeslot, and the TDM bus interface for the DRU or EDRU is three full-duplex timeslots.) For the CDMA access technology, four full-duplex timeslots on the TDM bus, called a *packet pipe*, can carry up to 14 digital-voice channels* for 8-kbit/s voice encoders (vocoders). (The TDM bus interface for the CCC is a single packet pipe.) The timeslots are assigned statically (“nailed up”) to the various TDM-bus client units in accordance with the Cell Site’s translations data base.

TDM buses are always installed "red stripe up."

TDM Bus Addresses

Supervisory and control information is passed from the CPU to the various TDM-bus clients via the TDM0 and TDM1 control channels. To control individual units selectively on a TDM bus, a unique 7-bit address is assigned to each slot position served by that bus. The figure identifies the 7-bit addresses—in hexadecimal format—for the various slot positions within the primary and growth RCFs.

The pin designations for the slot address are BA0 (LSB) through BA6 (MSB). The logic values for BA0 through BA6 are unique for each of the slot positions connected to the TDM bus. The 7-bit address for a slot position is established by grounding an address pin for a logic 0, and leaving an address pin unconnected for a logic 1. The 7-pin address for a slot position is realized only when a unit is installed in that slot position: each of the seven address pins is connected to a pull-up resistor on the installed unit.

The backplanes for the RCU shelves are identical; therefore, each RCU shelf has an associated 4-pole switch used to select unique logic values for the upper slot-address bits BA4, BA5, and BA6 (See Table 11-1, and Table 11-2). The switches are soldered to 8-pin paddleboard connectors that mount onto the wiring side (rear side) of the backplane pinfield at slot 14 (P14).

TDM buses are always installed "red stripe up."

* In CDMA (and TDMA) terminology, a digital-voice channel is usually referred to as a *traffic channel*.

Table 11-1. Switch Settings for RCU Shelves in First Growth RCF—RCF1

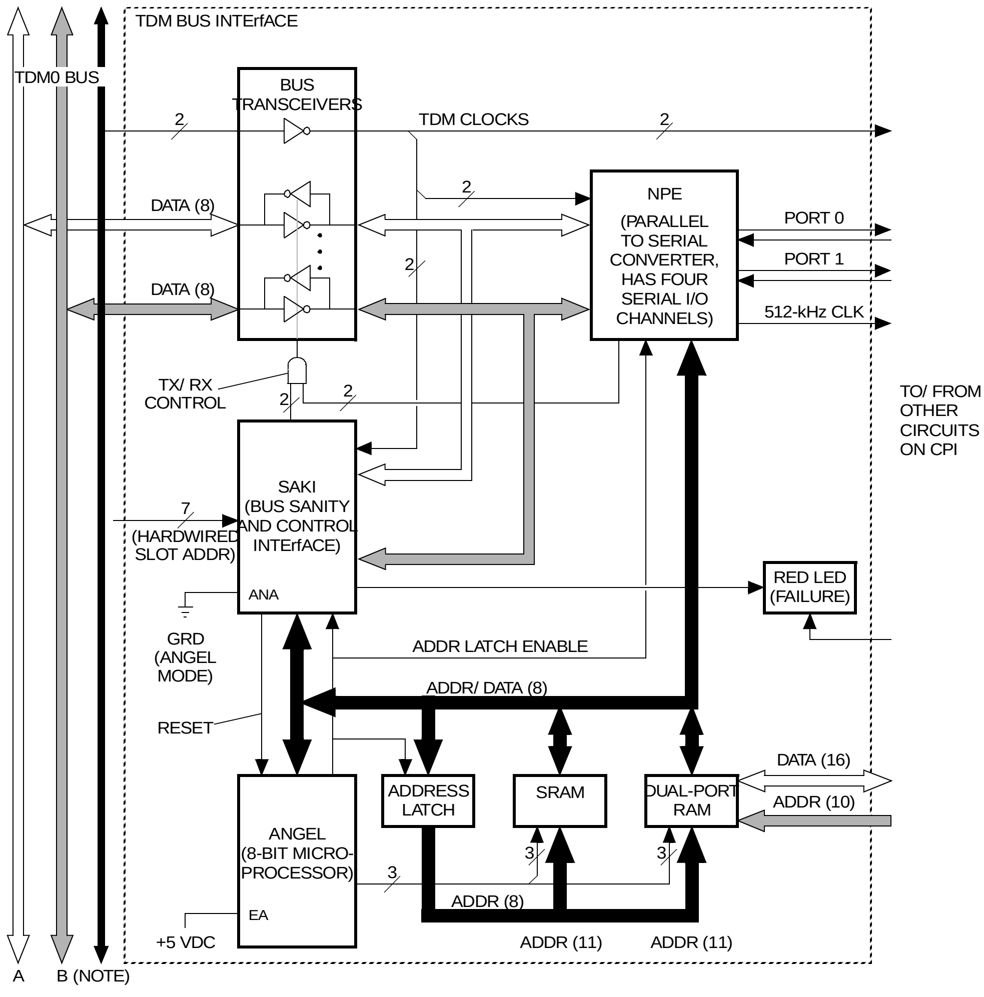
Shelf Number	Switch Position Settings*			
	1	**2**	**3**	**4**
0	Don’t Care	OFF	ON	ON
1	Don’t Care	OFF	ON	OFF
2	Don’t Care	OFF	OFF	ON
3	Don’t Care	OFF	OFF	OFF
4	Don’t Care	ON	ON	ON
5	Don’t Care	ON	ON	OFF
*** ON = Logic 0, OFF = Logic 1**				

Table 11-2. Switch Settings for RCU Shelves in Second Growth RCF—RCF2

Shelf Number	Switch Position Settings*			
	1	**2**	**3**	**4**
0	Don’t Care	ON	OFF	ON
1	Don’t Care	ON	OFF	OFF
2	Don’t Care	OFF	ON	ON
3	Don’t Care	OFF	ON	OFF
4	Don’t Care	OFF	OFF	ON
5	Don’t Care	OFF	OFF	OFF
*** ON = Logic 0, OFF = Logic 1**				

TDM Bus Communications: the Archangel/Angel Concept

This section lists and briefly describes the various hardware devices that form the TDM bus interface and perform the TDM bus communications. The NCI contains the primary TDM bus processor, or *archangel* (See Figure 11-9), through which all other TDM bus processors, or *angels* (See Figure 11-10), communicate. Angel processors reside on the TDM bus client units.



NOTE: TDM CLOCK AND CONTROL BUS.

Figure 11-10. TDM-Bus Interface Circuitry for the CPI—TDM Bus Angel

Angel

An *angel* (See Figure 11-10) is an 8-bit microprocessor that serves as the TDM-bus interface controller for a TDM bus client unit. On some units, it also serves as the main processor for the unit.

Archangel

An *archangel* (See Figure 11-9) is an 8-bit microprocessor on NCI_0 and NCI_1 that passes messages back and forth between the CPU and the TDM bus client units (angels). NCI_0 interfaces with TDM0, and NCI_1 interfaces with TDM1. The NCI is the distribution point for all downlink messages (messages from the CPU to the TDM bus client units) as well as the focal point for all uplink messages (messages from the TDM bus client units to the CPU). In addition to the transfer of messages, the archangel microprocessor monitors client-unit (angel) sanity and runs periodic audits on the client units under control of the CPU.

A communication sequence begins when the CPU requests an activity scan of all client units. In response to an activity scan, the client units that require uplink message transmission transmit their slot addresses to the NCI. Next, the archangel microprocessor grants permission to each client unit to enable uplink message transmission. When the complete message is received, the archangel microprocessor loads the message to the dual-port RAM for uplink transmission to the CPU.

Sanity And Control Interface

The sanity and control interface (SAKI) (See Figure 11-11), a Lucent Technologies custom device, provides a synchronous communications link between the archangel microprocessor and the angel microprocessors via the TDM bus. The SAKI transfers information to and from the TDM bus control channel—timeslots 0 through 4 of the TDM frame.

Each SAKI provides board-address recognition, message buffering, and bus synchronization functions for the archangel/angel microprocessor that it supports.

The SAKI can be configured for one of two modes of operation: archangel mode or angel mode. A logic 1 on the SAKI archangel/angel (ANA) input pin corresponds to archangel mode; a logic 0 on ANA corresponds to angel mode.

NOTE:
TDM buses are always installed "red stripe up."

In archangel mode, the SAKI (on the NCI) transmits a slot address followed by whatever message is to be sent to the client unit that has that slot address. It often takes several TDM frames to transmit the complete message to the targeted unit. In the receive direction, the SAKI reads and saves all five control channel timeslots of every TDM frame. Messages are passed to the archangel just as they are when the SAKI is in angel mode.

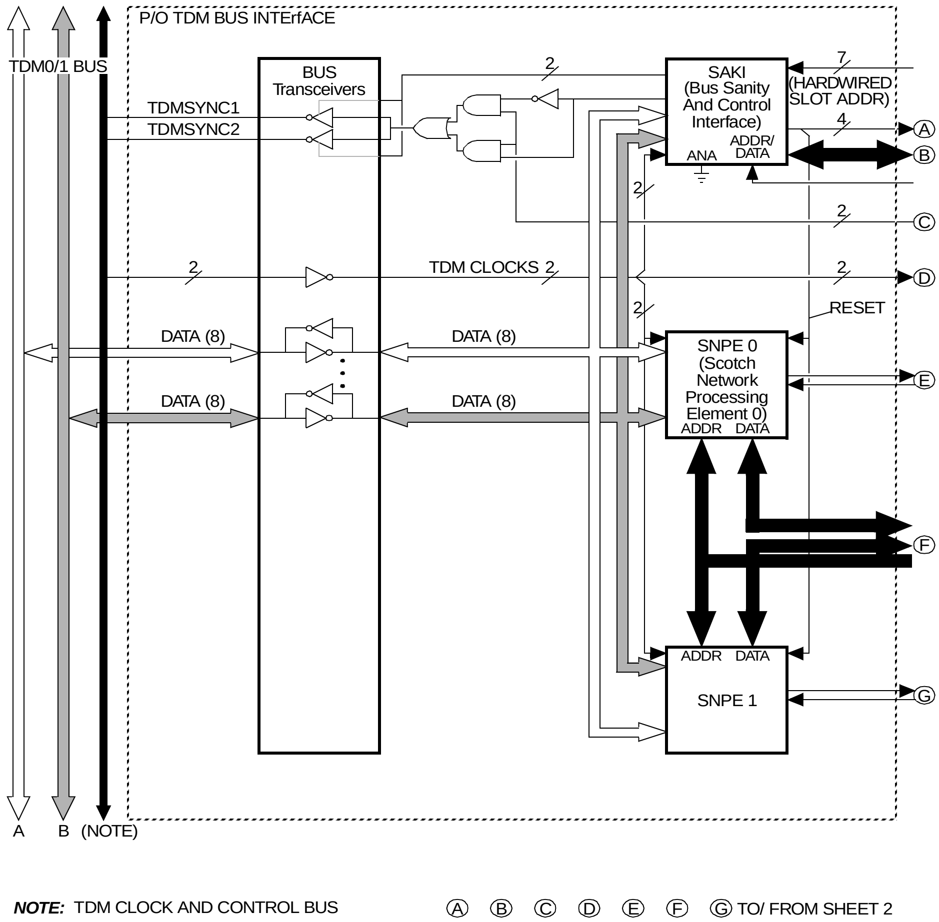


Figure 11-11. SAKI and SNPE Interface

In angel mode, the SAKI (on the TDM-bus client units) monitors the TDM bus control channel and extracts and holds any information addressed to its angel microprocessor until the angel microprocessor removes it. The SAKI also transmits information onto the TDM bus control channel on command from its angel microprocessor

Sanity checks between the archangel and angel microprocessor are routinely performed through the SAKI-angel interface. The SAKI monitors the TDM bus for sanity scans on the TDM bus control channel (directed from the archangel), and reports any scan request to its angel microprocessor. Sanity control is handled by a hardware timer that the angel must reset periodically. If the angel does not reset the timer within the allotted time, the SAKI resets (disables) the angel microprocessor, turns on the on-board red LED (indicating an error on the unit), and reports the loss to the archangel microprocessor.

NPE and SNPE

The network processing element (NPE) and SCOTCH network processing element (SNPE), both Lucent Technologies custom devices, perform timeslot exchange between the parallel TDM bus and serial data buses called *concentration highways*, that is, perform parallel-to-serial and serial-to-parallel conversion of digital-voice data.* They communicate with the TDM bus (highway A, highway B, or both) during timeslots 5 to 255 of the 256-slot TDM frame.

Each channel of an NPE or SNPE can be programmed by the angel microprocessor to access two different TDM timeslots: one to carry the channel's received samples (uplink information) and the other to carry the channel's transmitted samples (downlink information). When the CPU places a channel in loop-around mode, the channel's receive timeslot and transmit timeslot are looped together.

* The CPI TDM-bus interface circuitry uses the NPE device. Other units, such as the DFI and CCC, use SNPE devices because they provide eight times the capacity of NPE devices. An SNPE has 32 serial I/O channels, and an NPE has four serial I/O channels.

Synchronization of the Cell Site to the MSC

The DS1/DFI provides an external clock source used to synchronize all digital-voice and signaling transfers between the carrier lines and the internal TDM buses. The TDM buses, TDM0 and TDM1, are independently synchronized to the MSC via separate DS1/DFI units (See Figure 11-12, and Figure 11-13).

NOTE:
TDM buses are always installed "red stripe up."

Only one of two DS1s/DFIs may provide the external clock source for TDM0. Those units are the DS1/DFI in shelf 3, slot 12, of the primary RCF (*DS1 0* as seen at the ECP) and the DS1/DFI in shelf 4, slot 14, of the primary RCF (*DS1 1* as seen at the ECP).

Similarly, only one of two DS1s/DFIs may provide the external clock source for TDM1. Those units are the first two equipped DS1s/DFIs found by Cell Site system software residing on TDM1. There are occasions when only one DS1/DFI is designated as an external clock source for a TDM bus.

Only one DS1 or DFI can be the synchronization reference for a TDM bus at any given time. That unit will have a lighted green LED.

Only synchronization of TDM0 will be considered in the following discussion. The two DS1s/DFIs that may provide the external clock source for TDM0 will be referenced by their logical unit numbers, DS1 0 and DS1 1. All concepts applying to TDM0 synchronization will also apply to TDM1 synchronization.

For TDM0, a valid synchronization-reference configuration is (1) a carrier line connected to DS1 0, (2) a carrier line connected to DS1 1, or (3) for reliability, both a carrier line connected to DS1 0 and a carrier line connected to DS1 1. In the latter configuration, DS1 0 is the *primary* synchronization reference, or *sync_1*, and DS1 1 is the secondary synchronization reference, or *sync_2*.

In the figure, logical units DS1 0 and DS1 1 are realized by the DFI; all hardware units in the figure reside in the primary RCF. For simplicity, no TDM0 bus connection is shown for DS1 1.

Initially, when the primary RCF comes on-line, the system attempts to select sync_1 as the synchronization reference. If that source fails (or is not present) and assuming that the DS1/DFI and carrier line associated with sync_2 are operational (that is, DS1 1 is not insane and there is no alarm or only a *minor*, *misframe*, *slip*, or *10e-6 error-ratio* alarm on the carrier line), the system will select sync_2 as the new synchronization reference.

If neither sync_1 nor sync_2 is an acceptable synchronization reference, the system will use an internal oscillator as the synchronization reference. That oscillator, referred to as the *local reference* oscillator or just *local* oscillator, is located on the CAT unit. It is a free-running oscillator running at the carrier line rate of 2048 kHz. Since it is free running, that is, not locked (synchronized) to the carrier lines, *slips*[1] (which result in the repeat or loss of a frame of incoming data) are bound to occur. For that reason, the fault preventing the use of an external clock source should be isolated and corrected as soon as possible.

When a TDM bus is synchronized to the *local reference*, Cell Site system software attempts to switch to the primary or secondary reference DS!/DFI every five minutes. The switch will only proceed if the primary or secondary reference DS!/DFI is now free of alarms and in the active state.

NOTE:
TDM buses are always installed "red stripe up."

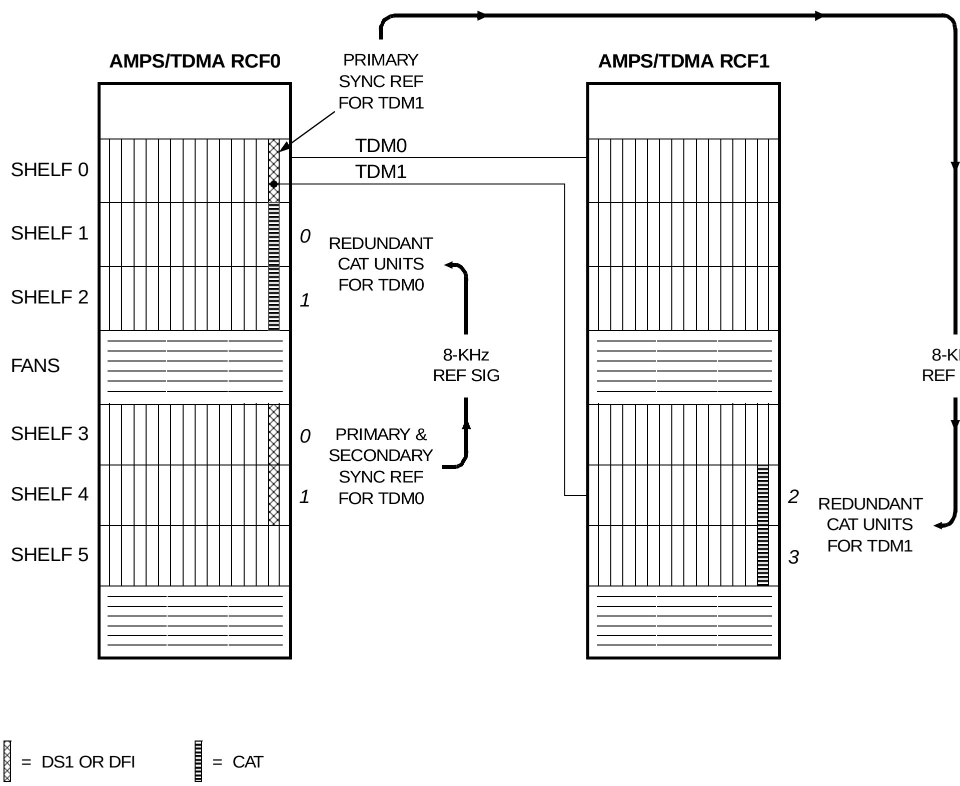


Figure 11-12. Synchronization References for TDM0 and TDM1—Example

In the figure, the active (on-line) CPU sends a message to DS1 0 specifying that the 8-kHz signal derived from the T1_0/ E1_0 receive bit stream be connected to TDMSYNC1. Likewise, the active CPU sends a message to DS1 1 specifying that the 8-kHz signal derived from the T1_0/ E1_0 receive bit stream be connected to TDMSYNC2. The active CPU also writes the control register of the active NCI_0 to specify which of the two CATs is to supply the TDM system clocks. (The NCI uses TDMCKSEL to activate the specified CAT.) And finally, the active CPU sends a message to the active CAT specifying which synchronization reference is to connect to the clock generator circuit.

NOTE:
TDM buses are always installed "red stripe up."

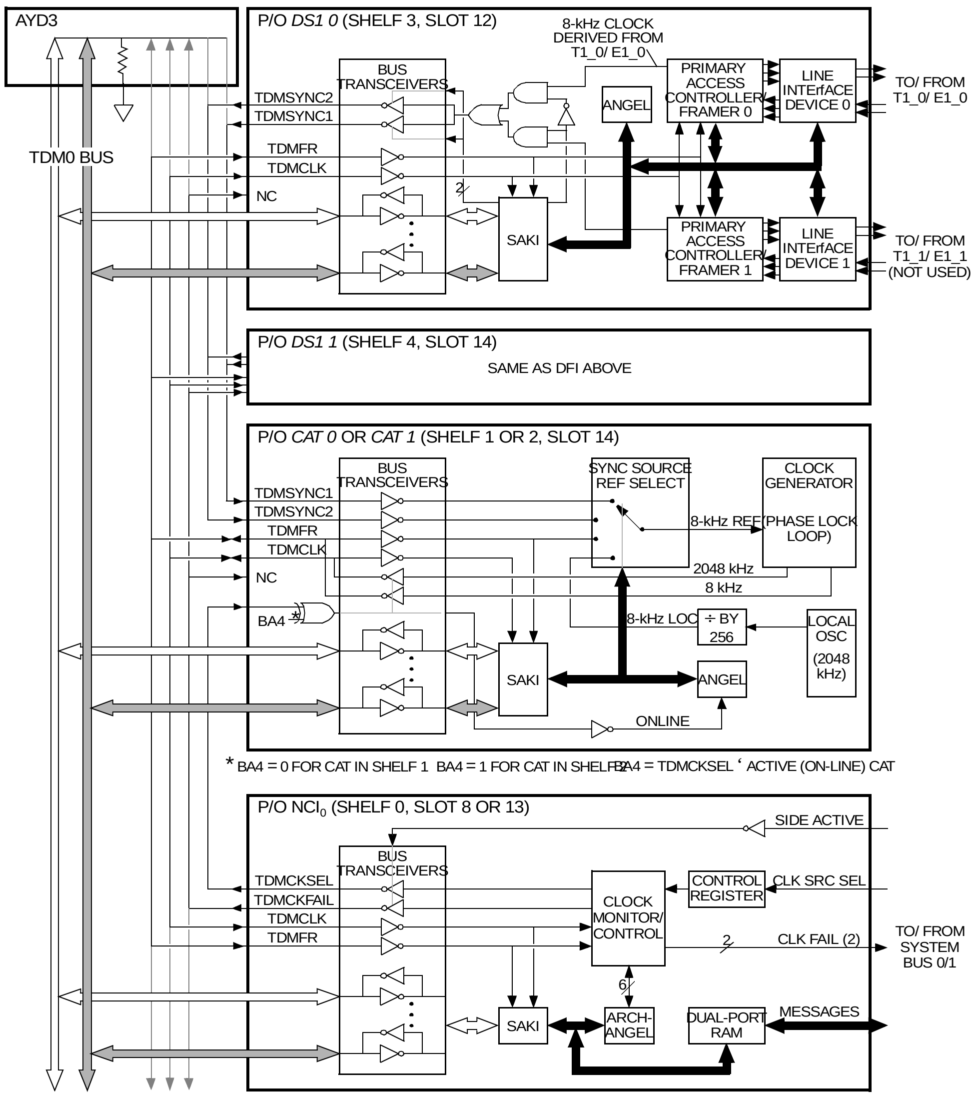


Figure 11-13. Synchronization of TDM0 to the MSC

For the active CAT, only TDMSYNC1, TDMSYNC2, and the 8-kHz LOC signals are valid choices as the synchronization reference. For the standby (off-line) CAT, only TDMFR is a valid choice as the synchronization reference; on-board hardware forces TDMFR as the synchronization reference to keep the standby clock generator in step with the active clock generator.

The signal lines called out in the figure are summarized below:

TDMCKSEL TDM clock select. Selects which of the two CAT units is to supply the TDM system clocks. A logic 0 on TDMCKSEL selects CAT 0, while a logic 1 selects CAT 1. The source of TDMCKSEL is the active NCI_0, which sets the logic state of the signal either (1) autonomously, if enabled by the active CPU, or (2) as directed by the active CPU.

TDMCKFAIL TDM clock failure. When asserted (logic 1), indicates the failure of one or both of the TDM system clocks. The source of TDMCKFAIL is the active NCI_0, which asserts the signal autonomously. (TDMCKFAIL is used to alert the attached TDM-bus client units of a TDM bus clock failure.)

TDMCLK TDM timeslot clock (2048 kHz). One of the two TDM system clocks supplied by the active CAT. A negative transition indicates the beginning of a TDM timeslot.

TDMFR TDM frame clock (8 kHz). One of the two TDM system clocks supplied by the active CAT. A positive-going pulse marks the beginning of the last timeslot in a TDM frame. (A TDM frame consists of 256 timeslots.)

TDMSYNC1 TDM bus synchronization reference 1. An 8-kHz framing signal derived from the T1_0/ E1_0 receive bit stream, used to synchronize the TDM bus with the MSC. This signal is sourced from DS1 0 as directed by the active CPU. TDMSYNC1 routes to both CAT units, where the active CAT uses the signal as a synchronization reference to generate the TDM system clocks.

TDMSYNC2 TDM bus synchronization reference 2. An 8-kHz framing signal derived from the T1_0/ E1_0 receive bit stream, used to synchronize the TDM bus with the MSC. This signal is sourced from DS1 1 under command of the active CPU. TDMSYNC2 routes to both CAT units, where the active CAT uses the signal as an *alternate* synchronization reference to generate the TDM system clocks. (TDMSYNC2 is an alternate signal to TDMSYNC1.)

There is another set of the same signal lines described above associated with TDM1, NCI_1, CAT 2, and CAT 3.

Mobile Switching Center (MSC) to Cell Site Communications

For all Cell Releases prior to R5.1, the data and voice communications between the Mobile Switching Center (MSC) and the Cell Site are based on a DS1 (Digital Signal - Level 1) interface facility. It is a bipolar return-to-zero signal at a 1.544-Mb/s rate. A DS1 signal consists of 24 DS0 (Digital Signal - Level 0) channels. The Cell Site data communication links are capable of operating at 9.6-kb/s, 56-kb/s, or 64-kb/s rates.

A DS1 carrier link can accommodate 24 digital voice communication channels or a combination of digital voice and data channels. For each DS1 link, the Radio Channel frames (RCFs) must have 1 DS1 interface circuit. One DS1 link and an interface circuit are needed for each of the 24 voice channels. Two data links are required between the P-RCF and the MSC for reliability. This is best accommodated by two DS1 links, with one data channel in each link. The two DS1 interface circuits needed in this arrangement are located on shelves 3 and 4 in the P-RCF.

All Cell Site interfaces are digital, using DS1 boards with a Digital Cross-Connect (DSX-1) interface. When the facility is a T1 carrier, the DSX-1 interface allows connection directly to channel service units without the need for D4 channel banks. If analog facilities are used, D4 banks would, however, be required. The DSX-1 interface allows up to 660 feet between the DS1 board and the interconnecting facility.

The DSX-1 interface also allows connection directly to microwave systems or to fiber-optic systems such as the DDM-1000. For the physical connections between the DS1 carrier facilities and each RCF, two cable/connector assemblies are used, one for transmit and one for receive.

The cell R5.1 Conference of European Postal and Telecommunications (CEPT) feature provides a Cell Site that can operate in “international mode”. A Cell Site operated in the “domestic mode” communicates via the DS1 protocol over T1 facilities; a Cell Site operated in the “international mode” communicates via the CEPT protocol over E1 facilities. A Cell Site operating in the “international mode” can provide 30 channels for voice traffic.

A Cell Site operated in the “domestic mode” can use either a DS1 communication circuit pack or a Digital Facilities Interface (DFI) circuit pack. A Cell Site operated in the “international mode” must use the DFI circuit pack.

All data and voice communications between the MSC and Cell Sites operating in the “international mode” are based on a CEPT interface facility. This is a high density binary three signal at a 2.048-Mb/s rate. CEPT signal consists of 31 digital signal channels.

DS1, DFI, and CAT Circuit Descriptions

This section presents circuit descriptions for the DS1, DFI, and CAT plug-in circuit boards. The DS1 apparatus code is TN171, the DFI apparatus code is TN3500, and the CAT apparatus code is TN170.

DS1 (TN171) Circuit Description

The DS1 provides the interface between the RCF TDM bus, TDM0 or TDM1, and a T1 digital transmission line. The T1 line interface is the lowest level in the hierarchy of the North American Tcarrier digital transmission facility, which multiplexes twenty-four 64-kbit/s channels into a serial digital trunk (1544A kbit/s).

The DS1 architecture is based on (1) the LC1046 DS1 line interface, (2) a DS1 chip set consisting of four large-scale integration circuits, and (3) the 327DA network processing element (NPE), all Lucent Technologies custom devices. The DS1 chip set provides the complete interface between a DS1 line interface device and 24 serial data channels that connect to the NPEs.

NOTE:
TDM buses are always installed "red stripe up."

DFI (TN3500) Circuit Description

The DFI provides the interface between the RCF TDM bus, TDM0 or TDM1, and two T1 or E1 (CEPT-1)* digital transmission lines, although only one T1 or E1 line interface is currently supported. The E1 line interface is the lowest level in the hierarchy of the European E-carrier digital transmission facility, which multiplexes thirty-two 64-kbit/s channels into a serial digital trunk (2048 kbit/s).

The DFI architecture is based on the following:

- The T7290 T1/CEPT line interface
- The T7230 primary access controller/framer (PAC) (See Figure 11-14)
- The 327HB SCOTCH network processing element (SNPE).

All of which are Lucent Technologies custom devices. Each of the two PACs, one for each carrier line, provides the complete interface between a T1/CEPT line interface device and a serial data bus known as the *concentration highway* that connects to the SNPEs.

Both the PAC and T1/CEPT line interface devices can be configured for T1 or E1 operation.

* CEPT stands for Conference of European Postal and Telecommunications Administrations. CEPT-1 and E1 are equivalent terms.

The T1/CEPT line interface device along with transformers, impedance-matching resistors, and manually set switches provide the digital transmission line interface (Refer to Table 11-3). The switches allow for T1 120-ohm operation or E1120-ohm or 75-ohm operation, as defined by the SW1 through SW5 switch settings in the table. The receive line-interface transmission format (on the line side) is alternate mark inversion (AMI), where a 1 is represented by either a positive or negative pulse, and a 0 is represented by a null pulse (no pulse). All pulse shapes are controlled by the T1/CEPT line interface device according to its equalizer control inputs, as defined by the SW6 and SW7 switch settings in the table. The receive digital output format (on the PAC side) is dual-rail nonreturn to zero (NRZ).

To set switches SW1 through SW7, ensure that the DFI is out-of-service and then remove the DFI from its slot location. (There is *no* need to remove power from the slot location.) The switches are located at the middle (SW1-SW5) and the faceplate end (SW6, SW7) of the circuit board. Always wear a wrist grounding strap when handling circuit boards.

NOTE:
TDM buses are always installed "red stripe up."

The PAC provides T1 or E1 framing, alarm reporting, performance monitoring, jitter attenuation, loopback, and independent receive and transmit framer paths. On the line interface side, the PAC receives dual-rail data and a receive line clock from the T1/CEPT line interface device, converts the data to a transistor-transistor logic (TTL) format, and then transmits the data onto the concentration highway using the TDM timeslot clock (2048 kHz). On the system side (TDM bus side), the PAC receives TTL data from the concentration highway at the TDM timeslot clock rate, converts the data to the dual-rail format, and then transmits the data and a transmit line clock (phase locked to the TDM timeslot clock) to the T1/CEPT line interface device. The PAC also derives an 8-kHz signal from the receive line clock to serve as a possible synchronization reference for the TDM clock source.

Both the PAC and the SNPE have a dual, high-speed, serial interface for connection to two pairs of transmit and receive serial data buses known as concentration highway A and concentration highway B. Data may be transmitted or received on either one of these highways. In the DFI implementation, only concentration highway A is used for data exchange between a PAC and an SNPE. The highway operates as a 2048-kbit/s 32-timeslot serial bus where each timeslot is 8-bits wide.

The SNPEs provide a programmable interface between the concentration highways and the parallel TDM bus. The SNPEs can provide a connection between any of the timeslots on the carrier line and any of the 251 timeslots on highway A or B of the TDM bus (TDM0 or TDM1).

NOTE:
TDM buses are always installed "red stripe up."

DFI (TN1713B) Circuit Operation

Currently supplied DFI.

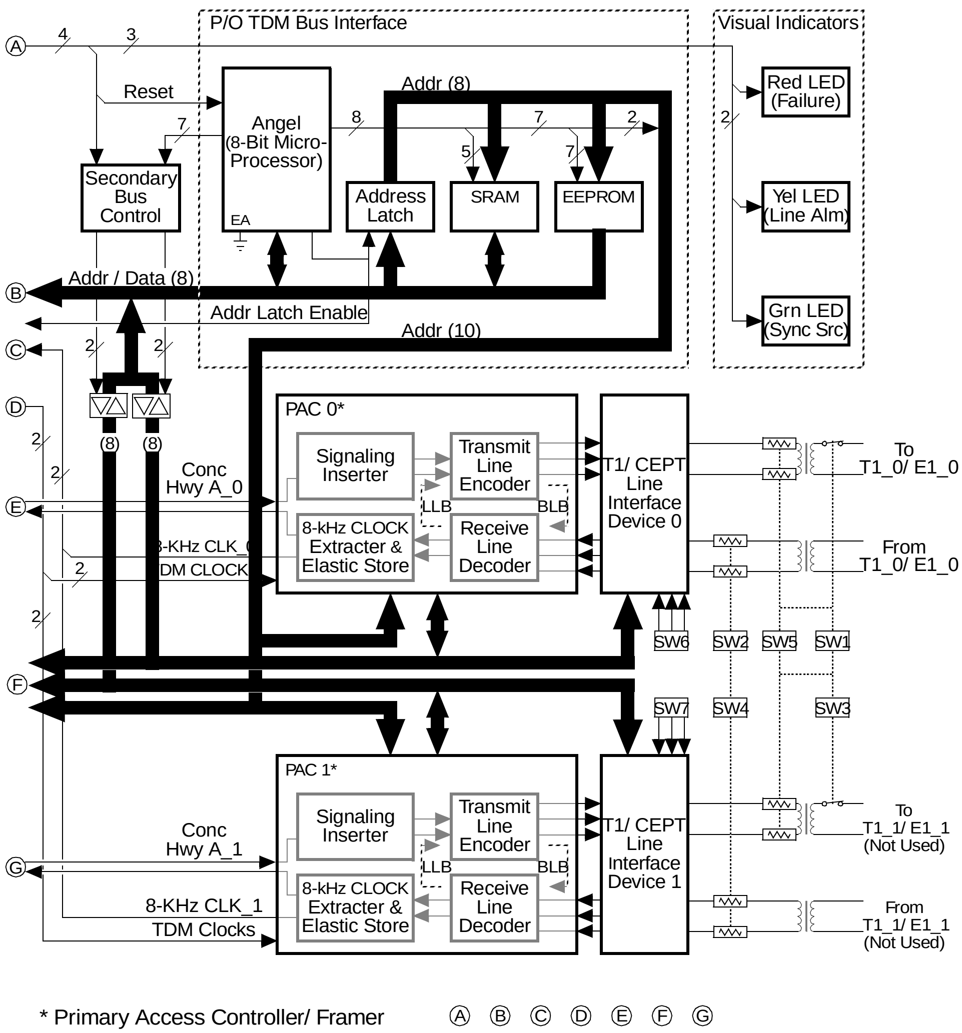


Figure 11-14. Primary Access Controller/Framer

Table 11-3. DFI Switch Settings

MODE	SW7-3	SW7-2	SW7-1	SW6-3	SW6-2	SW6-1	SW5	SW4	SW3	SW2	SW1
T1*	OFF	ON	OFF	OFF	ON	OFF	OFF	ON	ON	OFF	OFF
E1 120 Ohm	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF
E1 75 Ohm†	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF

* The T1 line equalization, or line length compensation (determined by SW6 and SW7), is set for a transmission distance of 0 to 133 feet between the DFI and its associated channel service unit (CSU).

† Since Lucent Technologies is using a *balun* device to accommodate E1 75-ohm operation, the DFI switch settings for E1 75-ohm operation are the same as for E1 120-ohm operation. (A balun is an impedance-matching device used to connect balanced twisted-pair cabling with unbalanced coaxial cable.)

The SNPEs, under microprocessor control, can loop back any receive timeslot data from the TDM bus to any transmit timeslot on the TDM bus. Transmit data will continue to be sent to the carrier line but receive data will be discarded.

The T1/CEPT line interface devices, the PACs, the SNPEs, and the SAKI are equipped with microprocessor interfaces that allow the on-board microprocessor to configure, monitor, and test the devices. The microprocessor, which serves as both the angel and main processor for the DFI, receives messages from the CPU via the TDM bus. The microprocessor interprets the messages and then addresses the appropriate device (or devices) to carry out the specified configuration or maintenance functions.

Once the DFI has successfully completed its self test at powerup or after a reset, only three messages will be required to set up a full-duplex connection: an initialization message, a network-update “Talk” message, and a network-update “Listen” message.

DFI Initialization Message for T1 Operation

The initialization message sets configuration parameters on the PAC and T1/CEPT line interface devices and may specify a synchronization reference for the TDM clocks. Configuration parameters for T1 operation include:

D4 or ESF Framing

To accommodate framing patterns, error detection, and signaling modes, individual T1/DS1 frames are grouped together to form superframe structures such as D4 and extended superframe (ESF). The D4 framing format uses a superframe structure consisting of 12 frames, and the ESF framing format uses a superframe structure consisting of 24 frames (See Figure 11-15, Sheets 1, 2, and 3).

The T1 framing configuration (D4 or ESF) is specified via translations.

D4 Framing Format									
Frame Number	Bit Number	F Bit*		Bit Use in Each Channel			Signaling Options†		
		Fs	Ft	Traffic	YA‡	Signaling	None	2-ST	4-ST
1	0		1	Bits 1–8	Bit 2	None			
2	193	0		Bits 1–8	Bit 2	None			
3	386		0	Bits 1–8	Bit 2	None			
4	579	0		Bits 1–8	Bit 2	None			
5	772		1	Bits 1–8	Bit 2	None			
6	965	1		Bits 1–7	Bit 2	Bit 8§		A	A
7	1158		0	Bits 1–8	Bit 2	None			
8	1351	1		Bits 1–8	Bit 2	None			
9	1544		1	Bits 1–8	Bit 2	None			
10	1737	1		Bits 1–8	Bit 2	None			
11	1930		0	Bits 1–8	Bit 2	None			
12	2123	0		Bits 1–7	Bit 2	Bit 8	–	A	B

* F bit sequence is Fs sequence interleaved with Ft sequence.
† Signaling option None: No robbed-bit signaling (bit 8 is used for traffic).
Signaling option 2-ST: 2-state signaling (channel A only).
Signaling option 4-ST: 4-state signaling (channels A and B).
‡ Remote yellow alarm – Bit 2 of each channel is set to a 0.
§ Robbed-bit signaling.
** Remote Japanese yellow alarm – Fs bit in frame 12 is set to a 1.

Figure 11-15. Information Sheets for T1 D4 and ESF Framing Format (Sheet 1 of 3)

Frame Number	Bit Number	F Bit*			Bit Use in Each Channel		Signaling Options†			
		Fe	DL	CRC	Traffic	Signaling ‡	None	2-ST	4-ST	16-ST
1	0	–	D	–	Bits 1–8	None	–	–	–	–
2	193	–	–	C1	Bits 1–8	None	–	–	–	–
3	386	–	D	–	Bits 1–8	None	–	–	–	–
4	579	0	–	–	Bits 1–8	None	–	–	–	–
5	772	–	D	–	Bits 1–8	None	–	–	–	–
6	965	–	–	C2	Bits 1–7‡	Bit 8‡	–	A	A	A
7	1158	–	D	–	Bits 1–8	None	–	–	–	–
8	1351	0	–	–	Bits 1–8	None	–	–	–	–
9	1544	–	D	–	Bits 1–8	None	–	–	–	–
10	1737	–	–	C3	Bits 1–8	None	–	–	–	–
11	1930	–	D	–	Bits 1–8	None	–	–	–	–
12	2123	1	–	–	Bits 1–7‡	Bit 8‡	–	A	B	B
13	2316	–	D	–	Bits 1–8	None	–	–	–	–
14	2509	–	–	C4	Bits 1–8	None	–	–	–	–
15	2702	–	D	–	Bits 1–8	None	–	–	–	–
16	2895	0	–	–	Bits 1–8	None	–	–	–	–
17	3088	–	D	–	Bits 1–8	None	–	–	–	–
18	3281	–	–	C5	Bits 1–7‡	Bit 8‡	–	A	A	C
19	3474	–	D	–	Bits 1–8	None	–	–	–	–
20	3667	1	–	–	Bits 1–8	None	–	–	–	–
21	3860	–	D	–	Bits 1–8	None	–	–	–	–
22	4053	–	–	C6	Bits 1–8	None	–	–	–	–
23	4246	–	D	–	Bits 1–8	None	–	–	–	–
24	4439	1	–	–	Bits 1–7‡	Bit 8‡	–	A	B	D

Figure 11-16. Information Sheets for T1 D4 and ESF Framing Format (Sheet 2 of 3)

CEPT-1, for Conference of European Postal and Telecommunications administrations, is the lowest level of hierarchy in the European E-carrier system. CEPT-1 and E1 are equivalent terms.

Frame and Multiframe. The following illustration shows the basic CCITT CEPT frame and multiframe structures.

1	2	3	4	5	6	7	8	8-Bit Timeslot, or Channel – 3.91 µs

Timeslot 0	Timeslot 1	- - - - - - -	Timeslot 31	256-Bit Frame – 125 µs

FR 0	FR 1	FR 2	- - - - - - - -	FR 15	16-Multiframe – 2 ms

The CCITT CEPT framing format consists of thirty-two 64 kbit/s timeslots, or channels, resulting in a 256-bit frame and a line rate of 2048 kbit/s (CEPT-1 rate). Framing information is carried in timeslot 0 (TS0), while local exchange carrier (LEC) signaling information, if used, is carried in timeslot 16 (TS16).

Framing information is contained in the TS0 frame alignment signal (FAS) word and the TS0 not-word. The TS0 FAS word is defined as the TS0 byte containing a 0011011 pattern in bit positions 2 through 8. The TS0 not-word is defined as the TS0 byte that does not contain the FAS pattern. TS0 FAS-word frames interleave with TS0 not-word frames, as shown in the facing table.

The CCITT CEPT line may contain both a TS0 and a TS16 multiframe. Both multiframes consist of 16 frames.

TS0 Multiframe. The TS0 multiframe, also known as the cyclic redundancy check (CRC) multiframe, is used in systems that use the CRC-4 error checking, which is an enhanced error-monitoring capability providing for additional protection against emulation of the FAS-word pattern. The multiframe is divided into two submultiframes, each consisting of eight frames. The multiframe is found by looking for the 001011 pattern in bit position 1 of TS0. This pattern is interleaved with the CRC-4 bits.

Note that association of frame numbers to TS0s is only applicable to the CEPT format with CRC-4. In CEPT without CRC-4, only two types of names can be identified: frames containing the TS0 FAS word, and frames not containing the TS0 FAS word (the TS0 not-word).

Figure 11-17. Information Sheets for T1 D4 and ESF Framing Format (Sheet 3 of 3)

ZCS or B8ZS Line Format

T1 standards require an average of at least one 1 in every eight bits of transmitted data. The T1 framing format uses zero code suppression (ZCS) or binary 8 zero substitution (B8ZS) to meet this requirement. The ZCS scheme inserts a 1 after every seventh-consecutive 0 to keep the density of 1s high enough to preserve accurate timing at the remote endpoint. The remote endpoint removes the inserted 1.

The B8ZS scheme is used for those applications requiring *clear-channel* transmission*. When eight consecutive 0s occur in a bit stream, the B8ZS scheme replaces the eight 0s with a specific pattern to keep the density of 1s high enough to preserve accurate timing at the remote endpoint. The remote endpoint recognizes the pattern and replaces it with the original string of eight 0s.

The T1 line format configuration (ZCS or B8ZS) is specified via translations.

Line-length Compensation Setting

There are five line-length compensation settings for T1 operation: 0 to 133 feet, 134 to 266 feet, 267 to 399 feet, 400 to 533 feet, and 534 to 655 feet. A line-length compensation setting offsets the cable loss in the path between the DFI and its associated channel service unit (CSU).

The line-length compensation setting is specified via translations.

Before a DFI is initialized, that is, during powerup or after a reset (at which time the DFI is transmitting an all 1s signal, or *blue alarm*, onto the T1 line), the DFI transmits in accordance to the line-length compensation setting of on-board switches SW6 and SW7. Once the DFI is initialized, it transmits in accordance to the line-length compensation setting specified in translations.

Enable or Disable On-demand LLB or BLB Control

Line loopback (LLB), board loopback (BLB), or both can be enabled so that the loopback can be invoked *on demand* through the microprocessor interface. The LLB loops the received signal from the line back to the transmit side without removing bipolar violations; a blue alarm (all 1s) is sent to the system (toward TDM bus). When BLB is enabled, the system data is fully processed by PAC and is then looped back to the system, but is not transmitted to the line; a blue alarm is sent to the line.

* Clear-channel transmission means that the full capacity of the T1 line is available to the user, that is, no portion of the channel is reserved for carrier framing or control bits.

Enabling or disabling of on-demand LLB/BLB control is not translatable. Cell Site system software *disables* this configuration option for both PAC devices.

Select Synchronization Reference

The 8-kHz signal derived from the received T1 data can be supplied back to the TDM clock source on the CAT.

Selecting a synchronization reference is not translatable. Cell Site system software determines whether the DFI is selected as a synchronization reference.

Specify Idle Code

All inactive T1 transmit timeslots will contain an idle code, which is a programmable 8-bit pattern.

Selecting an idle code is not translatable. Cell Site system software sets the idle code to 11111110.

DFI Initialization Message for E1 Operation

The initialization message sets configuration parameters on the PAC and T1/CEPT line interface devices and may specify a synchronization reference for the TDM clocks. Configuration parameters for E1 operation include:

CEPT Framing with or without CRC-4 Error Checking

To accommodate framing patterns, error detection, and signaling modes, 16 individual CEPT frames are grouped together to form a multiframe structure. Two different multiframe formats are defined: one associated with timeslot 0 (TS0) and the other associated with timeslot 16 (TS16). The TS0 multiframe structure provides an error checking capacity using a CRC-4 algorithm as defined by CCITT Recommendation G.704 (See Figure 11-18).

The CEPT framing configuration (with or without CRC-4 error checking) is specified via translations.

CCS or CAS Signaling Mode

Common-channel signaling (CCS) and channel-associated signaling (CAS) are signaling modes associated with the TS16 multiframe structure. In the CCS mode, TS16 is available to carry user (digital-voice) data. In the CAS mode, TS16 is reserved for local exchange carrier (LEC) signaling and therefore is not available to carry user data.

The CEPT signaling mode (CCS or CAS) is specified via translations.

Frame Number	Bit Use in TS0								Bit Use in TS16							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
0	C1/ Si	0	0	1	1	0	1	1	0	0	0	0	X0	Ym	X1	X2
1	0 /Si	1	Yf	Sa4	Sa5	Sa6	Sa7	Sa8	A1	B1	C1	D1	A17	B17	C17	D17
2	C2/ Si	0	0	1	1	0	1	1	A2	B2	C2	D2	A18	B18	C18	D18
3	0 /Si	1	Yf	Sa4	Sa5	Sa6	Sa7	Sa8	A3	B3	C3	D3	A19	B19	C19	D19
4	C3/ Si	0	0	1	1	0	1	1	A4	B4	C4	D4	A20	B20	C20	D20
5	1 /Si	1	Yf	Sa4	Sa5	Sa6	Sa7	Sa8	A5	B5	C5	D5	A21	B21	C21	D21
6	C4/ Si	0	0	1	1	0	1	1	A6	B6	C6	D6	A22	B22	C22	D22
7	0 /Si	1	Yf	Sa4	Sa5	Sa6	Sa7	Sa8	A7	B7	C7	D7	A23	B23	C23	D23
8	C1/ Si	0	0	1	1	0	1	1	A8	B8	C8	D8	A24	B24	C24	D24
9	1 /Si	1	Yf	Sa4	Sa5	Sa6	Sa7	Sa8	A9	B9	C9	D9	A25	B25	C25	D25
10	C2/ Si	0	0	1	1	0	1	1	A10	B10	C10	D10	A26	B26	C26	D26
11	1 /Si	1	Yf	Sa4	Sa5	Sa6	Sa7	Sa8	A11	B11	C11	D11	A27	B27	C27	D27
12	C3/ Si	0	0	1	1	0	1	1	A12	B12	C12	D12	A28	B28	C28	D28
13	E / Si	1	Yf	Sa4	Sa5	Sa6	Sa7	Sa8	A13	B13	C13	D13	A29	B29	C29	D29

Ai—Di — Per-channel signaling bits
C1—C4 — CRC-4 bits
E — Remote end block error bits
Si — International spare bits
Sa4—Sa8 — Additional spare bits for national use
X0—X2 — X spare bits
Yf — Remote frame alarm (RFA) bit (active high)
Ym — Remote multiframe alarm (RMA) bit (active high)

Figure 11-18. Information Sheets for CCITT CEPT Frame Format With and Without CRC-4

HDB3 or Transparent Line Format

CEPT standards require an average of at least one 1 in every eight bits of transmitted data. The CEPT framing format uses high-density binary 3 (HDB3) zero code suppression to meet this requirement. When four consecutive 0s occur in a bit stream, the HDB3 scheme replaces the four 0s with a specific pattern to keep the density of 1s high enough to preserve accurate timing at the remote endpoint. The remote endpoint recognizes the pattern and replaces it with the original string of four 0s. In contrast, the transparent line format allows the transmit bit stream to pass through without being modified.

The CEPT line format configuration (HDB3 or transparent) is specified via translations.

Enable or Disable On-demand LLB or BLB Control

Line loopback (LLB), board loopback (BLB), or both can be enabled so that the loopback can be invoked *on demand* through the microprocessor interface. The LLB loops the received signal from the line back to the transmit side without removing bipolar violations; an alarm indication signal (AIS, all 1s) is sent to the system (toward TDM bus). When BLB is enabled, the system data is fully processed by PAC and is then looped back to the system, but is not transmitted to the line; an AIS is sent to the line.

Enabling or disabling of on-demand LLB/BLB control is not translatable. Cell Site system software *disables* this configuration option for both PAC devices.

Select Synchronization Reference

The 8-kHz signal derived from the received CEPT data can be supplied back to the TDM clock source on the CAT.

Selecting a synchronization reference is not translatable. Cell Site system software determines whether the DFI is selected as a synchronization reference.

Select Idle Code

All inactive CEPT transmit timeslots will contain an idle code, which is a programmable 8-bit pattern.

Selecting an idle code is not translatable. Cell Site system software sets the idle code to 11111110.

DFI Network-Update Talk Message

A network-update “Talk” message is required to select a digital facilities receive timeslot and assign it to a TDM transmit timeslot. (This message is used to program the SNPEs.) It defines the timeslot of the carrier line that the DFI will receive data from and the timeslot of the TDM bus to which it will be transmitted.

NOTE:
TDM buses are always installed "red stripe up."

DFI Network-Update Listen Message

A network-update “Listen” message is required to select a TDM receive timeslot and assign it to a digital facilities transmit timeslot. (This message is used to program the SNPEs.) It defines the timeslot of the TDM bus that the DFI will receive data from and the timeslot of the carrier line to which it will be transmitted.

DFI Status Indicators

The DFI faceplate has three light-emitting diode (LED) indicators, one red, one yellow, and one green. Their meanings are as follows:

Red LED

Controlled by the DFI; lighted during the self-test initiated upon powerup or after a reset and goes off after successful completion of the self-test; lighted during normal operation if the DFI is insane.

Yellow LED

Controlled by Cell Site system software; lighted if the DFI detects any alarm other than a *minor*, *misframe*, or *slip* alarm for T1 operation (or a *10e-6 error-ratio* or *slip* alarm for E1 operation) on the line connected to the DFI.

Green LED

Controlled by Cell Site system software; the DFI selected as a synchronization reference has this LED lighted; only one DFI (or DS1) can have the green LED lighted for the TDM bus (TDM0 or TDM1); if the local oscillator on the CAT is the synchronization reference for the TDM bus, no DFI (or DS1) will have its green LED lighted for that bus.

During normal operation and assuming the DFI is *not* the synchronization reference, all three of its LEDs should be off. Also, as a troubleshooting aid, if the red and yellow LEDs are lighted, suspect that the line switches on the DFI are set to the wrong settings.

CAT (TN170) Circuit Description

The CAT performs three independent functions:

1. Bus clock generation and monitoring for the TDM bus
2. Maintenance tone generation
3. Maintenance tone detection and measurement.

These functions are implemented by the TDM bus clock generator circuit, the tone generator circuit, and the tone detector circuit .

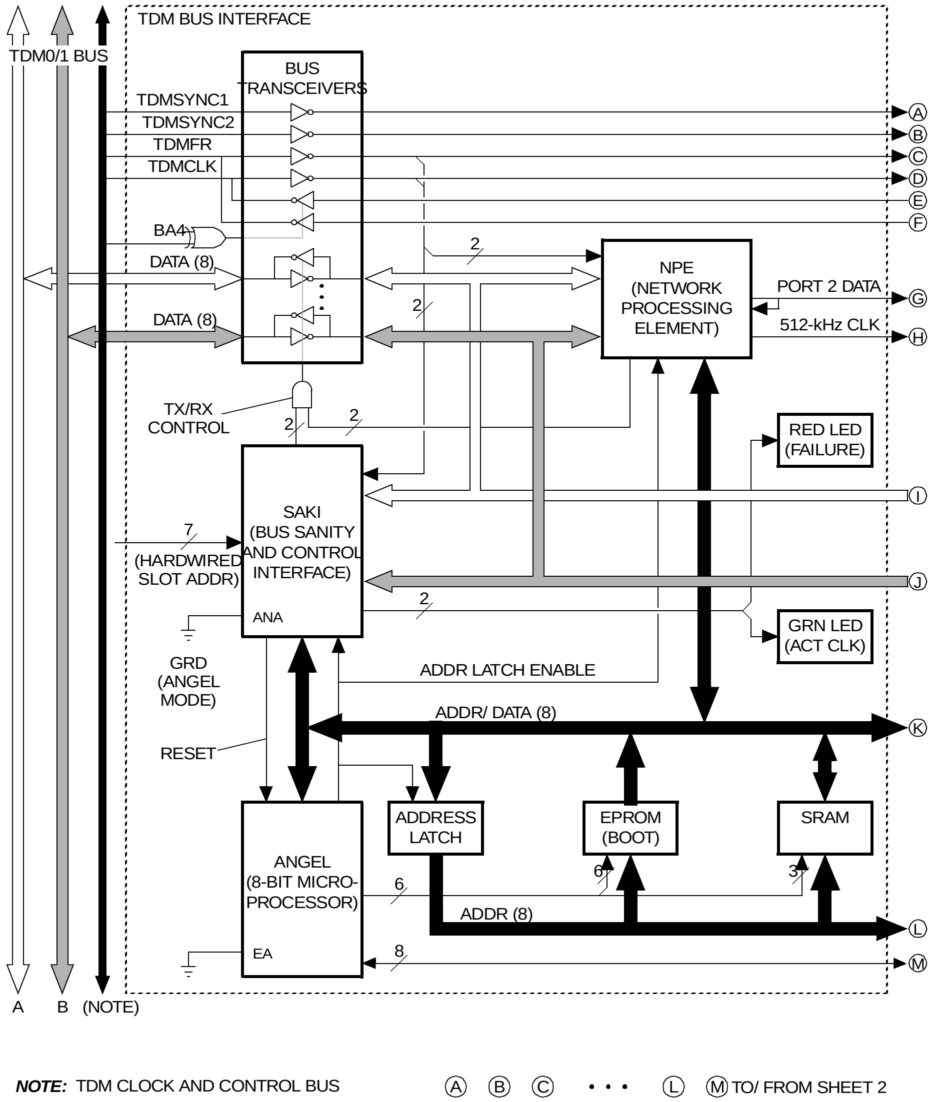


Figure 11-19. CAT Block Diagram (Sheet 1 of 2)

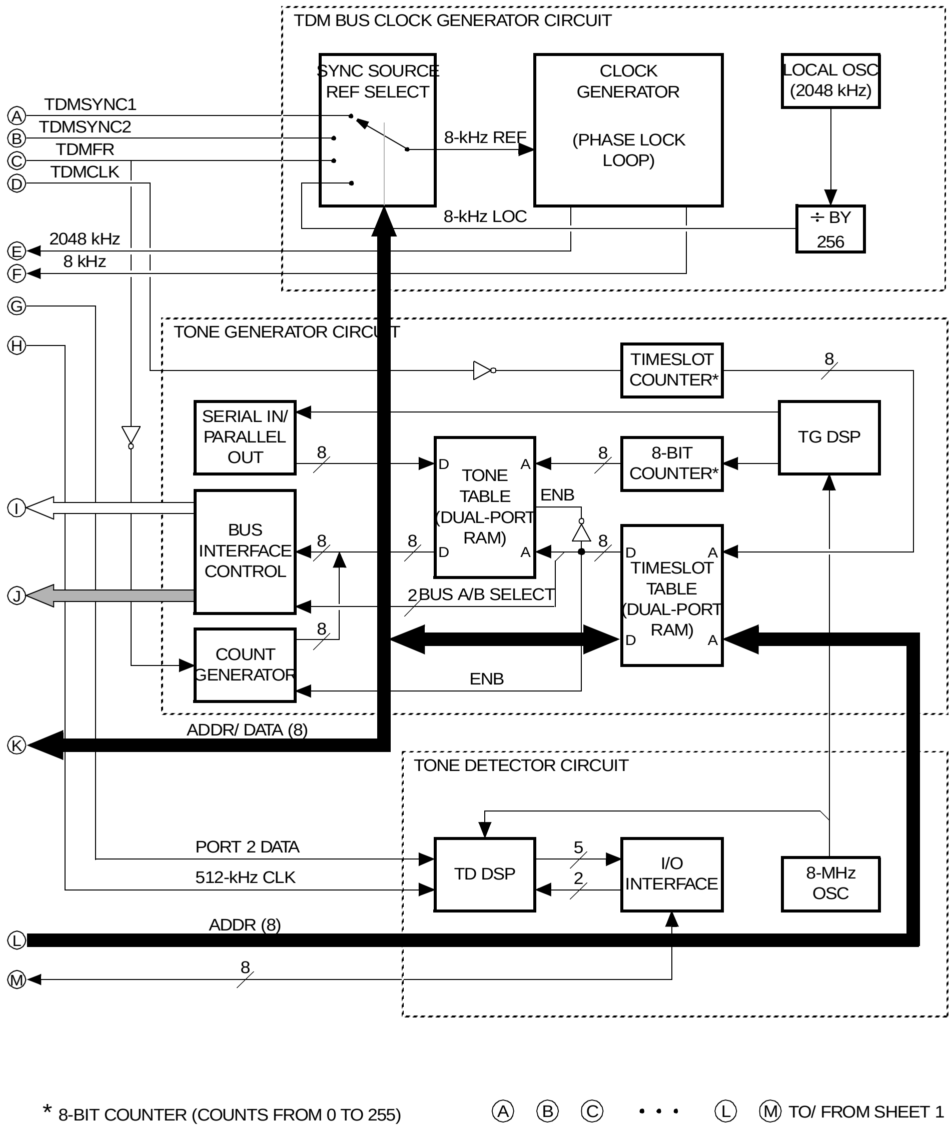


Figure 11-20. CAT Block Diagram (Sheet 2 of 2)

Bus Clock Generation and Monitoring for the TDM Bus

The TDM bus clock generator circuit provides an 8-kHz frame clock and a 2048-kHz timeslot clock for the TDM bus (TDM0 or TDM1). Possible synchronization references are the 8-kHz frame clock (*TDMFR*), 2 8-kHz signals derived from the carrier lines via the DS1 or DFI (*TDMSYNC1* and *TDMSYNC2*), and the 8-kHz signal derived from the on-board local reference oscillator (*8-kHz LOC*).

The TDM bus clock generator circuit monitors both the 8-kHz reference signal and the 8-kHz output clock of the phase lock loop (PLL) to determine when a *slip* occurs and to record the number of slips. A slip is declared when the 8-kHz output clock of the PLL moves one clock cycle ahead or one clock cycle behind the 8-kHz reference signal. (Presumably, this happens when the 8-kHz reference signal has a large degree of jitter, or is out of the frequency range of the PLL.) The CAT declares a *loss of signal* when a specified number of slips occur in any 5-ms period; the default value upon powerup or after a reset is 10.

Maintenance Tone Generation

The tone generator circuit provides test tones for system diagnostics and maintenance. These tones are transmitted on the TDM bus for detection and measurement by the tone detector circuit. There are two tone-generator sources: the tone generator digital signal processor (TG DSP) and the count generator.

The TG DSP generates the following tones:

404Hz at-16 dBm
1004Hz at-16 dBm
1004Hz at 0 dBm
2804Hz at-16 dBm
1000Hz at 0 dBm (digital miliwatt).*

The TG DSP generates new values for each tone every TDM bus frame (125 microseconds) and stores them in the tone table. The tone table is a dual-port RAM that is *written* by the TG DSP and *read* by the timeslot table (also a dual-port RAM). The tone table is logically split into two RAMs; the TG DSP writes into one half, while the timeslot table supplies an address to read the other half. Every TDM bus frame, special hardware alternates the TG-DSP and timeslot-table access to each half of memory, to guarantee that stable data is written to the TDM bus.

Both the angel microprocessor and the timeslot counter access the timeslot table. The address of each of the 256 memory locations in the timeslot table is associated with a timeslot on the TDM bus. To enable a tone *x* on timeslot *y*, the angel microprocessor writes an 8-bit code for tone *x* into address *y* of the timeslot table. The 8-bit code consists of six address bits for the tone table, one of which also enables the tone table (and disables the count generator), and two bus-select bits that determine whether the tone table connects to highway A or highway B, or both. The timeslot counter, which is incremented by the TDM timeslot clock (2048 kHz), supplies the addresses (0 through 255) to read the timeslot table.

To enable the count generator on timeslot *y*, the angel microprocessor writes an 8-bit code into address *y* of the timeslot table. The 8-bit code consists of five unused bits, one bit that enables the count generator (and disables the tone table), and two bus-select bits that determine whether the count generator connects to highway A or highway B, or both. The count generator, which is clocked by the TDM frame clock (8 kHz), continually cycles through a count of 0 through 255.

* The digital miliwatt, or dmW, is a 1-kHz sine-wave tone at a power level of 1 miliwatt (0 dBm). It is the standard reference level generated by eight 8-bit words as defined by the CCITT.

Maintenance Tone Detection and Measurement

The tone detector circuit consists of a tone detector digital signal processor (TD DSP), an angel input/output interface, and an 8-MHz oscillator. Port 2 of the network processing element (NPE) supplies the tone/count data from the TDM bus to the TD DSP. The angel commands the TD DSP to detect and measure a specific tone/count, and the DSP returns the measurement value to the angel.

The angel programs the NPE in accordance to two messages received from the CPU: a network-update “Listen” message and a network-update “Talk” message. A network-update “Listen” message defines the timeslot of the TDM bus from which the tone detector circuit will receive data. A network-update “Talk” message defines the timeslot of the TDM bus onto which the output of the tone generator circuit will be transmitted. The NPE controls when data is transmitted to and received from the TDM bus via the Tx/Rx control circuit.

CAT Status Indicators

The CAT faceplate has two LED indicators, one red and one green. Their meanings are as follows:

Red LED

This indicator is controlled by the CAT. The indicator is lighted during the self-test initiated upon powerup or after a reset and goes off after successful completion of the self-test; lighted during normal operation if the CAT is insane.

Green LED

This indicator is controlled by Cell Site system software. The CAT selected as the TDM clock source has this LED lighted. The CPU sends a message to the NCI (NCI_0 for TDM0 and NCI_1 for TDM1) specifying which of the two CATs is to supply the TDM system clocks for the bus. The NCI, in turn, uses the *TDMCKSEL* control line to activate the specified CAT.

Automatic Recovery Actions

All Cell Site faults fall into one of two categories, depending on the way they are handled:

- Those faults dealt with *initially* by the Cell Site, where there may or may not be follow-up action by the technician
- Those faults dealt with *only* by the technician.

The first category of faults involves Cell Site equipment having associated software diagnostic tests. The second category of faults pertains to scanned alarms, which are faults gathered from Cell Site equipment having *no* associated software diagnostic tests. This section deals with a subset of the first category of faults. *Specifically, this section describes automatic recovery actions for the RCC, DS1/ DFI, and CAT.*

The RCC contains software that takes automatic recovery actions (corrective actions) upon fault recognition. Recovery includes fault isolation and reconfiguration.

The recovery actions are dependent on the fault type. The RCC may take the suspect unit out-of-service and perform a diagnostic test on it. If the unit fails the diagnostic test, it is left in the out-of-service state. If the faulty unit belongs to the RCC controller, the entire controller is taken out-of-service, and its redundant mate is made the active controller.

The RCC reports the Cell Site faults to the ECP, including the results of RCC-initiated diagnostic tests. The RCC also reports any change in equipment (hardware) status as a result of the recovery action.

Hardware Error Handling Strategy

The automatic recovery actions in the RCC are done through the hardware error handler (HEH) software subsystem. HEH receives errors from hardware units, functional tests, and call-processing software. It determines when a recovery action (restore or remove) is needed and then issues a request to carry out the action.

Depending upon the severity of the error, either HEH takes immediate recovery action or waits until the error has occurred a predefined number of times before taking action. For other errors, HEH prints only an error report.

A throttling mechanism at the cell limits the number of alarms reported *on a per board basis* to the ECP. Within each 15-minute period, HEH reports no more than one alarm for any particular board.

HEH performs the following types of error analysis:

Immediate Action

For severe errors that are service-affecting, such as loss of communication between the MSC and the cell, HEH takes immediate action. For most on-board hardware errors, HEH will request a *conditional restore* of the suspect unit.

The conditional restore maintenance action schedules an event or process to restore the suspect unit after the unit passes a diagnostic test. If the unit fails the diagnostic test, the conditional restore aborts. The failed unit remains in the out-of-service state.

All Tests Pass (ATP) Analysis

For an HEH-initiated conditional restore request, if the unit passes all diagnostic tests, the unit is restored to service, and HEH adds a count to an ATP counter for the unit. If that count exceeds an assigned threshold within a predefined time period (typically *three* in 40 minutes or *five* in 24 hours), HEH will request a *conditional remove* of the unit. (Possibly, the diagnostic tests for the unit are not robust enough to detect the problem, or the problem is external to the unit.) This type of error analysis prevents a recovery cycle that might otherwise continue indefinitely.

Single Time-period Analysis

Refers to the use of error counters assigned to each hardware unit (DS1, DFI, CAT, and so on). If an error count for a unit remains below a predefined threshold for a specific period of time, HEH clears the counter. This type of error analysis is based on the theory that if a unit has remained reliable for an extended period of time, its error history should be forgotten completely. A timer value of 40 minutes is used.

Fail/Pass Analysis

HEH performs this type of error analysis on call-processing detected errors such as *voice channel confirmation failures*. When the number of failures exceeds some predefined value relative to the number of successful attempts (such as 2400 failures in 4000 attempts), HEH takes recovery action.

Leaky Bucket Analysis

Refers to the decrementing of non-zero error counters for the configurable hardware units. The decrementing is done at set time intervals. This technique is more flexible than a simple analysis based on the number of errors in a single fixed period of time.

RCC Hardware Errors and Recovery Actions

A fault within any of the units of the active RCC controller causes HEH to shut down the controller and to activate the mate RCC controller, *assuming the mate RCC controller is in the standby state.* If the mate RCC controller is out-of-service, HEH takes no action other than to *unconditionally remove the active RCC*; at that point, both RCCs would be out-of-service.

Assuming the mate RCC is in standby, HEH *conditionally restores the active RCC to standby*. This action spawns the following actions:

- A *switch* request that moves the active RCC to standby and the mate RCC to the active state.
- A *remove* request that moves the standby RCC to the out-of-service state.
- A *diagnose* request that diagnoses the out-of-service RCC; if successful, results in the RCC being restored to the standby state; if not successful, results in the RCC remaining in the out-of-service state.

NOTE:
The assumption here is that the active RCC is faulty. If, in fact, the standby RCC is faulty, HEH will *conditionally restore the standby RCC to standby*— no switching of RCC sides will occur.

DS1/DFI Hardware Errors and Recovery Actions

The DS1 or DFI provides serial-to-parallel and parallel-to-serial data conversion between the carrier lines and the TDM buses internal to the RCF frames. It also provides the external clock source by which all data and signaling transfers are synchronized over the TDM bus (TDM0 or TDM1).

The automatic fault-recovery procedure for a DS1/DFI depends upon the fault type for T1 operation and for E1 operation.

Throughout this section, the term “DS1” will be used to collectively represent both the DS1 and DFI units. Only when there is a need to distinguish between the DS1 and the DFI units will the term “DFI” be used.

HEH sends a *slip count inquiry* message to the DS1 every half hour, to which the DS1 responds with the number of slip conditions it has recorded during the last half hour. If the number of slip conditions is 44 or greater for a DS1 supplying synchronization for the TDM bus, HEH will change the synchronization reference to another DS1 *or* to *local* (for local oscillator) if no DS1 synchronization reference is available. This action may occur any time up to one half hour after HEH receives a DS1 slip count of 44 or greater. If the DS1 slip count exceeds 88, HEH will take action immediately.

In addition, HEH sends a *misframe count inquiry* message[*] to the DS1 every half hour, to which the DS1 responds with the number of misframe conditions it has recorded during the last half hour. If the number of misframe conditions is nine or greater for a DS1 supplying synchronization for the TDM bus, HEH will change the synchronization reference to another DS1 *or* to *local* if no DS1 synchronization reference is available. This action may occur any time up to one half hour after HEH receives a DS1 misframe count of nine or greater. If the DS1 misframe count exceeds 17, HEH will take action immediately.

When a TDM bus is synchronized to *local*, HEH will attempt to switch to the primary or secondary reference DS1 every five minutes. The switch will only proceed if the primary or secondary reference DS1 is now free of alarms and in the active state.

* T1 operation only. HEH does *not* send a misframe count inquiry message to a DFI configured for E1 operation.

DS1/DFI and T1 Errors—Detailed Description

This section describes alarms, error reporting, and performance monitoring functions performed by the DS1. In addition, this section discusses the subsequent actions that are taken by the DS1 as a result of various alarm conditions. For important background information concerning T1/DS1 frame structure as well as two types of superframe structures known as D4 and extended superframe (ESP).

The DS1 reports *autonomously* certain error conditions and statistics when a change of state occurs or a threshold is exceeded. The DS1 effectively filters the alarms to avoid reporting spurious conditions; that is, an alarm has to occur a certain amount times within a given time frame before the DS1 will report the alarm. The DS1 will report only the most serious of any alarms that may be present at any particular time. *The DS1 will also report autonomously when an alarm ceases (deactivates).*

Loss Of Signal (LOS)

The DS1 cannot detect the received signal on the T1 line. The DS1 inhibits the updating of the received signaling information from the T1 line. (That is, the DS1 blocks the signal of the T1 port to, but not from, the timeslots on the TDM bus carrying digital-voice or signaling for the T1 port.) It also begins transmitting a *yellow alarm* signal to the remote endpoint of the port.

The DS1 declares an LOS when it cannot detect a data signal for approximately one second, and deactivates LOS when the data signal is present for approximately 16 seconds.

Blue Alarm

The DS1 is receiving an all-1s pattern on the T1 line. The DS1 inhibits the updating of the received signaling information from the T1 line. It also begins transmitting a yellow alarm signal to the remote endpoint of the port.

The DS1 declares a blue alarm when it detects an all-1s pattern for approximately two seconds, and deactivates the blue alarm when the condition is clear for approximately 16 seconds.

The DS1, itself, will transmit a blue alarm to the remote endpoint during board initialization, that is, during the on-board self-test initiated upon powerup or after a system reset.

Red Alarm

The DS1 cannot detect the framing pattern in the received signal on the T1 line. The DS1 inhibits the updating of the received signaling information from the T1 line. It also begins transmitting a yellow alarm signal to the remote endpoint of the port.

The DS1 declares a red alarm when it detects framing errors for approximately three seconds, and deactivates the red alarm when the condition is clear for approximately 16 seconds.

In D4 or ESF, a framing error occurs when any two of four, or two of six, consecutive frame synchronization bits (*Fs* or *Ft* in D4, *Fe* in ESF) are in error.

Major Alarm

The received signal on the T1 line has a bit error ratio exceeding 10e-3 over a predefined period of time. (The average bit error rate exceeds 1 in 1000 bits.) The DS1 begins transmitting a yellow alarm signal to the remote endpoint of the port, but transmission and reception over the T1 line proceed with no interruption at this end of the connection.

The bit error ratio is measured with framing bit errors in D4 and with CRC errors in ESF. In D4, the DS1 declares a major alarm when the error ratio exceeds 10e-3 for 16 seconds, and deactivates the alarm when the clear threshold has been reached for 16 seconds. In ESF, the DS1 declares a major alarm when the error ratio exceeds 10e-3 for 6 seconds, and deactivates the alarm when the clear threshold has been reached for 6 seconds.

Yellow Alarm

The DS1 is receiving a yellow alarm signal from the remote endpoint (that is, the other endpoint has an LOS, blue alarm, red alarm, or major alarm condition, although there are no problems at this endpoint). The DS1 takes no action other than reporting this alarm.

The DS1 reports a yellow alarm condition when the condition persists for approximately 0.4 seconds, and negates the report when the yellow alarm condition has ceased for approximately 0.4 seconds.

In D4, a yellow alarm is indicated by a 0 in bit 2 of all incoming channels. In ESF, a yellow alarm is indicated by an alternating pattern of eight 1s and eight 0s on the 4-kbit/s data link (DL).

The DS1 cannot determine when receiving a yellow alarm whether the channels are usable—they would be if there were a major alarm at the other end—or not usable—they would *not* be if one of the other conditions were in effect.

Fan Alarms

Preamp Fan

All preamp fans in the Linear Amplifier Frame (LAF) are powered from two of the four 20A DC feeders which supply power to the LAC 0 position in the frame. **Preamp fans will not have power if the breakers to LAC 0 are open.**

To avoid overheating the preamps, do not power down LAC 0 for more than a few minutes if other Linear Amplifier Modules (LACs) are powered. If LAC 0 needs to be powered down for an extended period of time, disconnect the J1 power cable from LAC 0 (LAC 4 in LAF1), and close the **two** 20A breakers which supply connector J1.

Symptoms:

C-Series LACs:

Major Alarm

LAC LEDS = FANS and PREAMP

A/B-Series LACs:

Minor Alarm

LAC LEDS = LINEARIZER

Procedure:

Check that all 20A breakers feeding LAC 0 (LAC 4 in LAF1) are closed.

If a fan is stopped, check its wiring. Check the fan for blockage.

Check the 24-volt DC voltage on connector J1 supplying LAC 0. If normal, the fan should be replaced. Replace both preamp fans at the same time, even if the other fan is working normally.

LineariZeR Fan Procedure

Symptoms:

C-Series LACs:

Major Alarm

LAC LEDS = FANS and LINEARIZER

A/B-Series LACs:

Minor Alarm

LAC LEDS = LINEARIZER

Procedure:

Check the LINEARIZER FAN fuse on the front panel of the LineariZeR (LZR). Replace with a new fuse, if blown.

If the fuse is good, remove the front grille from the LZR and carefully check to see if the fan is turning. The fan is located on the far right side of the LZR cabinet.

Check the fan wiring for shorts or opens. If none are found, replace the fan.

LAU Fan Procedure

Symptoms:

C-Series LACs:

Major Alarm

LAC LEDS = FANS and LAU

A/B-Series LACs:

Minor Alarm

LAC LEDS = LAU

Procedure:

Check the LINEAR AMPLIFIER UNIT FAN fuse on the front panel of the LineariZeR (LZR) (Figure 4-17). Replace it with a new fuse, if blown.

If the fuse is good, check to see if the fan is turning. Check for blockage. Remove a few Linear Amplifier Modules (LAMs) at the top of the Linear Amplifier Unit (LAU) and check the DC voltage at the inductor terminals. If the voltage is greater than 22V, replace the fan. If the voltage is less than 22V, check the DC power cabling.

Measuring the Linear Amplifier Unit (LAU) Fan Voltage

DS1 Errors

Minor Alarm

The received signal on the T1 line has a bit error ratio between 10e-3 and 10e-6 over a predefined period of time. (The average bit error rate is less than 1 in 1000 bits but exceeds 1 in 1,000,000 bits.) The DS1 takes no action other than reporting this alarm.

The bit error ratio is measured with framing bit errors in D4 and with CRC errors in ESF. In D4, the DS1 declares a minor alarm when the error ratio exceeds 10e-6 for 41 minutes, and deactivates the alarm when the clear threshold has been reached for 41 minutes. In ESF, the DS1 declares a minor alarm when the error ratio exceeds 10e-6 for 10 minutes, and deactivates the alarm when the clear threshold has been reached for 10 minutes.

Misframe Count

The number of framing bit errors detected by the DS1 since the last system inquiry. The DS1 will report the number of misframes autonomously whenever the number of misframes reaches 17. The misframe count will be reset (misframe count = 0) when the DS1 receives a Misframe Count Inquiry message from the CPU.

DFI and E1 Errors - Detailed Description

This section describes alarms, error reporting, and performance monitoring functions performed by the DFI configured for E1 operation. In addition, this section discusses the subsequent actions that are taken by the DFI as a result of various alarm conditions.

The DFI reports the following autonomous alarms to HEH:*

Loss Of Signal (LOS)

The DFI cannot detect the received signal on the E1 line. The DFI inhibits the updating of the received signaling information from the E1 line. (That is, the DFI blocks the signal of the E1 port to, but not from, the timeslots on the TDM bus carrying digital-voice or signaling for the E1 port.) It also begins transmitting a remote frame alarm (RFA) signal to the remote endpoint of the port.

The DFI declares an LOS when it cannot detect a data signal for approximately 2.4 seconds, and deactivates LOS when the data signal is present for approximately 12 seconds.

Alarm Indication Signal (AIS)

The DFI is receiving an all-1s pattern on the E1 line. The DFI inhibits the updating of the received signaling information from the E1 line. It also begins transmitting an RFA signal to the remote endpoint of the port.

The DFI declares an AIS when it detects an all-1s pattern for approximately 0.6 seconds, and deactivates AIS when the condition is clear for approximately 0.2 seconds.

The DFI, itself, will transmit an AIS signal to the remote endpoint during board initialization, that is, during the on-board self-test initiated upon powerup or after a reset.

Loss of Frame Alignment (LFA)

The DFI cannot detect the framing pattern in the received signal on the E1 line. The DFI inhibits the updating of the received signaling information from the E1 line. It also begins transmitting an RFA signal to the remote endpoint of the port.

The DFI declares an LFA when it detects framing errors for approximately 2.4 seconds, and deactivates LFA when the condition is clear for approximately 12 seconds.

A framing error is defined as an incorrect bit in one of the seven framing bits in the timeslot 0 (TS0) frame alignment signal (FAS) word or an error in bit 2 of the TS0

* For any DFI autonomous alarm except the *10e-6 error-ratio alarm* and *slip count*, Cell Site system software will turn on the DFI's yellow LED.

not-word. The DFI begins a sequential search for new framing candidates, starting one bit position beyond the position where the LFA was detected and continuing until a valid candidate is found.

Loss of Multiframe Alignment (LMA)

The DFI cannot detect the multiframe alignment pattern (for the multiframe selected) in the received signal on an E1 line. The DFI inhibits the updating of the received signaling information from the E1 line. For a timeslot 16 (TS16) LMA, it also begins transmitting a remote multiframe alarm (RMA) signal to the remote endpoint of the port.

The DFI declares a TS0 LMA when an error has occurred in the 6-bit multiframe pattern (001011 interleaved with the CRC-4 bits) for approximately 2.4 seconds, and deactivates TS0 LMA when TS0 multiframe alignment has recovered for approximately 12 seconds.

The DFI declares a TS16 LMA when an error has occurred in the 4-bit multiframe alignment signal (MAS) pattern for approximately 2.4 seconds, and deactivates TS16 LFA when TS16 multiframe alignment has recovered for approximately 12 seconds.

10e-3 Error-ratio Alarm

The received signal on the E1 line has a bit error ratio exceeding 10e-3 over a predefined period of time. (The average bit error rate exceeds 1 in 1000 bits.) The DFI begins transmitting an RFA signal to the remote endpoint of the port, but transmission and reception over the E1 line proceed with no interruption at this end of the connection.

The DFI declares a 10e-3 error-ratio alarm when the frame-alignment error ratio exceeds 10e-3 for two consecutive four-second periods, and deactivates the alarm when the clear threshold has been reached for three consecutive four-second periods.

A frame alignment error, or framing error, is defined as an incorrect bit in one of the seven framing bits in the TS0 FAS word or an error in bit 2 of the TS0 not-word.

Remote Frame Alarm (RFA)

The DFI is receiving an RFA signal from the remote endpoint (that is, the other endpoint has an LOS, AIS, LFA, or 10e-3 error-ratio alarm condition, although there are no problems at this endpoint). The DFI takes no action other than reporting this alarm.

The DFI reports the RFA condition when the condition persists for approximately 0.6 seconds, and negates the report when the RFA alarm condition has ceased for approximately 0.2 seconds.

The DFI cannot determine when receiving an RFA alarm whether the channels are usable—they would be if there were a 10e-3 error-ratio alarm at the other end—or not usable—they would *not* be if one of the other conditions were in effect.

Remote Multiframe Alarm (RMA)

The DFI is receiving an RMA signal on an E1 line (that is, the other endpoint has a TS16 LMA condition, although there are no problems at this endpoint). The DFI takes no action other than reporting this alarm.

The DFI reports the RMA alarm condition when the condition persists for approximately 0.6 seconds, and negates the report when the RMA alarm condition has ceased for approximately 0.2 seconds.

10e-6 Error-Ratio Alarm

The received signal on the E1 line has a bit error ratio between 10e-3 and 10e-6 over a predefined period of time. (The average bit error rate is less than 1 in 1000 bits but exceeds 1 in 1,000,000 bits.) The DFI takes no action other than reporting this alarm.

The DFI declares a 10e-6 error-ratio alarm when the frame-alignment error ratio exceeds 10e-6 for 30 minutes, and deactivates the alarm when the clear threshold has been reached for 45 minutes.

Slip Count

The number of times the DS1 has either dropped a frame from the received data or repeated a frame since the last system inquiry. The DS1 will report the number of slips autonomously whenever the number of slips reaches 88. The slip count will be reset (slip count = 0) when the DS1 receives a Slip Count Inquiry message from the CPU.

The T1 port on the DS1 receives data from a T1 line into a two-frame buffer (by necessity, at the T1 line rate—8000 frames per second), and empties this buffer onto the TDM bus (by necessity, at the TDM bus rate). If these rates are not identical over a significant period of time, then the receive buffer will either overflow or underflow, resulting in the deletion of a frame or the repeat of a frame. Each overflow or underflow of the buffer is counted as a single slip.

CAT Hardware Errors and Recovery Actions

The CAT, which is phase-locked to one of the carrier lines attached to the primary RCF or growth RCF frame, provides system clocks for the TDM bus (either TDM0 or TDM1).

The automatic fault-recovery procedure for a CAT depends upon the fault type (See Table 11-4).

The CAT monitors both the 8-kHz reference signal and the 8-kHz output clock of its on-board phase lock loop (PLL) to determine when a *slip* occurs and to record the number of slips. A slip is declared when the 8-kHz output clock of the PLL moves one clock cycle ahead or one clock cycle behind the 8-kHz reference signal. (Presumably, this happens when the 8-kHz reference signal has a large degree of jitter, or is out of the frequency range of the PLL.) The CAT declares a *loss of signal* error when a specified number of slips occur in any 5-ms period. The default value upon powerup or after a reset is 10.

The CAT will report a *loss of signal* error to HEH as soon as it occurs.

HEH sends a *slip count inquiry* message to the CAT every half hour, to which the CAT responds with the number of slip conditions it has recorded during the last half hour. If the number of slip conditions is greater than 44, HEH will send a *PPM inquiry* message to the CAT to determine the total parts per million (PPM) counts detected by the CAT when using the *primary* or *secondary* DS1/DFI synchronization reference. Whether the PPM count is high or low, HEH takes *no* recovery action other than to report the PPM count to the ECP.

A high PPM count means that the quality of the reference source (carrier line) is poor. A further deterioration in the quality of the reference source will cause the CAT to declare a *loss of signal* error, at which time HEH will take corrective action.

When a TDM bus is synchronized to *local*, HEH will attempt to switch to the primary or secondary reference DS1/DFI every five minutes. The switch will only proceed if the primary or secondary reference DS1/DFI is now free of alarms and in the active state.

Call-Processing Errors and Recovery Actions

In addition to the hardware faults already described, HEH can detect certain AMPS, TDMA, and CDMA call-processing related errors.

Diversity Imbalance Errors and Recovery Actions

Diversity imbalance errors are reported *autonomously* by a Cell Site radio (AMPS, TDMA, or CDMA) when it perceives widely varying signal strengths in the receive antennas it is using. The Cell Site will diagnose the radio in question.

Manual Recovery Actions

The symptoms described in “DS1/DFI and T1 Errors- Detailed Description” indicate faults on the T1 facility or faults in the generation of the T1 signal by the remote end. While it is possible that faults in the DS1/DFI can cause these symptoms, they are more likely to be the result of a fault outside of the DS1/DFI.

In response to an alarming DS1/DFI that is supplying synchronization for the TDM bus, The Cell Site automatically switches the synchronization reference to another DS1/DFI, if available. If switching the synchronization reference to another DS1/DFI results in no further alarms, the DS1/DFI generating the alarm is probably faulty. In that case, the DS1/DFI generating the alarm should be conditionally restored. If the problem persists after taking this action, the digital facilities termination unit at the remote end is probably faulty; it should be conditionally restored.

A technician can check whether a DS1/DFI is operating properly by running a diagnostic test on the DS1/DFI. Or, for T1 operation, a line-related problem can be isolated to either the Cell Site equipment side of the channel service unit (CSU) or the T1 facility side of the CSU by putting the CSU in loopback. If the problem goes away, the T1 facility is at fault. The DS1/DFI port that is looped back should not be supplying system synchronization at the time it is looped.

Table 11-4. CAT Errors and Recovery Actions

Fault Type	Description	Automatic Recovery Action
CAT insane*	CAT-to-CPU communication broken	If mate is out-of-service, HEH takes no action other than to *unconditionally remove the active CAT*; at that point, both CATs would be out-of-service. Assuming mate is in standby, HEH *conditionally restores the active CAT to standby*, which spawns the following actions: 1. A *switch* request that sets the appropriate control bit in the NCI control register; NCI uses *TDMCKSEL* control line to move active CAT to standby and mate CAT to active state. 2. A *remove* request that moves standby CAT to out-of-service state. 3. A *diagnose* request that diagnoses out-of-service CAT; if successful, results in CAT being restored to standby state; if not successful, results in CAT remaining in out-of-service state.
CAT hardware failure	Hardware failures include parts per million (PPM) failure, slip detector failure, slip in local, local reference failure, SD0 failure, and SD1 failure.	HEH takes same recovery action as in case of "CAT insane" condition.
Loss of Signal	Excessive number of slip conditions (10 or more slips during any 5-ms period)	HEH switches synchronization reference to another DS1/ DFI if available; otherwise, HEH switches to CAT *local* source.

* The assumption here is that the active CAT is insane. If, in fact, the standby CAT is insane, HEH will *conditionally restore the standby CAT to standby*—no switching of CAT units will occur.

Or, for E1 operation, assuming that the associated customer-provided network termination unit (NTU) can be put into loopback, a line-related problem can be isolated to either the Cell Site equipment side of the NTU or the E1 facility side of the NTU by putting the NTU in loopback. If the problem goes away, the E1 facility is at fault. The DFI port that is looped back should not be supplying system synchronization at the time it is looped.

And finally, *for the DFI unit only*, if the on-board red and yellow LEDs are lighted, suspect that the line switches on the DFI are set to the wrong settings.

Routine Maintenance and Radio Performance Tests

12

Contents

Maintenance Process

The maintenance process consists of those activities designed to minimize the effects of any failure on system performance and to provide the operations personnel with the information and tools to locate and repair troubles rapidly. Operators are provided with the necessary information, such as fault and status information, and the control capability to monitor the system performance and perform the maintenance functions required to meet system reliability.

The Cell Site is responsible for fault recognition, fault analysis, fault recovery, and the reporting of faults and hardware maintenance states to the ECP. In those situations where no automatic recovery action is taken or automatic recovery fails, it is the responsibility of the technician to perform manual recovery procedures from the ECP.

Maintenance Objective

The objective of the maintenance process is to:

- Avoid unnecessary system initializations
- Avoid unnecessary manual diagnostics
- Minimize site visits
- Maximize system availability.

Maintenance Activities

Maintenance activities fall into one of three categories:

- Preventive maintenance
- Corrective maintenance
- Controlled maintenance.

Preventive Maintenance

Preventive maintenance consists of those activities performed at regular intervals that are designed to identify as soon as possible, potential failure conditions and/or equipment failures. The goal of preventive maintenance is to maintain normal system operations and to prevent loss of service. That goal is achieved by the use of software and manual routines.

Software routines include scheduled software diagnostic tests, functional tests, and audits.

Routine Maintenance

Cell Site routine maintenance tasks are listed in Equipment Test List (ETL). The Cell Site ETL divides Cell Site routines into three categories: (1) Radio and Control Equipment — those routines associated with call processing control and Radio Frequency (RF) transmission; (2) Power Equipment — those routines associated with on-line power supplies, auxiliary power equipment, and monitoring equipment; and (3) Building and Environmental Equipment — those routines associated with temperature and humidity control, fire and safety, emergency lighting, and building alarms.

The order in which routines are listed on the ETL is not intended to indicate a sequence for performing routines. Routines are performed at the intervals listed in the Interval column and as described within the routine procedures. The Lucent Technologies Practice contains a reference to the procedural information required to perform the cell site tests.

Diagnostic Routines

Diagnostic routines are run automatically by system software and are run manually when a unit is suspected of being faulty or when a unit is replaced. Diagnostic tests are run only on off-line units. Lucent Technologies 401-660-101, Series II Cell Site Diagnostic Test Descriptions, contains a complete description of the diagnostic tests.

Visual Inspection

Visual inspections at the Cell Site should be made on a bimonthly basis. Typical visual indications to look for are listed below:

- Alarm lamp indication
- Smoke
- Broken cables
- Blown fuses
- Overheating
- Out-of-range temperature and humidity.

Maintenance Assumptions

It is assumed that the technician is familiar with the following or that such conditions are otherwise met:

1. Wrist grounding straps must always be attached before working on any component or handling the Circuit Packs (CPs). This is to prevent or reduce electrostatic discharge that may damage or destroy circuit packs containing integrated circuits.
2. Powering down the failing unit (when required), reseating CPs, powering up the unit, and repeating diagnostics when an initial STF message is received to verify the corrective action.
3. Replacing one CP at a time when several are suspected, then replacing the CP, and repeating the diagnostics.
4. Handling CPs by the edges and the faceplates to avoid damaging contacts and deforming components.
5. Operations of the terminal to include mode changing, page manipulation, and message conventions.
6. Tagging faulty CPs with office location, mounting location, diagnostic phase and test that failed, and date removed.

7. All test equipment is known to be functioning properly.
8. A replacement unit or CP is known to be good.
9. Burned out lamps or Light Emitting Diodes (LEDs) are replaced without instruction.
10. Audible alarms are retired without instruction.

Routine Maintenance Procedures List

Table 12-1 provides a list of the Routine Maintenance Procedures for the Series II cell.

Table 12-1. Routine Maintenance Procedures

Routine Maintenance Procedure	Performance Interval	Source Document
RADIO/CONTROL EQUIPMENT		
Clean Power Amplifier Cooling	6 mo.	401-201-500
Performance Measurements		
Perform Setup Radio Performance Measurements	12 mo.	401-660-100
Perform Voice Radio Performance Measurements	12 mo.	401-660-100
Check Reference Generator Frequency	6 mo.	
POWER AND BATTERY PLANT EQUIPMENT		
STORAGE BATTERY		
Check Float Level	1 mo.	157-629-701
Check Electrolyte Level	1 mo.	157-629-701
Check Cell Voltage	3 mo.	157-629-701
Check Specific Gravity	6 mo.	157-629-701
150B BATTERY POWER PLANT		
Check Float Voltage Alarm	12 mo.	167-609-302
Check Fuse Alarms	12 mo.	167-609-302
RECTIFIER (MOD 1)		
Check High- and Low-Voltage Alarms	12 mo.	169-652-305
Check Rectifier Failure Alarm	12 mo.	169-652-305
RECTIFIER (MOD II)		
Check High- and Low-Voltage Alarms	12 mo.	169-609-311
Check Rectifier Failure Alarm	12 mo.	169-609-311
BUILDING AND ENVIRONMENTAL EQUIPMENT		
Air Conditioning Check	1 wk.	Local procedure

Table 12-1. Routine Maintenance Procedures (Contd)

Routine Maintenance Procedure	Performance Interval	Source Document
Tower Light Check	1 wk.	Local procedure
Humidifier Check	1 wk.	Local procedure
Dehumidifier Check	1 mo.	Local procedure
Emergency Lighting Check	1 mo.	Local procedure
Exhaust Fan Check	1 mo.	Local procedure
Fire and Safety Equipment Check	1 mo.	Local procedure
Air Dryer Inspection	6 mo.	Local procedure
Dust Cell Site Equipment Check	6 mo.	Local procedure
Fire Alarm Sensor Cleaning	6 mo.	Local procedure
Peripheral Alarms: Door, Fire, AC, Heat Check	6 mo.	Local procedure
Smoke Alarm Check	6 mo.	Local procedure
Heaters Check	12 mo.	Local procedure

Fan Screen Cleaning

Fan screens require checking/cleaning monthly. Screens should be vacuumed clean of dirt and cleaned with soap/water to remove any buildup of dirt.

Radio Performance Testing

Radio performance testing should be done annually and whenever any component of a transmit path is changed or altered (See Figure 12-1). The procedures for doing radio performance testing are given below.

Radio Test Overview

This procedure describes radio performance tests for power, frequency, and frequency deviation tests made on the Radio Channel Unit (RCU). This procedure applies to both setup and Voice RCUs (V-RCUs). These tests are designed to be run after an RCU is (1) initially installed and (2) when any component of the transmit path is changed or altered.

At the time of initial installation, the Preamplifier and the RCU associated with each Linear Amplifier Circuit (LAC) are adjusted and power level measurements are made to determine the Effective Radiated Power (ERP) from each LAC. All performance measurements (power, frequency, and deviation) are made at connector J3 (Incident Port) on the Radio Test Unit (RTU) switch panel. All of these measurements are recorded in the Cell Site Log to be used as a reference for these tests and other RCU measurements.

The value of ERP, input to the transmit (TX) antenna, and the power at J3 on the RTU switch panel should be the same for all RCUs connected to the same LAC. The maximum allowable ERP is 500 watts per channel.

These performance tests require a Cell Site to Mobile Switching Center (MSC) data link, the use of a data terminal keyboard, the use of an IFR FM/AM 1500 Communications Service Monitor (CSM) or equivalent, and test cables/adapters. Radio performance measurements are made in the following order: RCU Frequency, RCU Effective Radiated Power, RCU Frequency deviation due to 1004 Hz modulation (voice), RCU Frequency due to Supervisory Auditory Tone (SAT), and RCU Frequency deviation due to 10 kHz (data). Some steps require that input messages be entered. For each input message, there is a corresponding output message response. If an interpretation of a message is needed, refer to the Cell Site Input/Output (I/O) Manual.

The power level measurements made at J3 on the RTU switch panel and recorded in the Cell Site log at the time of initial installation are used as a reference for these performance tests. A portion of the power output from each LAC is fed from its directional coupler to the RTU switch panel (J3). Therefore, the power level at J3 is a function of the ERP from any RCU connected to the LAC. That is, all RCUs connected to a given LAC are adjusted to give the same value at J3. When an RCU is replaced, the new RCU output is adjusted to give the same value recorded

Radio Pretest Procedure

NOTE:
Run a diagnostic test on the Voice Radio Channel Unit (V-RCU) before running this test. Perform the following:

At data terminal keyboard:

Enter **RMV:CELL** a,RA b
Where: a = Cell Site number (1-222)
b = RCU number (0-191)

Enter **DGN:CELL** a,RA b
Response: **ATP** and then **ALL TEST PASS**

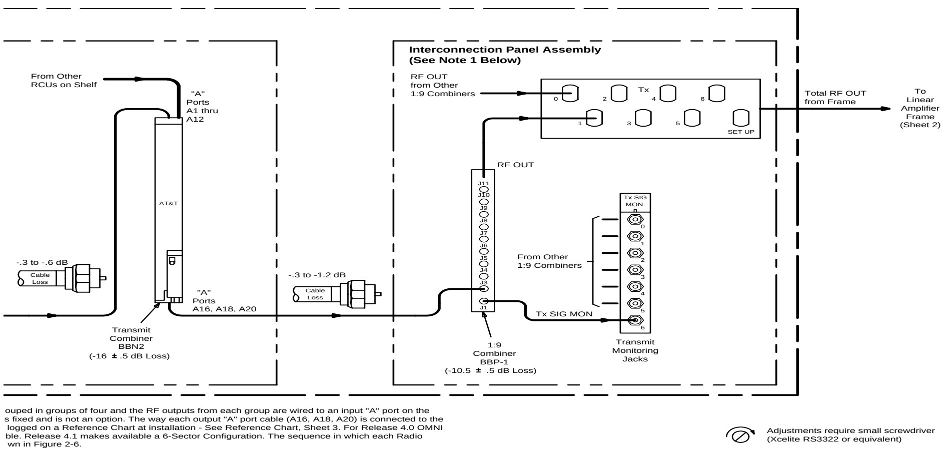


Figure 12-1. Voice Channel Test Paths

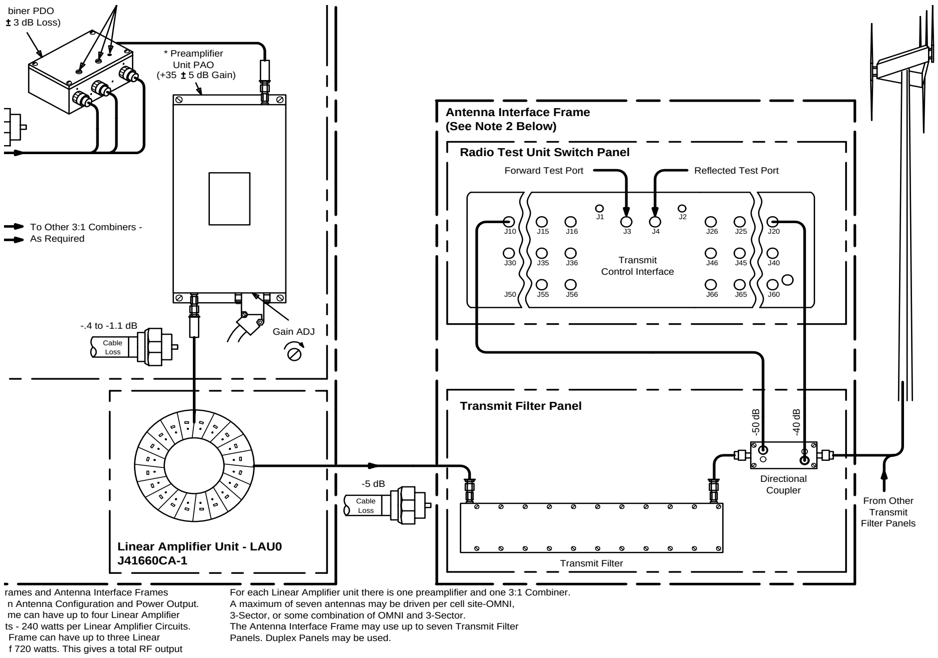


Figure 12-2. Voice Channel Test Paths

Cable Loss Measurement

1. Configure the IFR FM/AM 1500 Communications Service Monitor (CSM) as shown in Table 12-2 and allow 30 minutes warm-up:

Table 12-2. Configuration of IFR FM/AM 1500 CSM

ATTENUATOR	0 dB
DISPLAY	ANALY
ANALY DISPR	1M
DUPLEX/SIMPLEX	DUPLEX
GEN/REC	GEN
AVE PEAK/PEAK	AVG PEAK
MODULATION	FM3
DEV-PWR	20 kHz
DEV-VERT	5 kHz/DIV
dB/DIV	10
GEN/LOCK	FULLY CCW
INT TONE/RCVR	RCVR
VOLUME	AS DESIRED

Table 12-2. Configuration of IFR FM/AM 1500 CSM (Contd)

ATTENUATOR	**0 dB**
SQUELCH	FULLY CCW
FREQ ERROR	1 kHz
RF OUTPUT LEVEL	–40 dBm

2. Press **Enter** on the keyboard.
3. Press **RF** on the keyboard. Enter 8803200, press **Enter** on the keyboard. Confirm 880.3200 MHz is displayed.

> **NOTE:**
> For non-wireline company, use 875.0100 MHz.

4. Connect a reference cable from the DUPLEX OUTPUT jack to the ANTENNA jack.
5. The signal should appear near the -40 graticule level. Set the dB/DIV switch to 1 and use the VERT POS control to adjust the reference level so that the peak of the signal is at the -40 graticule level. (After this is done, do not adjust the VERT POS control for any reason while performing the alignment and measurements, otherwise inaccuracies occur.)
6. Disconnect the reference cable from the ANTENNA jack.
7. Connect the test cable and any associated adapters whose loss is to be measured to the ANTENNA jack. Connect the reference cable and the test cable to be measured together using a BNC jack/BNC jack adapter.
8. Read the Radio Frequency (RF) output level at the Cathode Ray Tube (CRT). The loss of the test cable is the difference between the measured output level and the reference level (measured output level minus -40 dBm). Retain this value for subsequent use.
9. In the Cell Site Log or in translations, look up the Radio Channel Unit (RCU) number (0 to 199), assigned channel number, and assigned frequency of the RCU to be tested.
10. If test is to be run from the Cell Site, establish a Cell Site/MSC data link (see procedure covering Cell Site to Mobile Switching Center (MSC) data link).
11. Configure the IFR FM/AM 1500 Communications Service Monitor (CSM) as follows:
12. Remove the 50-ohm terminator from J3 (Incident Port) on the Radio Test Unit (RTU) switch panel on the Antenna Interface Frame (AIF).

Table 12-3. Configuration of IFR FM/AM 1500 CDM

CONTROL	SET TO
DISPLAY	METER
ATTENUATOR	40 dB
AVG PEAK/PEAK	PEAK
MODULATION	FM3
DEV-PWR	15
FREQ ERROR	1 kHz
ANALY DISPR	10 kHz/DIV
DEV-VERT	5 kHz/DEV
dB/DIV	10
GEN/LOCK	LOCK
INT TONE/RCVR	RCVR
VOLUME	As desired
SQUELCH	FULLY CCW
GEN/REC	REC
DUPLEX/SIMPLEX	SIMPLEX

13. Connect the test cable with a known loss to J3 (Incident Port) on the RTU switch panel on the AIF, using a BNC jack/SMA plug adapter. Connect the other end of the test cable to Communications Service Monitor (CSM) as follows:
14. Tests performed are measurements of transmitter frequency, power output, and frequency deviation on the Voice Radio Channel Units (V-RCUs). Frequency deviation measurements are made for voice, Supervisory Audio Tone (SAT), and data transmissions.
15. All measurements are made at J3 on the RTU switch panel.
16. Effective Radiated Power (ERP) is calculated for the Radio Channel Unit (RCU) under test as a function of the power level at J3.
17. All measurements taken are recorded along with the serial number and calibration date of the test equipment used to perform the tests.
18. The value of the power input to the antenna (input from the foam jumper cable) should be the same for all RCUs connected to the same antenna.
19. The maximum allowable Federal Communications Commission's (FCC's) ERP is 500 watts per channel.

20. On the CSM, press RF and enter the assigned Radio Frequency (RF) of the RCU under test.
21. Frequency Measurement
22. At data terminal keyboard:

    Enter **CFR:CELL** a,RA n; **START**
    Response: **ALL WENT WELL**
    Where: a = Cell Site number (1-222)
    n = RCU number (0-191)

    Enter **CFR:CELL** a,RA n**; CONFIG 150**
    Response: **ALL WENT WELL**

    Enter **CFR:CELL** a,RA n**; XMITC 300**
    Response: **ALL WENT WELL**

    Enter **CFR:CELL** a,RA n**; VRADPC 357**
    Response: **ALL WENT WELL**

23. Read the frequency error on the Cathode Ray Tube's (CRT's) Communications Service Monitor (CSM) display.

NOTE:
If frequency error is small, increase resolution by changing **FRQ ERROR** to 300 or 100 Hz scale.

24. Is measured frequency less than ± 0.80 kHz?

    If **YES**, then record in Cell Site Log and continue to Step 25 for power measurement. If **No**, then continue to Step 24.

25. Replace the Radio Channel Unit (RCU) and repeat this procedure.

Power Measurement

26. At Communications Service Monitor (CSM), set **DISPLAY** to **ANALY**.
27. Read **RF** level (to the nearest dB) from the center of the Cathode Ray Tube (CRT) Communications Service Monitor (CSM) display.
28. Calculate the power level at J3 (Incident Port) by adding the Test Cable Loss (in dB) to the measured power level above.
29. The level obtained in Step 27 should equal the level recorded in the Cell Site Log (± x dBm) for the LAC associated with the Radio Channel Unit (RCU) under test. Adjust the RCU output until the correct level is obtained.
30. If the RCU under test is an existing RCU or the replacement for an existing RCU, the values recorded in columns 1 through 7 of the Cell Site log are valid.
31. If the RCU is being put into service for the first time, the values to be recorded in columns 1 through 7 are the same as other RCUs on the same Linear Amplifier Circuit (LAC).

NOTE:
If the RCU under test is a setup RCU, go to Step 48.

Voice 1004 Hz Deviation Measurement

32. At data terminal keyboard:

    Enter **CFR:CELL** a,RA n**; BASEB 106**
    Response: **ALL WENT WELL**

    Enter **CFR:CELL** a,RA n**; BASEB 101**
    Response: **ALL WENT WELL**

33. At the Communications Service Monitor (CSM) display set **DISPLAY** to **METER**, **MODULATION** to **FM2**, and **DEV** to **6 kHz**.

34. From the Cathode Ray Tube (CRT) display of the Communications Service Monitor (CSM), read **DEV in kHz**

35. Is measured peak frequency deviation within the limits shown in Table 12-4?

Table 12-4. Peak Frequency Deviation Limits

Network Transmission Level –TX (dB)*	**Peak Frequency Deviation (kHz)** **Nominal**	**Lower Limit**	Upper Limit
+3	5.47	4.99	5.95
+2	5.16	4.71	5.61
+1	4.87	4.45	5.32
0	4.60	4.20	5.00
–1	4.34	3.96	4.72
–2	4.10	3.74	4.46
–3	3.87	3.53	4.21
–4	3.65	3.33	3.97
–5	3.45	3.15	3.75
–6	3.26	2.98	3.54
–7	3.07	2.80	3.34
–8	2.90	2.65	3.15
–9	2.74	2.50	2.98
–10	2.59	2.36	2.82
–11	2.44	2.23	2.65
–12	2.31	2.11	2.51
–13	2.18	1.99	2.37

Table 12-4. Peak Frequency Deviation Limits (Contd)

Network Transmission	**Peak Frequency Deviation (kHz)**		
–14	2.05	1.87	2.23
–15	1.94	1.77	2.11
.*The Network Transmission Level - TX 9 (dB) is the value located in the Cell Site data base, *cell dB*, "Network Transmission Level - TX" in the RC/V (Recent Change & Verify) subsystem.			

If **YES**, then record in Cell Site Log as **PEAK FREQUENCY DEVIATION DUE TO 1004 Hz MODULATION AT -16 dBm** and do Step 36. If **NO**, then continue to Step 35.

36. Replace the Radio Channel Unit (RCU) and repeat this procedure.
37. At data terminal keyboard:

    Enter **CFR:CELL** a,RA n**; BASEB 102**
    Response: **ALL WENT WELL**

    Enter **CFR:CELL** a,RA n**; BASEB 100**
    Response: **ALL WENT WELL**

38. At CSM, set **DEV-PWR** to **20 kHz**.
39. From Cathode Ray Tube (CRT) of CSM, read **DEV in kHz**.
40. Is measured peak frequency deviation less than or equal to the **12 kHz maximum** limit?

    If **YES**, then record in Log as **PEAK FREQUENCY DEVIATION DUE TO 1004 Hz MODULATION AT 0 dBm** and do Step 41. If **NO**, then continue to Step 40.

41. Replace the Radio Channel Unit (RCU) and repeat this procedure.
42. At data terminal keyboard:

    Enter **CFR:CELL** a,RA n**; BASEB 102**
    Response: **ALL WENT WELL**

43. At data terminal keyboard:

    Enter **CFR:CELL** a,RA n**; BASEB 112**
    Response: **ALL WENT WELL**

44. At CSM, set **DEV-PWR** to **6 kHz**.
45. From CRT of CSM, read **DEV in kHz**.
46. Is measured peak frequency deviation within the **1.75** to **2.25 kHz** limits?

If **YES**, then record in Log as **PEAK FREQUENCY DEVIATION DUE TO SAT** and do Step 47. If **NO**, then continue to Step 46.

47. Replace the Radio Channel Unit (RCU) and repeat this procedure.
48. At data terminal keyboard:

    Enter **CFR:CELL** a,RA n**; BASEB 113**
    Response: **ALL WENT WELL**

    Data 10 kHz Deviation Measurement

49. At data terminal keyboard:

    Enter **CFR:CELL** a,RA n**; ECODC 201**
    Response: **ALL WENT WELL**

50. At the Communications Service Monitor (CSM), set **DEV/PWR** to **20 kHz** and **MODULATION** to **FM3**.
51. Is measured peak frequency deviation within **7.0 to 9.0 kHz** limits?

    If **YES**, then record in Cell Site Log as **PEAK FREQUENCY DEVIATION DUE TO 10 kHz** and do Step 52. If **NO**, then continue to Step 51.

52. Replace the Radio Channel Unit (RCU) and repeat this procedure.
53. Remove transmission test set from J3.
54. At data terminal keyboard:

    Enter **CFR:CELL** a,RA n**; ECODC 202**
    Response: **ALL WENT WELL**

    Enter **STOP:DGN;CELL** a,RA n
    Response: **OOS, MANUAL, RMVD**

    Enter **RST:CELL** a,RA n

NOTE:
This procedure must be repeated for each voice channel to be tested.

55. Is this the last voice channel to be tested?

    If **YES**, then continue to Step 55. If **NO**, then go to Pretest.

Post Test Procedure

56. In Cell Site Log, record test equipment model, serial number, and calibration date. Record Federal Communications Commission (FCC) radio telephone license number, its expiration date, the date of test, and then sign the Log.
57. Remove and store all test equipment and test cables.
58. STOP. YOU HAVE COMPLETED THIS PROCEDURE.

Transmitter Output Power Verification

NOTE:
Output power is measured at jack J3 on the Radio Test Unit (RTU) switch panel.

1. Verify that the cell's Radio Channel Unit (RCU) equipage per transmitter [Linear Amplifier Circuit (LAC)] agrees with the Cell Site Test Record Sheets. Update the sheets with the added Digital Radio Units (DRUs).
2. Specify and verify that the DRU output power is different from the RCU.

NOTE:
When determining the maximum number of radios that are assigned to a LAC, each DRU should be counted as 1.5 units, and each RCU should be counted as 1.0 units. Ensure that the units added to each transmitter (LAC) does not exceed the LAC's maximum allowable output power.

1. If the Cell Site Test Record Sheet is inaccurate or missing, verify that the transmitter's (LAC) maximum allowable output power is not exceeded.

Transmitter Output Power Adjustment

2. 1. Connect a test cable of known loss between the CSTS RF IN/OUT jack and jack J3 on the RTU switch panel.

NOTE:
The CSTS is operated in the manual mode during this subsection.

3. On the CSTS at the Lucent TESTS menu, press EXIT to set the CSTS to the manual mode. While in the manual mode, perform the following procedures:
   a. Press RESET.
   b. Select and punch TO SCREEN - SPEC ANL.
   c. Select and punch CENTER FREQ.
   d. Enter 882 via the DATA keys, and press ENTER.
   e. Select and punch REF LEVEL.
   f. Enter -10 via the DATA keys, and press ENTER.
   g. Select and punch SPAN.
   h. Enter 30 via the DATA keys, and press ENTER.
   i. Select and punch CONTROLS - MAIN.
   j. Under CHOICES, select and punch AUXILIARY.
   k. Select and punch CONTROLS - NO PK/AVG.
   l. Under CHOICES, select and punch AVG 10.

4. Enter the value of the RF IN/OUT test cable's loss into the CSTS as follows:
   a. Press SHIFT.
   b. Press DUPLEX.
   c. Select and punch CONFIGURE - RF LEVEL OFFSET. (ON should be underscored.)
   d. Select and punch CONFIGURE - RF IN/OUT.
   e. Enter the value of the test cable's loss (as a negative number) via the DATA keys, and press ENTER.
   f. Press PREV.
5. Choose an AMPS RCU that is assigned to the same transmitter (LAC) as that of the DRU under test.

NOTE:
The RCU is used as a reference radio for the DRU under test. Choose an RCU that is set to the same full power level value (0 VRAL) to that in which the DRU under test will be adjusted.

6. Configure the reference RCU under test for full power output as follows:

NOTE:
After each MSC command input, wait for the MSC response message: ALL WENT WELL.

RMV:CELL x,RA y;UCL (where x=cell number; y=radio number)
CFR:CELL x,RA y;START
CFR:CELL x,RA y;CONFIG 150
CFR:CELL x,RA y;XMITC 300
CFR:CELL x,RA y;VRADPC 357

7. Configure the RCU under test for full power output as follows: After each MSC command input, wait for the MSC response message: ALL WENT WELL.

RMV:CELL x,RA y;UCL (where x=cell number; y=radio number)
CFR:CELL x,RA y;START
CFR:CELL x,RA y;CONFIG 150
CFR:CELL x,RA y;XMITC 300
CFR:CELL x,RA y;VRADPC 357

8. Ensure that the DRU under test's AUTO/OFF switch is set to AUTO.
9. Identify the reference RCU and the DRU under test on the CSTS's display.

NOTE:
If multiple radios are in service, their signals will also be present on the display. Momentarily set the RCU's and/or DRU's AUTO/OFF switch to OFF to help to identify the signals.

10. On the Lucent CSTS, perform the following procedures:
    a. Select and punch CONTROLS - AUXILIARY.
    b. Under CHOICES, select and punch MARKER.
    c. Select and punch MARKER TO - NEXT PEAK multiple times until the display's marker is positioned on the peak of the reference RCU's signal.
    d. Record the MARKER LVL (dbm) as displayed on the CSTS's display (upper right corner).
    e. Select and punch MARKER TO - NEXT PEAK multiple times until the display's marker is positioned on the peak of the DRU under test's signal.
11. Slowly adjust the potentiometer on the front of the DRU under test until the DRU's signal level matches the reference RCU's level as displayed by MARKER LVL.

NOTE:
Because of the video averaging effect, the CSTS's response to adjusting the DRU's level is delayed. To improve the response, press MEAS RESET during the measurement.

12. Set the DRU under test's AUTO/OFF switch to OFF.
13. Repeat Step 6 through Step 12 under the Transmitter Output Power Adjustment section for all other newly installed DRUs that are assigned to the transmitter (LAC) under test.
14. Terminate the reference RCU as follows:

STOP:CFR;CELL X,RA Y (where X=cell number; Y=radio number)
RST:CELL X,RA Y;UCL

Table 12-5. Channel Number Center Frequencies

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
1	870.030	825.030	44	871.320	826.320
2	870.060	825.060	45	871.350	826.350
3	870.090	825.090	46	871.380	826.380
4	870.120	825.120	47	871.410	826.410
5	870.150	825.150	48	871.440	826.440
6	870.180	825.180	49	871.470	826.470
7	870.210	825.210	50	871.500	826.500
8	870.240	825.240	51	871.530	826.530
9	870.270	825.270	52	871.560	826.560
10	870.300	825.300	53	871.590	826.590
11	870.330	825.330	54	871.620	826.620
12	870.360	825.360	55	871.650	826.650
13	870.390	825.390	56	871.680	826.680
14	870.420	825.420	57	871.710	826.710
15	870.450	825.450	58	871.740	826.740
16	870.480	825.480	59	871.770	826.770
17	870.510	825.510	60	871.800	826.800
18	870.540	825.540	61	871.830	826.830
19	870.570	825.570	62	871.860	826.860
20	870.600	825.600	63	871.890	826.890
21	870.630	825.630	64	871.920	826.920
22	870.660	825.660	65	871.950	826.950
23	870.690	825.690	66	871.980	826.980
24	870.720	825.720	67	872.010	827.010
25	870.750	825.750	68	872.040	827.040
26	870.780	825.780	69	872.070	827.070
27	870.810	825.810	70	872.100	827.100

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
28	870.840	825.840	71	872.130	827.130
29	870.870	825.870	72	872.160	827.160
30	870.900	825.900	73	872.190	827.190
31	870.930	825.930	74	872.220	827.220
32	870.960	825.960	75	872.250	827.250
33	870.990	825.990	76	872.280	827.280
34	871.020	826.020	77	872.310	827.310
35	871.050	826.050	78	872.340	827.340
36	871.080	826.080	79	872.370	827.370
37	871.110	826.110	80	872.400	827.400
38	871.140	826.140	81	872.430	827.430
39	871.170	826.170	82	872.460	827.460
40	871.200	826.200	83	872.490	827.490
41	871.230	826.230	84	872.520	827.520
42	871.260	826.260	85	872.550	827.550
43	871.290	826.290	86	872.580	827.580
87	872.610	827.610	129	873.870	828.870
88	872.640	827.640	130	873.900	828.900
89	872.670	827.670	131	873.930	828.930
90	872.700	827.700	132	873.960	828.960
91	872.730	827.730	133	873.990	828.990
92	872.760	827.760	134	874.020	829.020
93	872.790	827.790	135	874.050	829.050
94	872.820	827.820	136	874.080	829.080
95	872.850	827.850	137	874.110	829.110
96	872.880	827.880	138	874.140	829.140
97	872.910	827.910	139	874.170	829.170

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
98	872.940	827.940	140	874.200	829.200
99	872.970	827.970	141	874.230	829.230
100	873.000	828.000	142	874.260	829.260
101	873.030	828.030	143	874.290	829.290
102	873.060	828.060	144	874.320	829.320
103	873.090	828.090	145	874.350	829.350
104	873.120	828.120	146	874.380	829.380
105	873.150	828.150	147	874.410	829.410
106	873.180	828.180	148	874.440	829.440
107	873.210	828.210	149	874.470	829.470
108	873.240	828.240	150	874.500	829.500
109	873.270	828.270	151	874.530	829.530
110	873.300	828.300	152	874.560	829.560
111	873.330	828.330	153	874.590	829.590
112	873.360	828.360	154	874.620	829.620
113	873.390	828.390	155	874.650	829.650
114	873.420	828.420	156	874.680	829.680
115	873.450	828.450	157	874.710	829.710
116	873.480	628.480	158	874.740	829.740
117	873.510	828.510	159	874.770	829.770
118	873.540	828.540	160	874.800	829.800
119	873.570	828.570	161	874.830	829.830
120	873.600	828.600	162	874.860	829.860
121	873.630	828.630	163	874.890	829.890
122	873.660	828.660	164	874.920	829.920
123	873.690	828.690	165	874.950	829.950
124	873.720	828.720	166	874.980	829.980

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
125	873.750	828.750	167	875.010	830.010
126	873.780	828.780	168	875.040	830.040
127	873.810	828.810	169	875.070	830.070
128	873.840	828.640	170	875.100	830.100
171	875.130	830.130	214	876.420	831.420
172	875.160	830.160	215	876.450	831.450
173	875.190	830.190	216	876.480	831.480
174	875.220	830.220	217	876.510	831.510
175	875.250	830.250	218	876.540	831.540
176	875.280	830.280	219	876.570	831.570
177	875.310	830.310	220	876.600	831.600
178	875.340	830.340	221	876.630	831.630
179	875.370	830.370	222	876.660	831.660
180	875.400	830.400	223	876.690	831.690
181	875.430	830.430	224	876.720	831.720
182	875.460	830.460	225	876.750	831.750
183	875.490	830.490	226	876.780	831.780
184	875.520	830.520	227	876.810	831.810
185	875.550	830.550	228	876.840	831.840
186	875.580	830.580	229	876.870	831.870
187	875.610	830.610	230	876.900	831.900
188	875.640	830.640	231	876.930	831.930
189	875.670	830.670	232	876.960	831.960
190	875.700	830.700	233	876.990	831.990
191	875.730	830.730	234	877.020	832.020
192	875.760	830.760	235	877.050	832.050
193	875.790	830.790	236	877.080	832.080

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
194	875.820	830.820	237	877.110	832.110
195	875.850	830.850	238	877.140	832.140
196	875.880	830.880	239	877.170	832.170
197	875.910	830.910	240	877.200	832.200
198	875.940	830.940	241	877.230	832.230
199	875.970	830.970	242	877.260	832.260
200	876.000	831.000	243	877.290	832.290
201	876.030	831.030	244	877.320	832.320
202	876.060	831.060	245	877.350	832.350
203	876.090	831.090	246	877.380	832.380
204	876.120	831.120	247	877.410	832.410
205	876.150	831.150	248	877.440	832.440
206	876.180	831.180	249	877.470	832.470
207	876.210	831.210	250	877.500	832.500
208	876.240	831.240	251	877.530	832.530
209	876.270	831.270	252	877.560	832.560
210	876.300	831.300	253	877.590	832.590
211	876.330	831.330	254	877.620	832.620
212	876.360	831.360	255	877.650	832.650
213	876.390	831.390	256	877.680	832.680
257	877.710	832.710	300	879.000	834.000
258	877.740	832.740	301	879.030	834.030
259	877.770	832.770	302	879.060	834.060
260	877.800	832.800	303	879.090	834.090
261	877.830	832.830	304	879.120	834.120
262	877.860	832.860	305	879.150	834.150
263	877.890	832.890	306	879.180	834.180

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
264	877.920	832.920	307	879.210	834.210
265	877.950	832.950	308	879.240	834.240
266	877.980	832.980	309	879.270	834.270
267	878.010	833.010	310	879.300	834.300
268	878.040	833.040	311	879.330	834.330
269	878.070	833.070	312	879.360	834.360
270	878.100	833.100	313	879.390	834.390
271	878.130	833.130	314	879.420	834.420
272	878.160	833.160	315	879.450	834.450
273	878.190	833.190	316	879.480	834.480
274	878.220	833.220	317	879.510	834.510
275	878.250	833.250	318	879.540	834.540
276	878.280	833.280	319	879.570	834.570
277	878.310	833.310	320	879.600	834.600
278	878.340	833.340	321	879.630	834.630
279	878.370	833.370	322	879.660	834.660
280	878.400	833.400	323	879.690	834.690
281	878.430	833.430	324	879.720	834.720
282	878.460	833.460	325	879.750	834.750
283	878.490	833.490	326	879.780	834.780
284	878.520	833.520	327	879.810	834.810
285	878.550	833.550	328	879.840	834.840
286	878.580	833.580	329	879.870	834.870
287	878.610	833.610	330	879.900	834.900
288	878.640	833.640	331	879.930	834.930
289	878.670	833.670	332	879.960	834.960
290	878.700	833.700	333	879.990	834.990

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
291	878.730	833.730	334	880.020	835.020
292	878.760	833.760	335	880.050	835.050
293	878.790	833.790	336	880.080	835.080
294	878.820	833.820	337	880.110	835.110
295	878.850	833.850	338	880.140	835.140
296	878.880	833.880	339	880.170	835.170
297	878.910	833.910	340	880.200	835.200
298	878.940	833.940	341	880.230	835.230
299	878.970	833.970	342	880.260	835.260
343	880.290	835.290	385	881.550	836.550
344	880.320	835.320	386	881.580	836.580
345	880.350	835.350	387	881.610	836.610
346	880.380	835.380	388	881.640	836.640
347	880.410	835.410	389	881.670	836.670
348	880.440	835.440	390	881.700	836.700
349	880.470	835.470	391	881.730	836.730
350	880.500	835.500	392	881.760	836.760
351	880.530	835.530	393	881.790	836.790
352	880.560	835.560	394	881.820	836.820
353	880.590	835.590	395	881.850	836.850
354	880.620	835.620	396	881.880	836.880
355	880.650	835.650	397	881.910	836.910
356	880.680	835.660	398	881.940	836.940
357	880.710	835.710	399	881.970	836.970
358	880.740	835.740	400	882.000	837.000
359	880.770	835.770	401	882.030	837.030
360	880.800	835.800	402	882.060	837.060

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
361	880.830	835.830	403	882.090	837.090
362	880.860	835.860	404	882.120	837.120
363	880.890	835.890	405	882.150	837.150
364	880.920	835.920	406	882.180	837.180
365	880.950	835.950	407	882.210	837.210
366	880.980	835.980	408	882.240	837.240
367	881.010	836.010	409	882.270	837.270
368	881.040	836.040	410	882.300	837.300
369	881.070	836.070	411	882.330	837.330
370	881.100	836.100	412	882.360	837.360
371	881.130	836.130	413	882.390	837.390
372	881.160	836.160	414	882.420	837.420
373	881.190	836.190	415	882.450	837.450
374	881.220	836.220	416	882.480	837.480
375	881.250	836.250	417	882.510	837.510
376	881.280	836.280	418	882.540	837.540
377	881.310	836.310	419	882.570	837.570
378	881.340	836.340	420	882.600	837.600
379	881.370	836.370	421	882.630	837.630
380	881.400	836.400	422	882.660	837.660
381	881.430	836.430	423	882.690	837.690
382	881.460	836.460	424	882.720	837.720
383	881.490	836.490	425	882.750	837.750
384	881.520	836.520	426	882.780	837.780
427	882.810	837.810	469	884.070	839.070
428	882.840	837.840	470	884.100	839.100
429	882.870	837.870	471	884.130	839.130

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
430	882.900	837.900	472	884.160	839.160
431	882.930	837.930	473	884.190	839.190
432	882.960	837.960	474	884.220	839.220
433	882.990	837.990	475	884.250	839.250
434	883.020	837.020	476	884.280	839.280
435	883.050	838.050	477	884.310	839.310
436	883.080	838.080	478	884.340	839.340
437	883.110	838.110	479	884.370	839.370
438	883.140	838.140	480	884.400	839.400
439	883.170	838.170	481	884.430	839.430
440	883.200	838.200	482	884.460	839.460
441	883.230	838.230	483	884.490	839.490
442	883.260	838.260	484	884.520	839.520
443	883.290	838.290	485	884.550	839.550
444	883.320	838.320	486	884.580	839.580
445	883.350	838.350	487	884.610	839.610
446	883.380	838.380	488	884.640	839.640
447	883.410	838.410	489	884.670	839.670
448	883.440	838.440	490	884.700	839.700
449	883.470	838.470	491	884.730	839.730
450	883.500	838.500	492	884.760	839.760
451	883.530	838.530	493	884.790	839.790
452	883.560	838.560	494	884.029	839.820
453	883.590	838.590	495	884.850	839.850
454	883.620	838.620	496	884.880	839.880
455	883.650	838.650	497	884.910	839.910
456	883.680	838.680	498	884.940	839.940

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
457	883.710	838.710	499	884.910	839.970
458	883.740	838.740	500	885.300	840.000
459	883.770	838.770	501	885.030	840.030
460	883.800	838.800	502	885.060	840.060
461	883.830	838.830	503	885.090	840.090
462	883.860	838.860	504	885.120	840.120
463	883.890	838.890	505	885.150	840.150
464	883.920	838.920	506	885.180	840.180
465	883.950	838.950	507	885.210	840.210
466	883.980	838.980	508	885.240	840.240
467	884.010	839.010	509	885.270	840.270
468	864.040	839.040	510	885.300	840.300
511	885.330	840.330	553	886.590	841.590
512	885.360	840.360	554	886.620	841.620
513	885.390	840.390	555	886.650	841.650
514	885.420	840.420	556	886.680	841.680
515	885.450	840.450	557	886.710	841.710
516	885.480	840.480	558	886.740	841.740
517	885.510	840.510	559	886.770	841.770
518	885.540	840.540	560	886.800	841.800
519	885.570	840.570	561	886.630	841.830
520	885.600	840.600	562	886.860	841.860
521	885.630	840.630	563	886.890	841.890
522	885.660	840.660	564	886.920	841.920
523	885.690	840.690	565	886.950	841.950
524	685.720	840.720	566	886.980	841.980
525	885.750	840.750	567	887.010	842.010

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
526	885.780	840.780	568	887.040	842.040
527	885.810	840.810	569	887.070	842.070
528	885.840	840.840	570	887.100	842.100
529	885.870	840.870	571	887.130	842.130
530	885.900	840.900	572	887.160	842.160
531	885.930	840.930	573	887.190	842.190
532	885.960	840.960	574	887.220	842.220
533	885.990	840.990	575	887.250	842.250
534	886.020	841.020	576	887.280	842.280
535	886.050	841.050	577	887.310	842.310
536	886.080	841.080	578	887.340	842.340
537	886.110	841.110	579	887.370	842.370
538	886.140	841.140	580	887.400	842.400
539	886.170	841.170	581	887.430	842.430
540	886.200	841.200	582	887.460	842.460
541	886.230	841.230	583	887.490	842.490
542	886.260	841.260	584	887.520	842.520
543	886.290	841.290	585	887.550	842.550
544	886.320	841.320	586	887.580	842.580
545	886.350	841.350	587	887.610	842.610
546	886.380	841.380	588	887.640	842.640
547	886.410	841.410	589	887.670	842.670
548	886.440	841.440	590	887.700	842.700
549	886.470	841.470	591	887.730	842.730
550	886.500	841.500	592	887.760	842.760
551	886.530	841.530	593	887.790	842.790
552	886.560	841.560	594	887.820	842.820

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
595	887.850	842.850	636	889.080	844.080
596	887.880	842.880	637	889.110	844.110
597	887.910	842.910	638	889.140	844.140
598	887.940	842.940	639	889.170	844.170
599	887.970	842.970	640	889.200	844.200
600	888.000	843.000	641	889.230	844.230
601	886.030	843.030	642	889.260	844.260
602	888.060	843.060	643	889.290	844.290
603	888.090	843.090	644	889.320	844.320
604	888.120	843.120	645	889.350	844.350
605	888.150	843.150	646	889.380	844.380
606	888.180	843.180	647	889.410	844.410
607	888.210	843.210	648	889.440	844.440
608	888.240	843.240	649	889.470	844.470
609	888.270	843.270	650	889.500	844.500
610	888.300	843.300	651	889.530	844.530
611	888.330	843.330	652	889.560	844.560
612	888.360	843.360	653	889.590	844.590
613	888.390	843.390	654	889.620	844.620
614	888.420	843.420	655	889.650	844.650
615	888.450	843.450	656	889.680	844.680
616	888.480	843.480	657	889.710	844.710
617	888.510	843.510	658	889.740	844.740
618	888.540	843.540	659	889.770	844.770
619	886.570	843.570	660	889.800	844.800
620	888.600	843.600	661	889.830	844.830
621	888.630	843.630	662	869.860	844.860

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
622	888.660	843.660	663	689.890	844.890
623	886.690	843.690	664	889.920	844.920
624	888.720	843.720	665	889.950	844.950
625	888.750	843.750	666	689.980	844.980
626	888.780	843.780	667	890.010	845.010
627	888.810	843.810	668	890.040	845.040
628	888.840	843.840	669	890.070	845.070
629	888.870	843.870	670	890.100	845.100
630	888.900	843.900	671	890.130	845.130
631	888.930	843.930	672	890.160	845.160
632	888.960	843.960	673	890.190	845.190
633	888.990	843.990	674	890.220	845.220
634	889.020	844.020	675	890.250	845.250
635	889.050	844.050	676	890.280	845.200
677	890.310	845.310	718	891.540	846.540
678	890.340	845.340	719	891.570	846.570
679	890.370	845.370	720	891.600	846.600
680	890.400	845.400	721	891.630	846.630
681	890.430	845.430	722	891.660	846.660
682	890.460	845.460	723	891.690	846.690
683	890.490	845.490	724	891.720	846.720
684	890.520	845.520	725	891.750	846.750
685	890.550	845.550	726	891.780	846.780
686	890.580	845.580	727	891.810	846.810
687	890.610	845.610	728	891.840	846.840
688	890.640	845.640	729	891.870	846.870
689	890.670	845.670	730	891.900	846.900

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
690	890.700	845.700	731	891.930	846.930
691	890.730	845.730	732	891.960	846.960
692	890.760	845.760	733	891.990	846.990
693	890.790	845.790	734	892.020	847.020
694	890.820	845.820	735	892.050	847.050
695	890.850	845.850	736	892.080	847.080
696	890.680	845.880	737	892.110	847.110
697	890.910	845.910	738	892.140	847.140
698	890.940	845.940	739	892.170	847.170
699	890.970	845.970	740	892.200	847.200
700	891.000	846.000	741	892.230	847.230
701	891.030	848.030	742	892.260	847.260
702	891.060	846.060	743	892.290	847.290
703	891.090	846.090	744	892.320	847.320
704	891.120	846.120	745	892.350	847.350
705	891.150	846.150	746	892.380	847.380
706	891.180	846.180	747	892.410	847.410
707	891.210	846.210	748	892.440	847.440
708	891.240	846.240	749	892.470	847.470
709	891.270	846.270	750	892.500	847.500
710	891.300	846.300	751	892.530	847.530
711	891.330	846.330	752	892.560	847.580
712	891.360	846.360	753	892.590	847.590
713	891.390	846.390	754	892.620	847.620
714	891.420	846.420	755	892.650	847.650
715	891.450	846.450	756	892.680	847.680
716	891.480	846.480	757	892.710	847.710

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
717	891.510	846.510	758	892.740	847.740
759	892.770	847.770	796	893.860	848.860
760	892.800	847.800	797	893.910	848.910
761	892.830	847.830	798	893.940	848.940
762	892.860	847.860	799	893.970	848.970
763	892.890	847.890	991	869.040	824.040
764	892.920	847.920	992	869.070	824.070
765	892.950	847.950	993	869.100	824.100
766	892.980	847.980	994	869.130	824.130
767	893.010	848.010	995	869.160	824.160
768	893.040	848.040	996	869.190	824.190
769	893.070	848.070	997	869.220	824.220
770	893.100	848.100	998	869.250	824.250
771	893.130	848.130	999	869.280	824.280
772	893.160	848.160	1000	869.310	824.310
773	893.190	848.190	1001	869.340	824.340
774	893.220	848.220	1002	869.370	824.370
775	893.250	848.250	1003	869.400	824.400
776	893.280	848.280	1004	869.430	824.430
777	893.310	848.310	1005	869.460	824.460
778	893.340	848.340	1006	869.490	824.490
779	893.370	848.370	1007	869.520	824.520
780	893.400	848.400	1008	869.550	824.550
781	893.430	848.430	1009	869.580	824.580
782	893.460	848.460	1010	869.610	824.610
783	893.490	848.490	1011	869.640	824.640
784	893.520	848.520	1012	869.670	824.670

Table 12-5. Channel Number Center Frequencies (Contd)

Channel Number	Center Freq(MHz) Cell Site	Subscriber	Channel Number	Center Freq (MHz) Cell Site	Subscriber
785	893.550	848.550	1013	869.700	824.700
786	893.580	848.580	1014	869.730	824.730
787	893.610	848.610	1015	869.760	824.760
788	893.640	848.640	1016	869.790	824.790
789	893.670	848.670	1017	869.820	824.820
790	893.700	848.700	1018	869.850	824.850
791	893.730	848.730	1019	869.880	824.880
792	893.760	848.760	1020	869.910	824.910
793	893.790	848.790	1021	869.940	824.940
794	893.820	848.820	1022	869.970	824.970
795	893.850	848.850	1023	870.000	825.000

Table 12-6. Watts-to-dBm

Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm
0.50	27.0	1.32	31.2	3.55	35.5	9.77	39.9
0.51	27.1	1.35	31.3	3.63	35.6	10.0	40.0
0.52	27.2	1.38	31.4	3.72	35.7	10.2	40.1
0.54	27.3	1.41	31.5	3.80	35.8	10.4	40.2
0.55	27.4	1.45	31.6	3.89	35.9	10.7	40.3
0.56	27.5	1.48	31.7	3.98	36.0	10.9	40.4
0.50	27.6	1.51	31.0	4.07	36.1	11.22	40.5
0.59	27.7	1.55	3.19	4.17	36.2	11.48	40.6
0.60	27.8	1.58	32.0	4.27	36.3	11.75	40.7
0.62	27.9	1.62	32.1	4.37	36.4	12.02	40.8
0.63	28.0	1.66	32.2	4.47	36.5	12.30	40.9
0.65	28.1	1.70	32.3	4.57	36.6	12.59	41.0
0.66	28.2	1.74	32.4	4.68	36.7	12.88	41.1
0.68	28.3	1.78	32.5	4.79	36.8	13.18	41.2
0.69	28.4	1.82	32.6	4.90	36.9	13.49	41.3

Table 12-6. Watts-to-dBm (Contd)

Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm
0.71	28.5	1.86	32.7	5.01	37.0	13.80	41.4
0.72	28.6	1.91	32.8	5.13	37.1	14.13	41.5
0.74	28.7	1.95	32.9	5.25	37.2	14.45	41.6
0.76	28.8	2.00	33.0	5.37	37.3	14.79	41.7
0.78	28.9	2.04	33.1	5.50	37.4	15.14	41.8
0.79	29.0	2.09	33.2	5.62	37.5	15.49	41.9
0.81	29.1	2.14	33.3	5.75	37.6	15.85	42.0
0.83	29.2	2.19	33.4	5.89	37.7	16.22	42.1
0.85	29.3	2.24	33.5	6.03	37.8	16.60	42.2
0.87	29.4	2.29	33.6	6.17	37.9	16.98	42.3
0.89	29.5	2.34	33.7	6.31	38.0	17.38	42.4
0.91	29.6	2.40	33.8	6.46	38.1	17.78	42.5
0.93	29.7	2.45	33.9	6.61	30.2	18.20	42.6
0.95	29.8	2.51	34.0	6.76	38.3	18.62	42.7
0.90	29.9	2.57	34.1	6.92	38.4	19.05	42.8
1.00	30.0	2.63	34.2	7.08	38.5	19.50	42.9
1.02	30.1	2.69	34.3	7.24	38.6	19.95	43.0
1.05	30.2	2.75	34.4	7.41	38.7	20.89	43.2
1.07	30.3	2.82	34.5	7.59	38.8	21.38	43.3
1.10	30.4	2.95	34.7	7.76	38.9	21.88	43.4
1.12	30.5	3.02	34.8	7.94	39.0	22.39	43.5
1.15	30.6	3.09	34.9	8.32	39.2	22.91	43.6
1.17	30.7	3.16	35.0	8.51	39.3	23.44	43.7
1.20	30.8	3.24	35.1	8.71	39.4	23.99	43.8
1.23	30.9	3.31	35.2	8.91	39.5	24.55	43.9
1.26	31.0	3.39	35.3	9.12	39.6	25.12	44.0
1.29	31.1	3.47	35.4	9.55	39.8	25.70	44.1
26.30	44.2	70.79	48.5	186.20	52.7	26.30	44.2
26.92	44.3	72.44	48.6	190.54	52.8	26.92	44.3
27.54	44.4	74.13	48.7	194.98	52.9	27.54	44.4
28.18	44.5	75.85	48.8	199.52	53.0	28.18	44.5
28.84	44.6	77.62	48.9	204.17	53.1	28.84	44.6
29.51	44.7	79.43	49.0	208.92	53.2	29.51	44.7

Table 12-6. Watts-to-dBm (Contd)

Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm
30.90	44.9	81.28	49.1	213.79	53.3	30.90	44.9
31.62	45.0	83.17	49.2	218.77	53.4	31.62	45.0
32.36	45.1	85.11	49.3	223.87	53.5	32.36	45.1
33.11	45.2	87.09	49.4	229.08	53.6	33.11	45.2
33.88	45.3	89.12	49.5	234.42	53.7	33.88	45.3
34.67	45.4	91.20	49.6	239.88	53.8	34.67	45.4
35.48	45.5	93.32	49.7	245.47	53.9	35.48	45.5
36.31	45.6	95.49	49.8	251.18	54.0	36.31	45.6
37.15	45.7	97.72	49.9	263.02	54.2	37.15	45.7
38.02	45.8	100.00	50.0	269.15	54.3	38.02	45.8
38.90	45.9	102.32	50.1	275.42	54.4	38.90	45.9
39.81	46.0	104.71	50.2	281.83	54.5	39.81	46.0
40.74	46.1	107.15	50.3	288.40	54.6	40.74	46.1
41.69	46.2	109.64	50.4	295.12	54.7	41.69	46.2
42.66	46.3	112.20	50.5	301.99	54.8	42.66	46.3
43.65	46.4	114.81	50.6	309.02	54.9	43.65	46.4
44.67	46.5	117.48	50.7	316.22	55.0	44.67	46.5
45.71	46.6	120.22	50.8	323.59	55.1	45.71	46.6
46.77	46.7	123.02	50.9	331.13	55.2	46.77	46.7
47.86	46.8	125.89	51.0	338.84	55.3	47.86	46.8
48.98	46.9	128.82	51.1	346.73	55.4	48.98	46.9
50.11	47.1	131.82	51.2	354.81	55.5	50.11	47.1
51.28	47.1	134.89	51.3	363.07	55.6	51.28	47.1
52.48	47.2	138.03	51.4	371.53	55.7	52.48	47.2
53.70	473	141.25	51.5	380.18	55.8	53.70	473
54.95	47.4	144.54	51.6	389.04	55.9	54.95	47.4
56.23	47.5	147.91	51.7	398.10	56.0	56.23	47.5
57.54	47.6	151.35	51.8	407.38	56.1	57.54	47.6
58.88	47.7	154.88	51.9	416.86	56.2	58.88	47.7
60.25	47.8	158.48	52.0	426.57	56.3	60.25	47.8
61.65	47.9	162.18	52.1	436.51	56.4	61.65	47.9
63.09	48.0	165.95	52.2	446.68	56.5	63.09	48.0

Table 12-6. Watts-to-dBm (Contd)

Watts	dBm	Watts	dBm	Watts	dBm	Watts	dBm
66.06	48.2	173.78	52.4	467.73	56.7	66.06	48.2
67.60	48.3	177.82	52.5	478.63	56.8	67.60	48.3
69.18	48.4	181.97	52.6	489.77	56.9	69.18	48.4

Table 12-7. Cell Site Station Log Format (Sheet 1 of 2)

AUTOPLEX® Cell Site TEST RECORD													
										Date _________			
										Page 1 of _____			
Cell Site Identification _________________ Operator's Signature _____________													
Equipment Used _____________________ Calibration Date ______________													
Signal level at the J3 port of the RTU Switch Panel for LAC 0 _________ dBm													
Radio ID				Carrier		Power Level				Peak Frequency Deviation			
				Frequency									
R	S	S	Chan	Channel	Meas	Foam	Foam	Input	Eff	1004	1004	SAT	10 kHz
C	H	L	No	Frequency	Freq	Jmpr	Jmpr	to TX	Rad	-16	0.0	kHz	0 dBm
F	E	O		MHz	Err	Watts	dBm	Ant	Pwr	dBm	dBm		kHz
	L	T			Hz			dBm	(ERP)	kHz	kHz		
	F												
(1)				(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SETUP - RCUs													
VOICE - RCUs													

Table 12-7. Cell Site Station Log Format (Contd) (Sheet 1 of 2)

AUTOPLEX® Cell Site TEST RECORD													

Table 12-8. Cell Site Station Log Format (Sheet 2 of 2)

AUTOPLEX® Cell Site TEST RECORD													
(continued)													
Page _____ of _____													
Radio ID				Carrier Frequency		Power Level				Peak Frequency Deviation			
R C F	S H E L F	S L O T	Chan No	Channel Frequency MHz	Meas Freq Err Hz	Foam Jmpr Watts	Foam Jmpr dBm	Input to TX Ant dBm	Eff Rad Pwr (ERP)	1004 -16 dBm kHz	1004 0.0 dBm kHz	SAT kHz	10 kHz 0 dBm kHz
(1)				(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VOICE - RCUs													

Table 12-8. Cell Site Station Log Format (Contd)(Sheet 2 of 2)

AUTOPLEX® Cell Site TEST RECORD													

Enhanced Maintenance Features

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Improved Boot Read-Only Memory (ROM) / Non-Volatile Memory (NVM) Update

Radio hardware self-identification is built into the Boot ROMs of the SBRCU, DRU, and EDRU. They are all capable of returning codes that identify their hardware type. Using this information, NVM updates are now performed as follows:

- The decision is made at the MSC to perform an NVM update.
- The Executive Cellular Processor (ECP) requests the Radio Control Complex (RCC) at the Cell Site (CS) to identify the radio's hardware type.
- The RCC sends a command to read the radio's Boot ROM and returns the code identifying the radio's hardware type to the ECP. The SBRCU, DRU, and EDRU all return their unique identifier codes. Because of its older technology, the RCU will not respond. The NVM update process takes this into account.
- The RCC returns the radio's hardware identification to the ECP.
- The ECP downloads the NVM image.

If the hardware identification received by the ECP does not match the type stored in the NVM DataBase, the NVM update is not performed.

For existing radios, this feature ensures that no radio is put out of service or damaged because of an incorrect NVM. For the installation of future radios, this feature supports the use of various differing radio technologies with the assurance that their NVM updates will be performed correctly.

The MSC software subsystems affected by the improved Boot ROM / NVM Update are RCV, TR, TI, and NVM.

NVM Image for Single-Board RCU (SBRCU)

The improved Boot ROM / NVM Update feature also supports the SBRCU and greatly increases its capacity. The SBRCU has 64K of RAM. The RCU has 16K of RAM. Previously, because the SBRCU did not have an NVM image of its own, it used the RCU image.

After the RCU image was downloaded into the SBRCU, the SBRCU was left with 48K of RAM (64 - 16 = 48). This 48K of RAM was left unusable because as far as the RCU’s NVM image was concerned it did not exist. The 48K RAM was not recognized by the RCU’s NVM image and could not be accessed and used for enhancements or new AMPS features. The new SBRCU image can recognize and therefore utilize all of the SBRCU’s RAM and can, therefore, support and implement enhancements and new features developed for the SBRCU.

Keying Multiple RCU Transmitters

Starting with Series II Cell Site Release 4.3, the CFR command provided the capability to turn on transmitters of several Radio Channel Units (RCUs) simultaneously. The following options are available:

- Turn on any number (one to all) of RCU transmitters of a cell site by executing several **CONFIG** options sequentially.
- A single **CONFIG** option can specify adding/removing all the RCUs on a specified transmit face having a Linear Amplifier Circuit (LAC) and/or Lightwave Microcell Transceiver (LMT).
- A single **CONFIG** option can specify adding/removing up to 16 individual RCUs.

The cell site software stores the operational state of each RCU, then removes the RCU from service. At the end of the session, all the RCUs that are in the session are unconditionally restored to the operational state at the time they were last added to the session. When multiple RCUs are turned on, only the **CONFIG, VRADPC, XMITC, START,** and **STOP** options are supported. All the RCUs in the session are given the same treatment for the **XMITC** and **VRADPC** options.

Opening Transmit and Receive Audio

Release 4.3 also supports an additional option of the **CFR** command that allows the opening of the RCU transmit/receive audio while maintaining the voice connections to a specified DS1/DS0. The RCU under test has to be out-of-service. This feature connects the Voice RCU (V-RCU) to a specified DS0/1. The cell ensures that the specified DS0/1 is unassigned or is currently assigned to the specified RCU. This feature can perform receiver sensitivity tests and can verify the effect of network transmission and receive level parameters in translations.

Cell Site Power Measurements

Beginning with Release 4.3, the cell site can perform transmit and receive power level measurements at the specified Radio Frequency (RF) levels and report them to the Mobile Switching Center (MSC). The request is issued by the **MEAS:CELL** command, which supports various options including the RF level and **EXT**. The **EXT** option allows the use of external test equipment to generate the test signal or to detect the RCU signal. When **EXT** is not specified, the Radio Test Unit (RTU) generates and detects the test signal.

The feature also supports a range of RCUs to perform the measurements. For each requested RCU, the feature sequentially repeats the following process at the cell site:

1. Stores the current operational state of the first requested RCU
2. Performs the specified measurements using the RTU
3. Reports measurements to the user
4. Unconditionally restores the RCU to its original operational state.

Transmit and Receive Audio Level Measurements

The **MEAS** command performs transmit/receive audio level measurements and reports them to the user. The system Clock and Tone (CAT) board provides the specified tone and measures the audio level unless the **EXT** option is specified. The cell reports the audio levels as measured by the CAT board.

The user can specify one of the following tones:

- 404 Hz at -16 dBm
- 1004 Hz at -16 dBm
- 1004 Hz at 0 dBm
- 2804 Hz at -16 dBm.

The feature also supports a range of RCUs to perform the measurements. The feature sequentially repeats the following process for each requested RCU. The cell site will:

- Store the current operational state of the first requested RCU
- Perform the specified measurements using the RTU and CAT
- Report measurements to the user
- Unconditionally restore the RCU to its original operational state.

When the **EXT** option is specified, an external audio signal (for example, mobile audio) can be injected or an external audio analyzer can be used to detect the audio levels.

Supervisory Audio and Signaling Tone Detection

The **MEAS** command is used for the detection of the Supervisory Audio Tone (SAT) and the Signaling Tone (ST). If the EXT option is specified, an external test signal has to be injected in the Voice-RCU receive path. Otherwise, the RTU generates the test RF signal with the specified SAT and/or ST. The cell reports for each SAT whether it was detected or not (reports no SAT, multiple SAT, or incorrect SAT).

As previously stated, measurements can be performed for a range of RCUs.

Remote Data Link Reconfiguration

Beginning with Release 4.3 there are two ways to update data link parameters: by Factory Installation Test System (FITS) and by cell data links (that is, from the MSC). While changing data link parameters from the MSC, the cell remains in service. However, at least one Core Processor Unit (CPU) must have the correct current data link options to keep the cell site in service. The new data link parameters are downloaded to the inactive (mate) CPU. A Radio Control Complex (that is, Cell Site Controller) side switch is then made, and the parameters are copied from the new active, updated CPU to the new mate CPU.

Corrective Maintenance - Introduction

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Contents

Maintenance Tools

This section explains the status reporting, diagnostic, and maintenance tools and procedures required to keep a cell site operating smoothly and to recover from any malfunction or other trouble that might occur that would damage the efficient operation of the cell site.

During routine operation of the cell site, if any malfunction or other trouble occurs and no automatic recovery action is taken, or automatic recovery action fails, then the technician must intercede and perform the necessary diagnostic and recovery procedures. Three of the interfaces that will help the technician maintain and restore the system are briefly discussed first, followed by specific procedures for particular cell site problems.

Status Display Pages

Status display pages are the principle interface between the technician/operator and the Series II cellular system. They allow the technician to view system status, generate status reports, enter commands, and receive system responses.

Status display pages are graphical displays that represent the hardware and software subsystems of the cell site and also display a nearly real-time status of all the cell sites serving the Executive Cellular Processor (ECP). Fault conditions received by the ECP for any of the cell sites on the network are indicated at the top of the status display page via colors and flashing indicators. The technician may then bring up a visual display of the particular cell site that issued the fault condition.

Status display pages allow the ECP technician do the following:

- Check the status of cell site hardware units
- Generate output reports on cell site hardware units
- Remove (deactivate
- Restore (activate)
- Switch cell site hardware units;
  - Inhibit
  - Allow
  - Run diagnostics on cell site hardware units.

The commands entered using the status display page are entered at the command line at the bottom of the status display page.

ECP Craft Shell

The ECP Craft Shell is another one of several software interfaces between the technician and the ECP. The same commands that are entered via status display pages may also be entered at the ECP Craft Shell. This section will describe customized commands that can be entered at either the ECP Craft Shell or at the command line at the bottom of a status display page.

This section describes entering customized commands at the ECP Craft Shell prompt or at the command line at the bottom of a status display page.

Maintenance Request Administrator

Maintenance activities for the cell site's primary and growth radio channel frames (RCFs) are done through a series of software subsystems that reside in the radio control complex (RCC). One such software subsystem is the maintenance request administrator (MRA), which provides maintenance personnel with control, routing, and diagnostic maintenance procedures.

MRA receives maintenance requests from the ECP, performs the maintenance activities associated with the requests, and returns the results and collected data (if any) to the ECP. MRA handles requests to return information about the cell site, to remove (deactivate) cell site equipment, to restore (activate) cell site equipment, to perform diagnostic tests on cell site equipment, and so on.

The MRA subsystem not only responds to external requests from the ECP, but also responds to internal requests submitted by other software subsystems, such as those performing automatic fault recovery or scheduled maintenance.

The rest of this section describes the Cell Site units that require maintenance, the types of maintenance states that exist, and the maintenance actions that can be taken.

Maintenance Units

Hardware elements in the primary and growth RCFs are identified in Table 14-1. The *NULL*, *c* (for conditional), *u* (for unconditional), *yes*, and *no* entries under the maintenance actions in the Maintenance Actions table indicate the possible maintenance actions for a give hardware element.

Table 14-1 does not list the Maintenance units where obtaining status is the only maintenance action possible. The units not mentioned are the LAC, RCG, RFG, RFTG, GPS, and OTU/LMT (microcell only).

A Series II Cell Site can have either an RFG or an RFTG, but not both. If the Cell Site has *no* CDMA radios, the RFG is installed; if the Cell Site has at least one CDMA radio, the RFTG is installed. An individual oscillator plug-in unit in the RFG or RFTG is denoted as RG (for reference generator) in the status display pages.

A BCR and its associated BIU and ACU form a CDMA radio set—the BBA (for BCR-BIU-ACU). For OA&M purposes, the BBA is treated as a single maintenance unit.

NOTE:
Unlike the AMPS or TDMA radio hardware, the CDMA radio hardware consists of an entire shelf of plug-in units.

Table 14-1. Cell Site Maintenance Units and Actions (Sheet 1 of 2)

		Maintenance Action					
Unit	**Subunit**	**Remove**	**Restore**	**Diagnose**	**Stop a Diagnostic**	**Switch to Redundant Unit**	**Obtain Status**
RCC*	NULL	c,u	c,u	yes	yes	yes	yes
RCC	CPU	no	no	yes	yes	no	no
RCC	MEM	no	no	yes	yes	no	no
RCC	NCI	no	no	yes	yes	no	no
RCC	CPI	no	no	yes	yes	no	no
RCC	AFI	no	no	yes	yes	no	no
CAT	NULL	c,u	c,u	yes	yes	yes	yes
DS1	NULL	c,u	c,u	yes	yes	no	yes
DFI	NULL	c,u	c,u	yes	yes	no	yes
DL	NULL	c,u	c,u	yes	yes	no	yes
S-RCU†	NULL	c,u	c,u	yes	yes	yes	yes

Table 14-1. Cell Site Maintenance Units and Actions (Contd) (Sheet 2 of 2)

Unit	Subunit	Maintenance Action					
		Remove	Restore	Diagnose	Stop a Diagnostic	Switch to Redundant Unit	Obtain Status
V-RCU‡	NULL	c,u	c,u	yes	yes	no	yes
L-RCU**	NULL	c,u	c,u	yes	yes	no	yes
S-SBRCU†	NULL	c,u	c,u	yes	yes	yes	yes
V-SBRCU‡	NULL	c,u	c,u	yes	yes	no	yes
L-SBRCU**	NULL	c,u	c,u	yes	yes	no	yes
RTU	NULL	c,u	c,u	yes	yes	no	yes
D-DRU††	NULL	u	u	yes	yes	no	yes
V-DRU‡	NULL	c,u	c,u	yes	yes	no	yes
B-DRU‡‡	NULL	u	u	yes	yes	no	yes
L-DRU**	NULL	c,u	c,u	yes	yes	no	yes
D-EDRU††	NULL	u	u	yes	yes	no	yes
V-EDRU‡	NULL	c,u	c,u	yes	yes	no	yes
B-EDRU‡‡	NULL	u	u	yes	yes	no	yes
TRTU	NULL	c,u	c,u	yes	yes	no	yes
SCT	NULL	c,u	c,u	yes	yes	yes	yes
CCC	NULL	c,u	c,u	yes	yes	no	yes
CCU	NULL	c,u	c,u	yes	yes	no	yes
CCU	CE	no	no	no	no	no	no
BBA	NULL	c,u	c,u	yes	yes	yes	yes
CRTU	NULL	c,u	c,u	yes	yes	no	yes

* The RCC is denoted as CSC (for Cell Site controller) in the status display pages.

† The S-RCU and S-SBRCU are denoted as SU (for setup radio) in the status display pages.

‡ The V-RCU, V-SBRCU, V-DRU, and V-EDRU are denoted as RA (for voice radio) in the status display pages.

** The L-RCU, L-SBRCU, and L-DRU are denoted as LC (for location radio) in the status display pages.

†† The D-DRU and D-EDRU are denoted as DCCH (for digital control channel radio) in the status display pages.

‡‡ A V-RCU or V-SBRCU may also be configured as a *beacon* radio, which is denoted as BC (for beacon radio) in the status display pages. A beacon radio transmits at a fixed power level and is instrumental in the TDMA mobile-assisted handoff procedure.

AMPS Radio Maintenance Units and Personality Types

For the RCU radio type, there is one non-volatile memory (NVM) image file for the setup radio (S-RCU), analog voice radio (V-RCU), and analog locate radio (L-RCU). At initialization, the RCC downloads the personality type and other specific parameter values to each RCU. There is another NVM image file for the RTU.

For the SBRCU radio type, there is one NVM image file for the S-SBRCU, V-SBRCU, and L-SBRCU. As of ECP Release 8.0, the Cell Site software downloads a new NVM image file to the SBRCU, separate and distinct from the NVM image file downloaded to the RCU.

Prior to ECP Release 8.0, the Cell Site downloaded the same NVM image file to both the RCU and SBRCU radio types.

The following list provides a brief description of each AMPS radio personality type (Refer to Figure 14-1):

- **Setup radio**: Performs the analog setup function—establishes calls via the analog control channel (ACC) with mobile subscribers using AMPS or IS-54B compliant TDMA/AMPS dual-mode mobiles.
- **Analog voice radio:** Performs the analog voice function—carries one over-the-air AMPS call.
- **Analog locate radio:** Performs the analog locate function—assists with handoffs when the established AMPS call can be better served by an adjacent sector or cell by measuring the signal strength and verifying the supervisory audio tone (SAT) of the mobile targeted for handoff.

An RCU or SBRCU having a voice radio personality may also have a beacon radio personality. Thus, an RCU or SBRCU can serve two functions concurrently: (1) carry an over-the-air AMPS call and (2) provide signal strength measurements for the TDMA mobile-assisted handoff (MAHO) procedure. Because the RF carrier power level remains fixed for beacon radios, the dual-personality RCU or SBRCU is ineligible for dynamic power control.

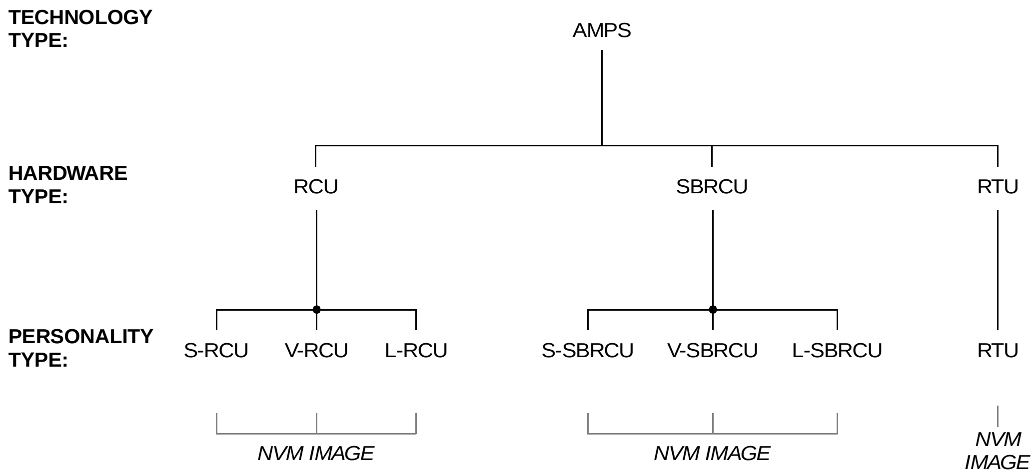

Figure 14-1. AMPS Radio Maintenance Units and Personality Type

TDMA Radio Maintenance Units and Personality Types

For the DRU radio type, there is one NVM image file for the digital control channel radio (D-DRU), digital voice radio (V-DRU), and digital beacon radio (B-DRU). At initialization, the RCC downloads the personality type and other specific parameter values to each DRU. There is another NVM image file for the digital locate radio (L-DRU), and still another for the TRTU.

For the EDRU radio type, there is one NVM image file for the D-EDRU, V-EDRU, and B-EDRU.

A DRU or EDRU provides a basic modulation efficiency of three user channels per 30-kHz of bandwidth. The three user channels are designated user channel 1, user channel 2, and user channel 3. Each user channel is assigned one trunk (DS0) on the T1 line and one duplex timeslot on the RCF internal TDM bus.

NOTE:
TDM buses are always installed "red stripe up."

The following list is a brief description of each TDMA radio personality type (Refer to Figure 14-2):

- **Digital voice radio**: Performs the digital traffic channel function—carries up to three over-the-air TDMA calls.

- **Digital control channel (DCCH) radio:** Performs the digital setup and short message service functions—establishes calls via the DCCH with mobile subscribers using IS-136 compliant TDMA/AMPS dual-mode mobiles. The DCCH is carried on user channel 1. Typically, there is one DCCH per physical antenna face, or sector, in a TDMA system.
- **Digital beacon radio:** Performs the digital beacon channel function—transmits at a fixed level at all times to provide signal strength measurements for the TDMA MAHO procedure. Typically, there is one beacon radio per physical antenna face in a TDMA system.
- **Digital locate radio**: Performs the digital locate channel function—assists with handoffs when the established TDMA call can be better served by an adjacent sector or cell by measuring the signal strength and verifying the digital verification color code (DVCC) of the IS-54B or IS-136 compliant TDMA/AMPS dual-mode mobile targeted for handoff. The digital locate radio is instrumental in the DVCC verification procedure.

A D-DRU or D-EDRU may also carry digital traffic and beacon channels. Thus, a D-DRU or D-EDRU can serve three functions concurrently: (1) perform the digital setup function—establish calls via the DCCH with mobile subscribers using IS-136 compliant TDMA/AMPS dual-mode mobiles, (2) carry one or two over-the-air TDMA calls, and (3) provide signal strength measurements for the TDMA MAHO procedure. Since the RF carrier power level remains fixed for DCCH radios, the D-DRU or D-EDRU is ineligible for dynamic power control.

The EDRU, unlike the DRU, will be able to carry more than one DCCH. That is, in a future release, an EDRU will be able carry one, two, or three DCCHs.

A B-DRU or B-EDRU may also carry digital traffic channels. Thus, a B-DRU or B-EDRU can serve two functions concurrently: (1) provide signal strength measurements for the TDMA MAHO procedure and (2) carry one, two, or even three over-the-air TDMA calls. (A digital beacon channel may double as a digital traffic channel.) Since the RF carrier power level remains fixed for beacon radios, the B-DRU or B-EDRU is ineligible for dynamic power control.

A V-DRU or V-EDRU may only carry digital traffic channels. A V-DRU or V-EDRU can carry one, two, or three digital traffic channels.

An L-DRU may only carry digital locate channels. An L-DRU can carry one, two, or three digital locate channels.

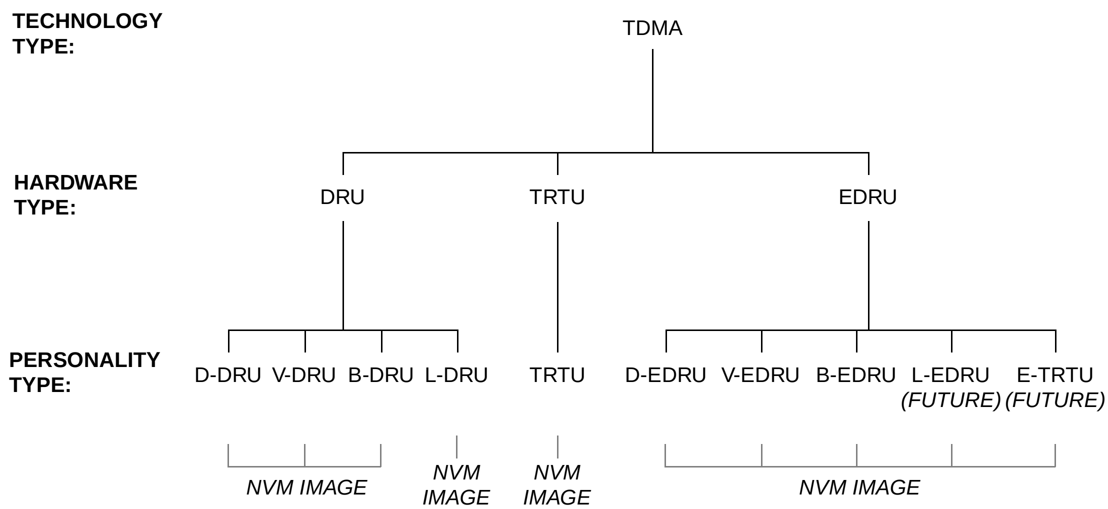

Figure 14-2. TDMA Radio Maintenance Units and Personality Types

CDMA Radio Maintenance Units and Personality Types

For each CDMA cluster (one CCC managing up to seven CCUs), there is one NVM image file for each of the following elements:

- the CCC
- the pilot/sync/access (P/S/A) CE personality
- the page CE personality
- the traffic CE personality
- the orthogonal-channel noise simulator (OCNS) CE personality.

At initialization, the CCC downloads the personality-type image files and other specific parameter values into active memory of the CCUs—the CCC downloads exactly one personality-type image file to each CCU CE. There is another NVM image file for the BBA, another for the CRTUi, and still another for the SCT.

The CCU contains two on-board CEs. Thus, a CCC can manage up to 14 CEs.

For the cellular band class (850 MHz), the TIA IS-95A standard defines two common carriers: the primary CDMA carrier, which is centered on RF channel 283 for System A (A band) and 384 for System B (B band), and the secondary CDMA carrier, which is centered on RF channel 691 for System A (A’ band) and 777 for System B (B’ band). Each CDMA omni cell or cell sector must be assigned at least one common carrier. For the PCS band class (1900 MHz), candidates for common CDMA carriers range from channel numbers 25 to 1175 in increments of 25.

Each common CDMA carrier (primary, secondary) on an antenna face has one CE configured as the P/S/A CE and another configured as the page CE. The two CEs may be on the same CCU or on different CCUs within the same CDMA cluster.

The following list provides a brief description of each CDMA CE personality type (Refer to Figure 14-3):

- **Pilot/Sync/Access CE:** Performs part of the CDMA call setup function—establishes calls with mobile subscribers using IS-95A or IS-95B compliant CDMA/AMPS dual-mode mobiles.

  The pilot channel is an unmodulated, direct-sequence spread-spectrum signal transmitted continuously by each sector of a CDMA cell. It allows the mobile to acquire the timing of the forward control channels and provides a coherent carrier phase reference for demodulating the sync and paging channels.

  The sync channel provides time-of-day and frame synchronization to the mobile. The mobile uses this channel to acquire cell and sector-specific information.

  The access channel is a CDMA reverse channel used for short signaling message exchange such as mobile registration, mobile call origination, and response to pages. The access channel is a slotted random access channel used by mobiles to communicate to the Cell Site.

- **Page CE**: Performs part of the CDMA call setup function—transmits control information to idle mobiles during mobile powerup and when a mobile is acquiring a new Cell Site. It conveys pages to the mobiles.

- Traffic CE: Performs the CDMA traffic channel function—carries one over-the-air CDMA call. A traffic channel, which is a communication path between a mobile station and a Cell Site, carries user and signaling information. The term traffic channel implies a forward and reverse pair.

- **OCNS CE**: Simulates a specified number of mobile users operating in a specified sector on a specified carrier. OCNS allows generation of a simulated user load on the CDMA forward channels in order to assist in verifying the capacity of the CDMA system.

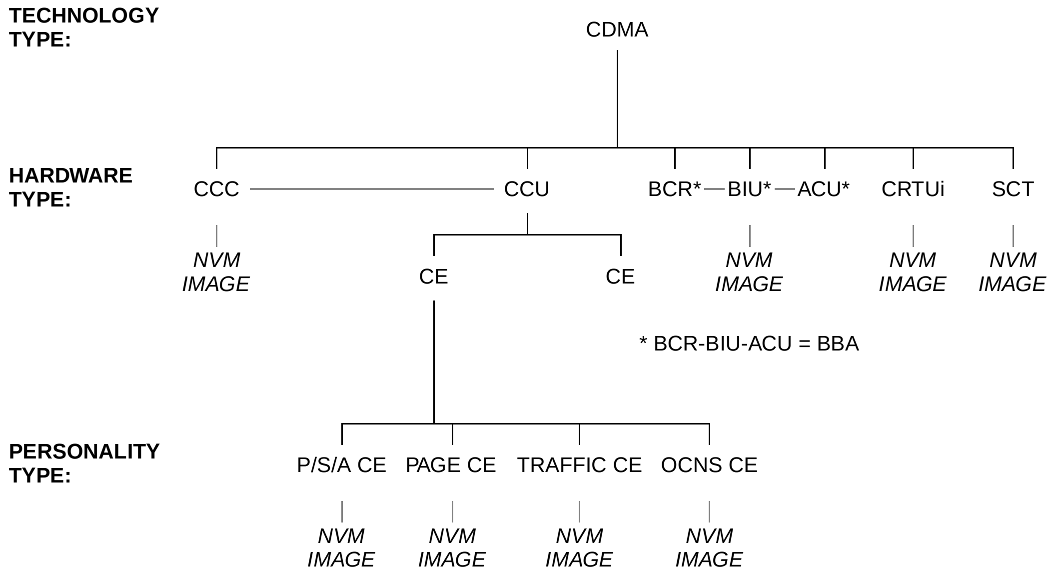

Figure 14-3. CDMA Radio Maintenance Units and Personality Types

Maintenance States

During installation, each unit is assigned an equipment state of *unequipped*, *growth*, or *equipped* via translations (system configuration parameter settings). Each equipped unit is further assigned a state of *active*, *out-of-service*, or *standby* (redundant unit only) via maintenance requests sent to the MRA subsystem.

Maintenance states

The meanings of the maintenance states are as follows:

Active

Unit is available for its intended use; for example, an RCU can service a call, the RTU can be used to test analog radio equipment, etc.

Standby

Unit is available to be placed into the active state; applies only to redundant units RCC, CAT, SCT, BBA, and setup radio (S-RCU, S-SBRCU).

(Because the BBA is a single point failure for a sector, redundant BBAs—one active and the other in standby mode—may be installed for increased reliability. Currently, redundant BBAs may only be installed in the non-subcell configuration.)

(Setup radios are considered redundant when there are spare setup radios at the Cell Site. For Cell Sites having the automatic radio reconfiguration—ARR—feature active for setup radios, there are no spare setup radios at the Cell Site: in that case, setup radios are not redundant.)

Unequipped

Unit exists in the translations data base strictly as a place holder. MRA will reject any maintenance request targeted for an unequipped unit.

Out-Of-Service

Unit is *not* available for its intended use (exact opposite of active state), but is available to be diagnosed or updated with NVM.

Growth State

Unit is not available to be placed in use, but is available to be diagnosed or updated with NVM.

Throughout the maintenance process, MRA records locally the maintenance status of the Cell Site equipment in the *equipment status table*. The maintenance status of equipment is reported to the ECP when the status changes or the ECP requests an update. The status of Cell Site equipment appears in the status display pages.

Corrective Maintenance using MRA

15

Contents

Maintenance Request Administrator (MRA)

Maintenance activities for the cell site's primary and growth radio channel frames (RCFs) are done through a series of software subsystems that reside in the radio control complex (RCC). One such software subsystem is the maintenance request administrator (MRA), which provides maintenance personnel with control, routing, and diagnostic maintenance procedures.

MRA receives maintenance requests from the ECP, performs the maintenance activities associated with the requests, and returns the results and collected data (if any) to the ECP. MRA handles requests to return information about the cell site, to remove (deactivate) cell site equipment, to restore (activate) cell site equipment, to perform diagnostic tests on cell site equipment, and so on.

The MRA subsystem not only responds to external requests from the ECP, but also responds to internal requests submitted by other software subsystems, such those performing automatic fault recovery or scheduled maintenance.

The rest of this section describes the Cell Site units that require maintenance, the types of maintenance states that exist, and the maintenance actions that can be taken.

Diagnose

The diagnose maintenance action can be applied to a unit in the out-of-service or growth state, to a redundant unit in the standby state, or to a redundant unit in the active state. In the latter case, MRA initiates a switch before executing the diagnose request.

NOTE:
For redundant units, if the targeted unit is in the active state but the mate is out-of-service, the diagnose aborts with no action taken. In addition, if the targeted unit is an active SCT, the diagnose aborts with no action taken even if the SCT has a standby mate.

In addition, the diagnose maintenance action can be applied to a CCC, CCU, or CRTU in the active state. The first step in a diagnose maintenance action for an active CCC, CCU, or CRTU is the automatic execution of a conditional remove.

Whether a unit passes or fails diagnostics, the unit is left in the out-of-service state except for a unit in the growth state. A unit initially in the growth state remains in the growth state. The diagnostic test results (pass, fail) are reported to the ECP.

A diagnostic test can be called for the whole RCC (in which all controller circuit boards are tested), or a diagnostic test can be called for an individual controller circuit board (for example, CPU).

For diagnose requests pertaining to radios involved in ARR, you need to be aware of the following conditions:

- A diagnose request without the qualifier orig is applied to the replacement radio; the rules governing the behavior of the diagnose command remain in effect dur-ing an ARR condition. A diagnose request of a setup, DCCH, beacon, or analog locate radio involved in an ARR condition is rejected because diagnosing an active unit is not permitted.

To diagnose a replacement radio, first unconditionally remove the radio, then diagnose the radio. Whether the replacement radio passes or fails diagnostics, the radio is left in the out-of-service state and the ARR condition remains in effect.

- A diagnose request with the qualifier orig is applied to the original radio; whether the original radio passes or fails diagnostics, the radio is left in the out-of-service state and the ARR condition remains in effect.
- A diagnose request applied directly to the replacement radio (say RA10) is rejected because that functionality is unavailable due to the ARR. An output report message appears stating that the radio is being borrowed by the ARR fea-ture and is not available.

Related Documents

For more information on the diagnose maintenance action, refer to the DGN CELL, DGN CELL DL, and DGN CELL SG commands in the *Input Messages manual* (401-610- 055).

Stop a Diagnostic

The stop maintenance action stops a diagnostic test on a maintenance unit. If the diagnostic test request is still in the job queue, MRA removes the request from the queue. If the diagnostic test is running, MRA aborts the test.

MRA leaves the unit in the out-of-service or growth state unless the unit is a CCC, CCU, BBA, or CRTU. Upon terminating a diagnostic test for one of those units, MRA returns the unit to the state it was in just prior to the diagnostic request (out-of-service, growth, or active) unless the diagnostic test is already running on the unit, in which case the unit is left in the out-of-service state.

For more information on the stop a diagnostic maintenance action, refer to the STOP DGN CELL, STOP DGN CELL DL, and STOP DGN CELL SG commands in the Input Messages manual (401-610-055).

Obtain Status

The obtain status maintenance action determines the status (state) of a maintenance unit, that is, MRA reads the recorded status from the equipment status table and forwards the status to the ECP. In addition, MRA automatically reports the maintenance status of equipment to the ECP whenever the status changes. A status display page is refreshed with new maintenance status every 15 seconds.

Related Documents

For more information on the obtain status maintenance action, refer to the OP CELL, OP CELL DL, OP CELL DLOPTS, OP CELL EXTERN, OP CELL GENERIC, OP CELL OVLD, OP CELL SCSM, OP CELL SG, and OP CELL VERSION commands in the *Input Messages manual* (401-610-055).

Qualifiers Associated with the Out-Of-Service (OOS) State

A maintenance unit can be placed in the out-of-service state due to one of several reasons. To identify the reason that a unit is in the out-of-service state, MRA assigns the unit a qualifier in addition to its final state of OOS. MRA assigns a qualifier to a unit during execution of the maintenance request (See Table 15-1). Both the qualifier and final state of the unit are reported to the ECP.

Table 15-1. OOS State Quilifiers

Qualifier	Description
OOS-DGN	The unit is in the out-of-service state due to the successful completion of a diagnose request.
OOS-FAULT	The unit is in the out-of-service state due to fault detection during diag-nostics in the Cell Site.
OOS-INITF	The unit is in the out-of-service state due to an unsuccessful initial-iza-tion process.
OOS-NVMUPT	The unit is in the out-of-service state because its NVM is being updated.

Table 15-1. OOS State Quilifiers (Contd)

Qualifier	Description
OOS-RMVD	The unit is in the out-of-service state due to the successful completion of a remove request.
OOS-TBLANL	This qualifier is used for leaving a unit in OOS state after it has suc-cess-fully passed diagnostics but is still reporting faults. This state is known as the trouble-analysis state.
OOS-CDMAF	The CCC, CCU, or BBA is in the out-of-service state due to no CDMA timing.
OOS-CFR	The BBA is in the out-of-service state due to its involvement in a multi-ple configure (MULTI CFR) test.
OOS-DNP	The previously active CCU is in the out-of-service state due to the removal of two consecutive downstream
CCUs. OOS-POS	The previously active CCU is in the out-of-service state due to the suc-cessful completion of a remove request of the parent
CCC. OOS-RMVIP	The DS1 is currently being removed.

Dual Server Group Out-Of-Service (OOS) Limits

For a Series II Dual Server Group cell, configured as either a 3-sector or 6-sector cell, Voice Radio Out-Of-Service (OOS) limits can now be set on a per Logical Antenna Face (LAF) level, rather than on a per-cell level.

Previously, OSS limits functioned as follows: The OOS limits could only be defined, or set, on a per-cell basis. However, the software that performed OOS checking for conditional OA&M commands, checked on a per LAF basis. Therefore, it was possible for per- cell OSS limits to block the testing of radios on a particular LAF.

This is no longer a problem. The ability to set OOS limits on a per LAF basis allows the service-provider to set the voice radio OSS limits at the same level at which the Cell Site software performs the OOS checking for conditional OA&M commands; that is, at the per LAF level.

New RC/V Translation Parameters

This feature adds 4 new AMPS and TDMA Voice Radio OOS limit translations to the ceqface form, as below:

1. AMPS Voice Radio OOS Limit Server Group 0. This parameter defines the AMPS Voice Radio Out of Service Limit for Server Group 0.
2. AMPS Voice Radio OOS Limit Server Group 1. This parameter defines the AMPS Voice Radio Out of Service Limit for Server Group 1.
3. TDMA Voice Radio OOS Limit Server Group 0. This parameter defines the TDMA Voice Radio Out of Service Limit for Server Group 0.
4. TDMA Voice Radio OOS Limit Server Group 1 This parameter defines the TDMA Voice Radio Out of Service Limit for Server Group.

For all 4 translations, the following apply:

- The view is Per Logical Face.
- The Allowable Values are 1 to 100% or Blank.
- The Default is Blank.
- The Restriction is that, if no value is entered (i.e., Blank), the value defaults to the Per Cell Voice.
- Radio Out of Service Limit.
- Update is allowable.

Remove/Restore/Switch Actions

Maintenance actions can be applied to maintenance units through commands from the ECP or by Cell Site software processes.

The yes and no entries under the maintenance actions in shown in the figures at the beack of this chapter indicate whether a maintenance action is permitted for a maintenance unit. In the rows of the table that have NULL in the Subunit column, the action is applied to the maintenance unit specified in the Unit column; in the rows of the table that do not have NULL in the Subunit column, the action is applied to the maintenance unit specified in the Subunit column.

The c and u entries under the maintenance actions in the table indicate whether a remove or restore maintenance action is conditional or unconditional. In general, a conditional maintenance request will not result in any action that causes calls to be dropped or service denied to a user during the course of command execution; if executing a conditional request would violate either condition, MRA would reject the request. In contrast, an unconditional maintenance request will result in the execution of the request immediately or within five minutes of MRA accepting the request, with little concern to whether calls are dropped or service denied to a user during the course of command execution.

If a unit is involved in an automatic radio configuration (ARR) when a maintenance action is applied, the maintenance action is applied to the replacement radio unless orig is specified in the maintenance request, in which case the maintenance action is applied to the original radio. Any maintenance action applied directly to the replacement radio (say RA10) will be rejected because that functionality is unavailable due to the ARR.

The ARR feature applies to AMPS and TDMA but not to CDMA.

All maintenance actions (remove, restore, diagnose, stop a diagnostic, switch to redundant unit, and obtain status) are reported to the ECP.

Once a maintenance action has started on a maintenance unit, MRA will reject any subsequent maintenance-action request for that unit until the current action has completed with the following exception: for any given unit, an unconditional maintenance-action request can terminate a conditional maintenance-action request.

Conditional Remove

The conditional remove maintenance action changes the state of a maintenance unit from active or standby to out-of-service. It schedules an event or process to place the specified maintenance unit to out-of-service assuming that it is idle_NOT busy. An idle unit is in the active state but not currently performing its intended purpose; a busy unit is in the active state and currently performing its intended purpose, such as a V-RCU supporting an active call.

If the unit is a busy V-RCU, V-SBRCU, V-DRU, V-EDRU, CCC, or CCU when the conditional remove action is applied, the unit is blocked (not allowed to accept new calls), and the remove is deferred for up to five minutes. As soon as the unit becomes idle (free of all calls) during the five-minute interval, it is removed from service. If the unit is still busy after five minutes, the conditional remove aborts with no action taken.

If the unit is a CCC carrying overhead channels, MRA will attempt to migrate the overhead channels to CEs on the other-side CDMA cluster on the same shelf_select two idle traffic CEs on the other-side CDMA cluster on the same shelf and reconfigure them as the overhead channels. The overhead channel CEs for a common CDMA carrier on an omni cell or cell sector must be on the same CDMA cluster, that is, must be controlled by the same CCC.

If the unit is a CCU carrying an overhead channel, MRA will attempt to migrate the overhead channel to another CE on the same CDMA cluster_select an idle traffic CE on the same CDMA cluster and reconfigure it as the overhead channel. If that attempt fails, MRA will attempt to migrate the overhead channel to an idle traffic CE on the other-side CDMA cluster on the same shelf.

If the migration is successful, MRA will initiate a CDMA overhead channel functional test to verify the operation of the newly assigned overhead channels (or channel).

For redundant units, if the unit is in the standby state when the conditional remove action is applied, the unit is removed from service immediately. If the unit is in the active state and the mate in the standby state when the conditional remove action is applied, MRA automatically executes a switch before removing the unit from service. And finally, if the unit is in the active state and the mate in the out-of-service state when the conditional remove action is applied, the conditional remove aborts with no action taken. (Exception: if the BBA out-of-service threshold limit is set to 100%, the remove request will continue.)

Currently, redundant BBA operation is supported in the non-subcell configuration but not the subcell configuration. Only simplex BBA operation_one BBA per CDMA shelf_ is supported in the subcell configuration. Other conditions that will cause the conditional remove to abort with no action taken are described as follows:

- A conditional remove action on a unit in the growth state is not permitted unless the unit is a CCC, CCU, or BBA. A conditional remove action of a CCC, CCU, or BBA in the growth state simply resets the unit; the unit remains in the growth state.
- If placing the unit out-of-service would result in exceeding the out-of-service threshold limit for that type of unit, the conditional remove action is not permitted.

A 100% out-of-service threshold limit for a particular type of unit means that any number (one to all) of those units may be conditionally removed. A 0% out-of-service threshold limit for a particular type of unit means that not even one of those units may be conditionally removed.

Out-of-service threshold limits for analog voice radios, analog locate radios, digital voice radios, and digital locate radios are translatable, that is, specified using the recent change/verify (RC/V) subsystem at the ECP (specifically, using RC/V form cell2). Out-of-service threshold limits for setup radios, DCCH radios, and beacon radios are not translatable. Effectively, the out-of-service limit for each of these radio types is 0%, meaning that removing just one such radio would exceed the radio out-of-service threshold limit.

Out-of-service threshold limits for CDMA traffic CEs and BBAs are translatable on a per antenna face (sector and carrier) basis using the RC/V form cell2. The range is 25% to 100%; the default is 25%. Blocked traffic CEs are included in the out-of-service threshold limit calculations. Overhead CEs (pilot/sync/ access and page) are not included in the out-of-service threshold limit calculations.

(In a CDMA subcell configuration, MRA adds the individual antenna face out-of-service threshold limits together to obtain a total out-of-service threshold limit for the whole subcell. For example, if the face out-of-service threshold limit is 25% and each shelf is equipped with 26 traffic channels, the individual face out-of-service threshold limit is six traffic channels. If all three faces are served by all three shelves_a 3-shelf subcell configuration, the total out-of-service threshold limit for the whole subcell is 18 traffic channels, meaning that MRA would check for an out-of-service threshold limit of 18 traffic channels for the whole subcell. In this example, MRA would only allow a single CDMA cluster to be conditionally removed.)

(The removal of any two adjacent CCUs will break the transmit bus path, thereby disrupting the transmit data upstream from the break. As an example, removing CCUs 2 and 3 will also remove CCUs 4 through 7. For a conditional remove request, MRA will not permit the removal of two adjacent CCUs if the removal would result in exceeding the traffic CE out-of-service threshold limit.)

- A conditional remove action on a DS1 or DFI is not permitted if the out-of-service limit would be exceeded for voice radios.
- A conditional remove action on a DS1 or DFI is not permitted if that unit controls the last data link to a Cell Site.
- A conditional remove action on the last data link to a Cell Site is not permitted. (Only an unconditional remove action on the last data link can remove the data link from service.)

- A conditional remove action on an RTU, TRTU, or CRTU involved in diagnostics of another unit_such as during a setup radio, DCCH radio, or CDMA radio functional test_is not permitted. (This restriction avoids false errors that may be generated upon premature termination of the diagnostic test involving the RTU, TRTU, or CRTU.)
- A conditional remove action on a CAT or SCT involved in diagnostics of another unit_that is, CAT or SCT supplying a digital tone source_is not permitted. (This restriction avoids false errors that may be generated upon premature termination of the diagnostic test involving the CAT or SCT.)
- Neither a conditional nor unconditional remove action is permitted on the last CAT or SCT on a TDM bus (TDM0 or TDM1). Note: TDM buses are always installed "red stripe up."
- Neither a conditional nor unconditional remove action is permitted on SCT 4 if SCT 5 is already out-of-service, on SCT 5 if SCT 4 is already out-of-service.
- A conditional remove action on an active SCT_even though its mate may be in standby_is not permitted.

(In general, any conditional maintenance request that would normally cause redundant units to switch is not permitted for SCTs. The switching of SCTs could leave the associated CDMA hardware_the CCCs and CCUs that are receiving CDMA timing from the redundant SCTs_in an unknown state, which would require the manual restore of the affected CCCs.)

- A conditional remove action on a setup radio having no associated spare is not permitted. (Only an unconditional remove action on a setup radio having no associated spare_other than a hard fault_can remove the radio from service.)
- A conditional remove action on a DCCH radio is not permitted. (Only an uncondi-tional remove action on a DCCH radio_other than a hard fault_can remove the radio from service.)
- A conditional remove action on a beacon radio is not permitted. (Only an uncon-ditional remove action on a beacon radio_other than a hard fault_can remove the radio from service.)

  (By definition, a beacon radio may be a B-DRU or a B-EDRU, or a V-RCU or V-SBRCU configured as a beacon radio. Be aware, though, that because setup and DCCH radios have their transmitters On all the time and transmit at fixed power levels, they too may serve as beacon-like radios.)
- For radios involved in ARR:

— A conditional remove request without the qualifier orig is applied to the replacement radio; the rules governing the behavior of the conditional remove command for each type of radio (setup, DCCH, beacon, analog locate) remain in effect during an ARR condition.

A conditional remove request of a setup, DCCH, or beacon radio involved in an ARR condition is not permitted. A conditional remove request of an analog locate radio involved in an ARR condition is permitted as long as such an action would not violate out-of-service limits for analog locate radios.

— A conditional remove request with the qualifier orig is applied to the origi-nal radio; the request is rejected because the orig qualifier is not sup-ported for the RMV CELL (remove cell) command.

— A conditional remove request applied directly to the replacement radio (say RA10) is rejected because that functionality is unavailable due to the ARR. An output report message appears stating that the radio is being borrowed by the ARR feature and is not available.

For more information on the remove maintenance action, refer to the RMV CELL and RMV CELL SG commands in the *Input Messages manual* (401-610-055).

Unconditional Remove

Unconditional remove requests may be service affecting because of the out-of-service limits that may be exceeded. For example, service to a Cell Site is affected if the last setup radio is removed.

The unconditional remove maintenance action changes the state of a maintenance unit from active or standby to out-of-service. It promptly places the specified maintenance unit in the out-of-service state unless any of the following conditions are in effect:

- The unconditional remove action is targeted for a busy V-RCU, V-SBRCU, V-DRU, V-EDRU, CCC, CCU, or a BBA having no mate or the mate is out-of-ser-vice. The remove is deferred for up to five minutes. As soon as the unit becomes idle during the five-minute interval, MRA removes the unit from service. If the unit is still busy after five minutes, MRA drops the calls and removes the unit from service.

Be aware that the removal of any two adjacent CCUs will break the transmit bus path, thereby disrupting the transmit data upstream from the break. As an example, removing CCUs 2 and 3 will also remove CCUs 4 through 7. For an unconditional remove request, MRA will allow the removal of two adjacent CCUs with no regard for the traffic CE out-of-service threshold limit.

- The unconditional remove action is targeted for a DS1 or DFI that, if removed, would result in the exceeding of the out-of-service limit for voice radios. The unconditional remove aborts with no action taken.

- The unconditional remove action is targeted for a unit in the growth state. The unconditional remove aborts with no action taken unless the unit is a CCC, CCU, or BBA. An unconditional remove action of a CCC, CCU, or BBA in the growth state simply resets the unit; the unit remains in the growth state.
- The unconditional remove action is targeted for a redundant RCC, CAT, or SCT having an out-of-service mate. The unconditional remove aborts with no action taken.

An unconditional remove action targeted for a redundant setup radio having an out-of-service mate will be honored immediately by MRA. After the removal, both the setup radio and its mate will be out-of-service.

Be aware that an unconditional remove request of an active SCT having a standby mate will result in a SCT switch, which could leave the associated CDMA hardware_ the CCCs and CCUs that are receiving CDMA timing from the redundant SCTs_in an unknown state. You would have to manually restore the affected CCCs.

If an RTU, TRTU, or CRTU is involved in diagnostics of another unit, an unconditional remove request of the unit terminates the ongoing diagnostics, which may result in the generation of false errors upon premature termination of the diagnostic test.

Similarly, if a CAT or SCT is involved in diagnostics of another unit, an unconditional remove request of the unit terminates the ongoing diagnostics, which may result in the generation of false errors upon premature termination of the diagnostic test.

Other conditions pertaining to unconditional remove requests that you need to be aware of are as follows:

- If the requested unit is a setup radio having no associated spare, the radio will be removed without invoking ARR. A warning message appears stating that the radio removed was a setup radio.
- If the requested unit is a DCCH radio, the radio will be removed without invoking ARR, even if it is the last DCCH for the sector. A warning message appears stat-ing that the radio removed was a DCCH radio.
- If the requested unit is a beacon radio, the radio will be removed without invoking ARR. A warning message appears stating that the radio removed was a beacon radio.
- For radios involved in ARR:

- — An unconditional remove request without the qualifier orig is applied to the replacement radio; when the radio is removed, MRA remembers the ARR condition; when the radio is restored, MRA continues the ARR_the ARR condition remains in effect.
- — An unconditional remove request with the qualifier orig is applied to the original radio; the request is rejected because the orig qualifier is not sup-ported for the RMV CELL (remove cell) command.
- — An unconditional remove request applied directly to the replacement radio (say RA10) is rejected because that functionality is unavailable due to the ARR. An output report message appears stating that the radio is being borrowed by the ARR feature and is not available.

Conditional and Unconditional Restore

The restore maintenance action can be applied to units that are in the out-of-service, active, or standby state. Except for a unit that is already out-of-service or in the growth state, the first step in a conditional restore maintenance action is the automatic execution of a conditional remove. Therefore, all the restrictions associated with a conditional remove are also associated with a conditional restore.

Similarly, except for a unit that is already out-of-service or in the growth state, the first step in an unconditional restore maintenance action is the automatic execution of an unconditional remove. Therefore, the lack of restrictions associated with an unconditional remove_unconditional remove requests may be service affecting_are also associated with an unconditional restore.

The conditional restore maintenance action changes the state of a maintenance unit to active. It schedules an event or process to restore the specified maintenance unit after the unit passes a diagnostic test. If the unit fails the diagnostic test, the conditional restore aborts. The failed unit remains in the out-of-service state.

The unconditional restore maintenance action changes the state of a maintenance unit to active. It schedules an event or process to restore the specified maintenance unit without first running a diagnostic test on the unit.

NOTE:
For a redundant unit (RCC, CAT, SCT, BBA, or setup radio), you can specify the STBY parameter in the RST command line to restore the unit to the standby state.

A conditional restore request on a unit in the growth state will diagnose and initialize the unit but will not change the state of the unit: the unit remains in the growth state. An unconditional restore of a unit in the growth state is not permitted unless the unit is a CCC, CCU, or BBA. An unconditional restore action of a CCC, CCU, or BBA in the growth state (1) initializes the CCC as an active CCC with call processing and error reporting inhibited, (2) configures all CEs on the CCU as traffic channels, or (3) initializes the BBA as a standby BBA; the unit remains in the growth state.

Other conditions pertaining to conditional and unconditional restore requests that you need to be aware of are as follows:

- For data links (DLs):
  - A conditional restore request reverts to unconditional if there is no link currently in-service; no diagnostic test is run.
  - No action is performed if an unconditional restore request is made on the currently in-service link.
- For redundant units:
  - An RCC conditional restore request compares the active and mate mem-ories of the controller sides (RCC 0 and RCC 1) after the RCC being restored has elevated to the standby state. A mismatch in memory drops the RCC back to the out-of-service state and aborts the restore request.
  - An active RCC, CAT, or SCT having an out-of-service mate cannot be conditionally or unconditionally restored.
  - An active BBA having an out-of-service mate cannot be conditionally restored unless (1) the BBA out-of-service threshold limit is set to 100% and (2) the BBA becomes idle_free of calls_within five minutes of issu-ing the conditional restore command. An active BBA having an out-of-ser-vice mate can be unconditionally restored.
  - An active setup radio having an out-of-service mate cannot be condition-ally restored but can be unconditionally restored.
  - An active SCT having a standby mate cannot be conditionally restored but can be unconditionally restored.

    (In general, any conditional maintenance request that would normally cause redundant units to switch is not permitted for SCTs. The switching of SCTs could leave the associated CDMA hardware_the CCCs and CCUs that are receiving CDMA timing from the redundant SCTs_in an unknown state, which would require the manual restore of the affected CCCs.)
  - A standby SCT can be conditionally restored to the standby state but not the active state. In contrast, a standby SCT can be unconditionally restored to either the standby or active state.
- For setup radios:
  - A conditional restore action on an active setup radio having no associated spare is not permitted.

- An unconditional restore action on an active setup radio having no associated spare is permitted.
- If call processing is inhibited, setup radios are in the standby state.

■ For both setup and analog locate radios:

- If a radio that was conditionally restored becomes active, a functional test is immediately scheduled for the radio.

■ For DCCH radios:

- A conditional restore action on an active DCCH radio is not permitted.
- An unconditional restore action on an active DCCH radio is permitted, even if it is the last DCCH for the sector. The unconditional restore action resets the DCCH (that is, resets the DRU or EDRU carrying the DCCH).

■ For beacon radios:

- A conditional restore action on an active beacon radio is not permitted.
- An unconditional restore action on an active beacon is permitted.
- A beacon radio's transmitter is always turned back On as part of a radio restore request sequence.

For radios involved in ARR:

■ A conditional restore request without the qualifier orig is applied to the replace-ment radio; the rules governing the behavior of the conditional restore command for each type of radio (setup, DCCH, beacon, analog locate) remain in effect dur-ing an ARR condition.

A conditional restore request of an active setup, DCCH, or beacon radio involved in an ARR condition is not permitted. A conditional restore request of an active analog locate radio involved in an ARR condition is permitted as long as such an action would not violate out-of-service limits for analog locate radios

To conditionally restore a replacement radio, first unconditionally remove the radio, then conditionally restore the radio. If the replacement radio passes diag-nostics, the radio is restored to the active state. If the replacement radio fails diagnostics, the radio is left in the out-of-service state. Whether the replacement radio passes or fails diagnostics, the ARR condition remains in effect.

■ A conditional restore request with the qualifier orig is applied to the original radio. If the original radio passes diagnostics, the radio is restored to service with its original personality and the replacement radio resumes its former personality_ the ARR condition is terminated (reversed). If the original radio fails diagnostics, the radio is left in the out-of-service state and the ARR condition remains in effect.

- A conditional restore request applied directly to the replacement radio (say RA10) is rejected because that functionality is unavailable due to the ARR. An output report message appears stating that the radio is being borrowed by the ARR feature and is not available.
- An unconditional restore request without the qualifier orig is applied to the replacement radio. If the restore action is successful, the replacement radio is restored to the active state. If the restore action fails, the replacement radio is left in the out-of-service state. Whether the restore action is successful or unsuc-cessful, the ARR condition remains in effect.
- An unconditional restore request with the qualifier orig is applied to the original radio. If the restore action is successful, the original radio is restored to the active state and the ARR condition is terminated (reversed). If the restore action fails, the original radio is left in the out-of-service state and the ARR condition remains in effect.
- An unconditional restore request applied directly to the replacement radio (say RA10) will be rejected because that functionality is unavailable due to the ARR. An output report message appears stating that the radio is being borrowed by the ARR feature and is not available.

Related Documents

For more information on the restore maintenance action, refer to the RST CELL and RST CELL SG commands in the *Input Messages manual* (401-610-055).

Switch to a Redundant Unit

The switch to redundant unit maintenance action changes the state of a maintenance unit from active to standby while at the same time changing the state of a second unit (the associated redundant unit) from standby to active. The purpose of the maintenance action is to transfer the functions of the first unit to the second unit. (This maintenance action applies only to the RCC, CAT, SCT, BBA, or setup radio).

If either of the redundant units is in the out-of-service state, the switch request aborts with no action taken. For the CAT or SCT, the switch request will fail if the CAT/ SCT is involved in diagnostics of another unit. (Does not apply to SCT units having logical CAT numbers 4 and 5.)

CAUTION:
Be aware that a switch action on a SCT could leave the associated CDMA hard-ware_the CCCs and CCUs that are receiving CDMA timing from the redundant SCTs_in an unknown state. You would have to manually restore the affected CCCs.

Related Documents

For more information on the switch to redundant unit maintenance action, refer to the SW CELL command in the *Input Messages manual* (401-610-055).

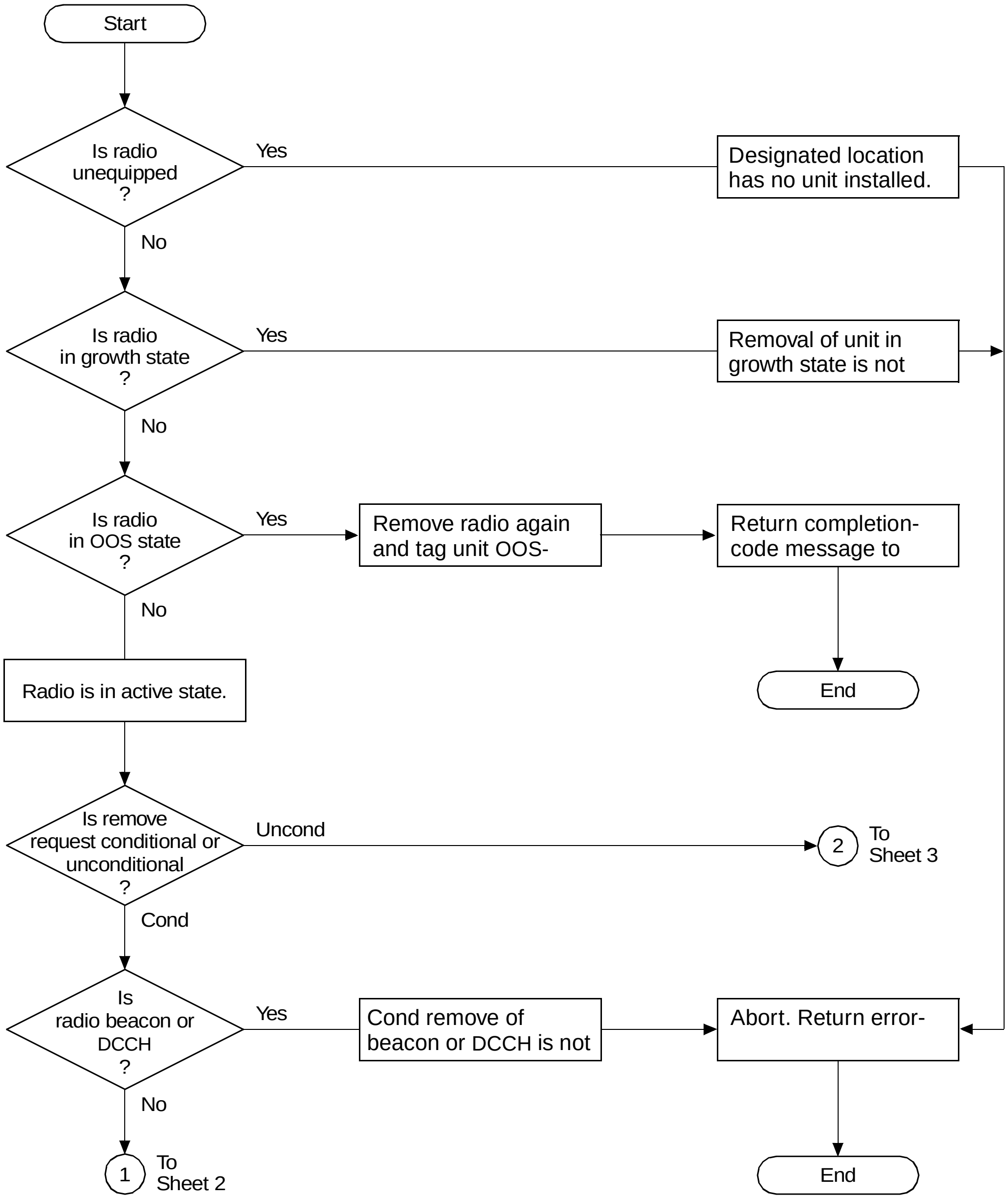

Figure 15-1. Remove Flow of Voice Radio RCU, SBRCU, DRU, or EDRU (Sheet 1 of 3)

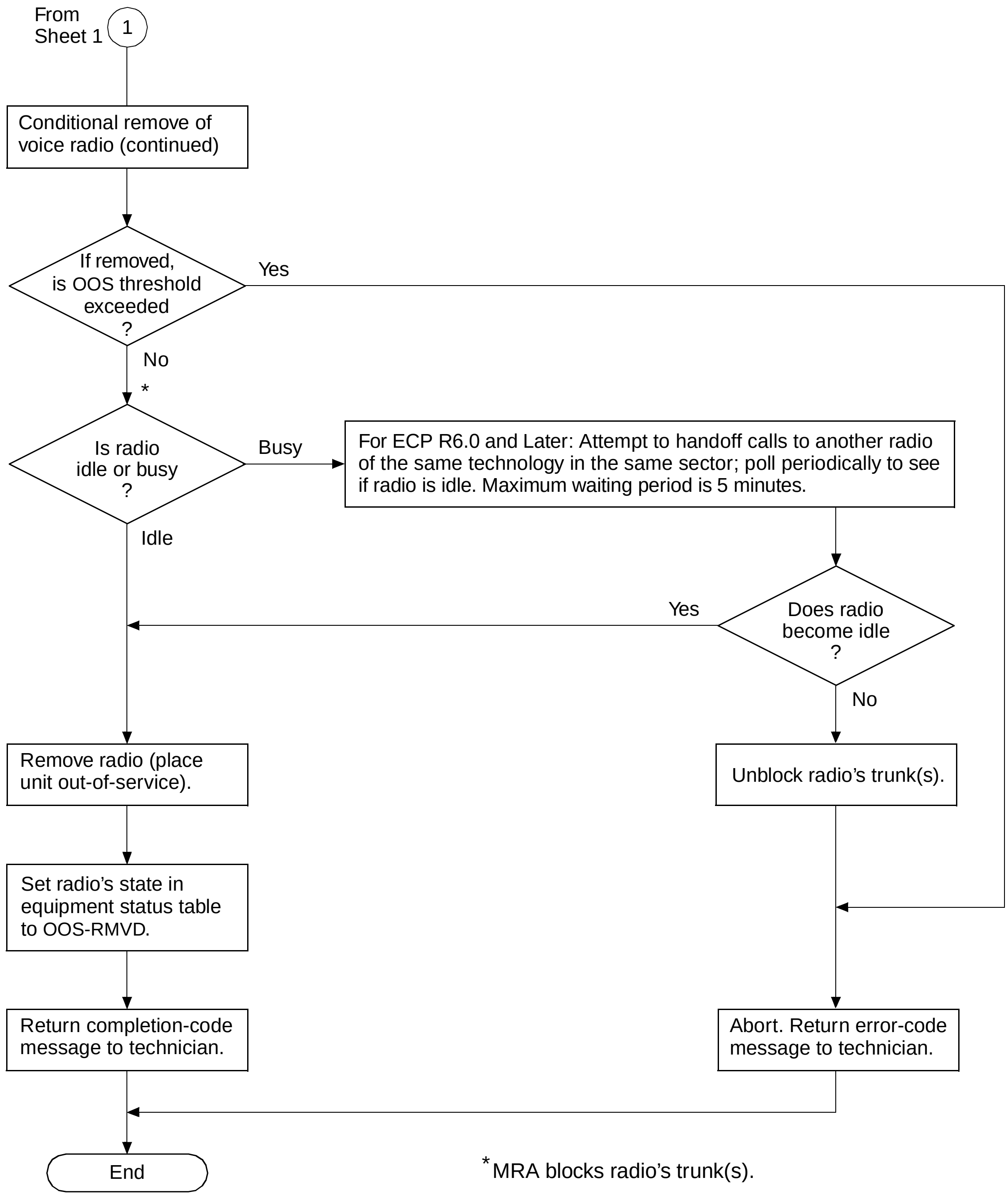

Figure 15-2. Remove Flow of Voice Radio RCU, SBRCU, DRU, or EDRU (Sheet 1 of 3)

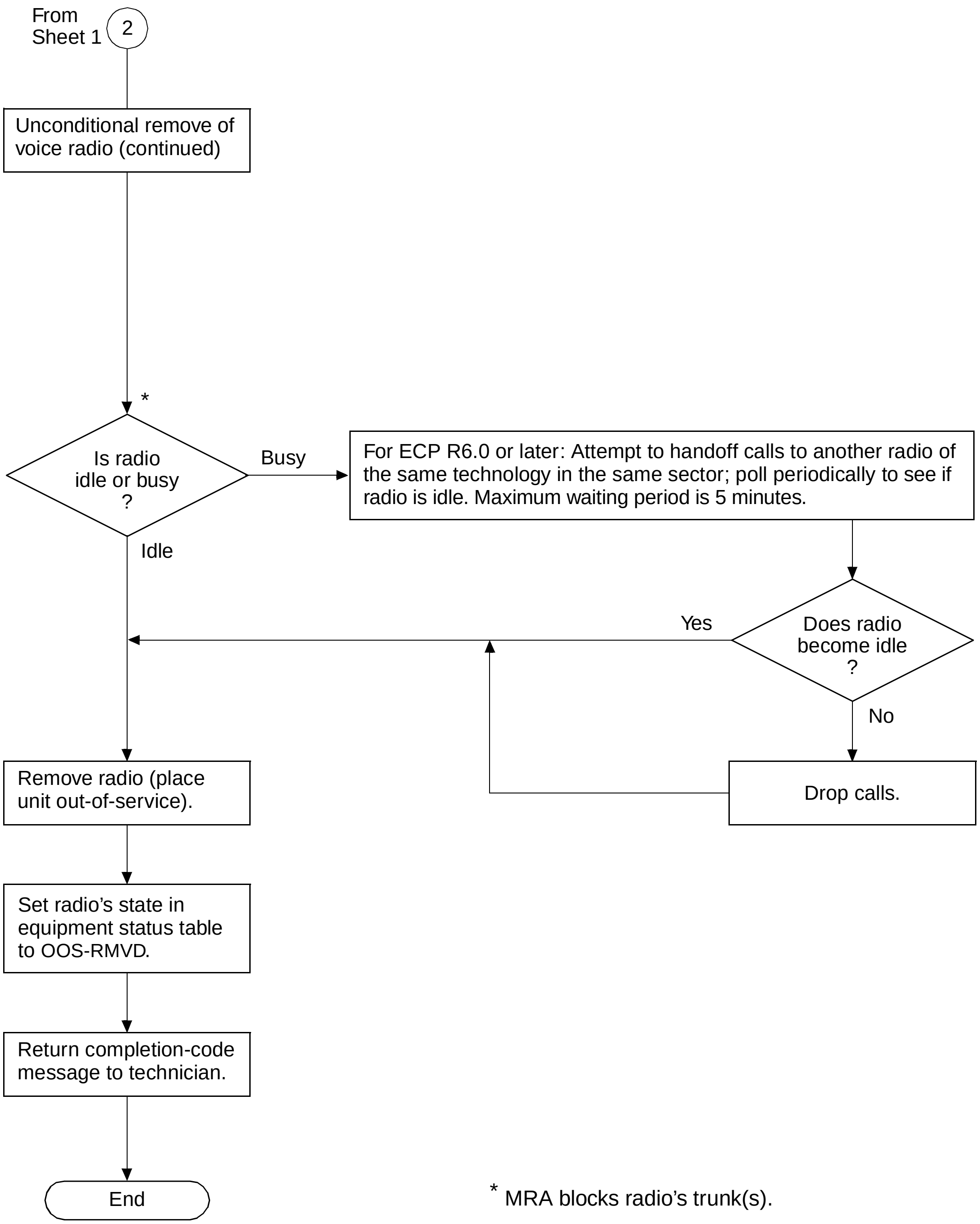

Figure 15-3. Remove Flow of Voice Radio RCU, SBRCU, DRU, or EDRU (Sheet 3 of 3)

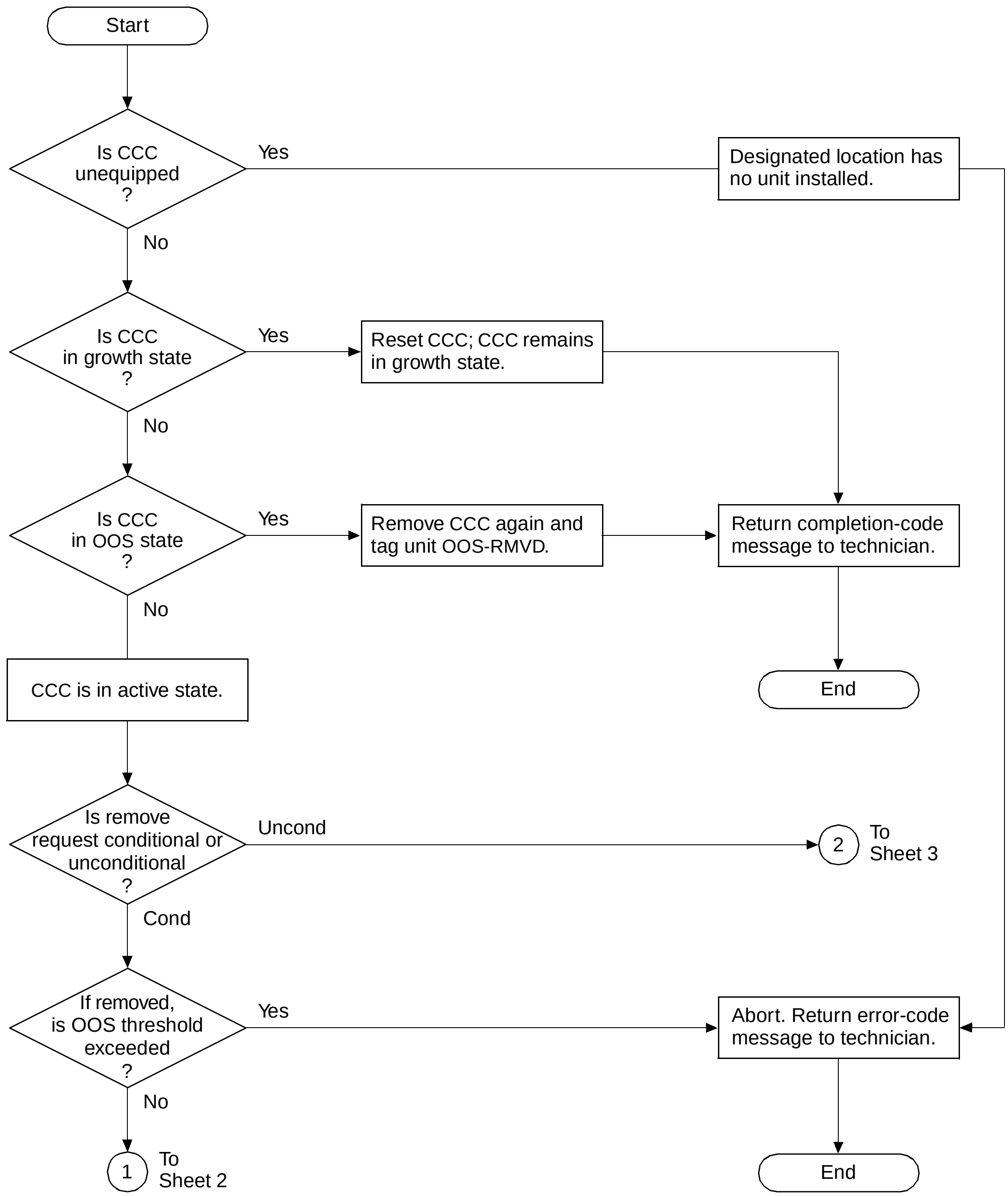

Figure 15-4. Remove Flow of CCC (Sheet 1 of 3)

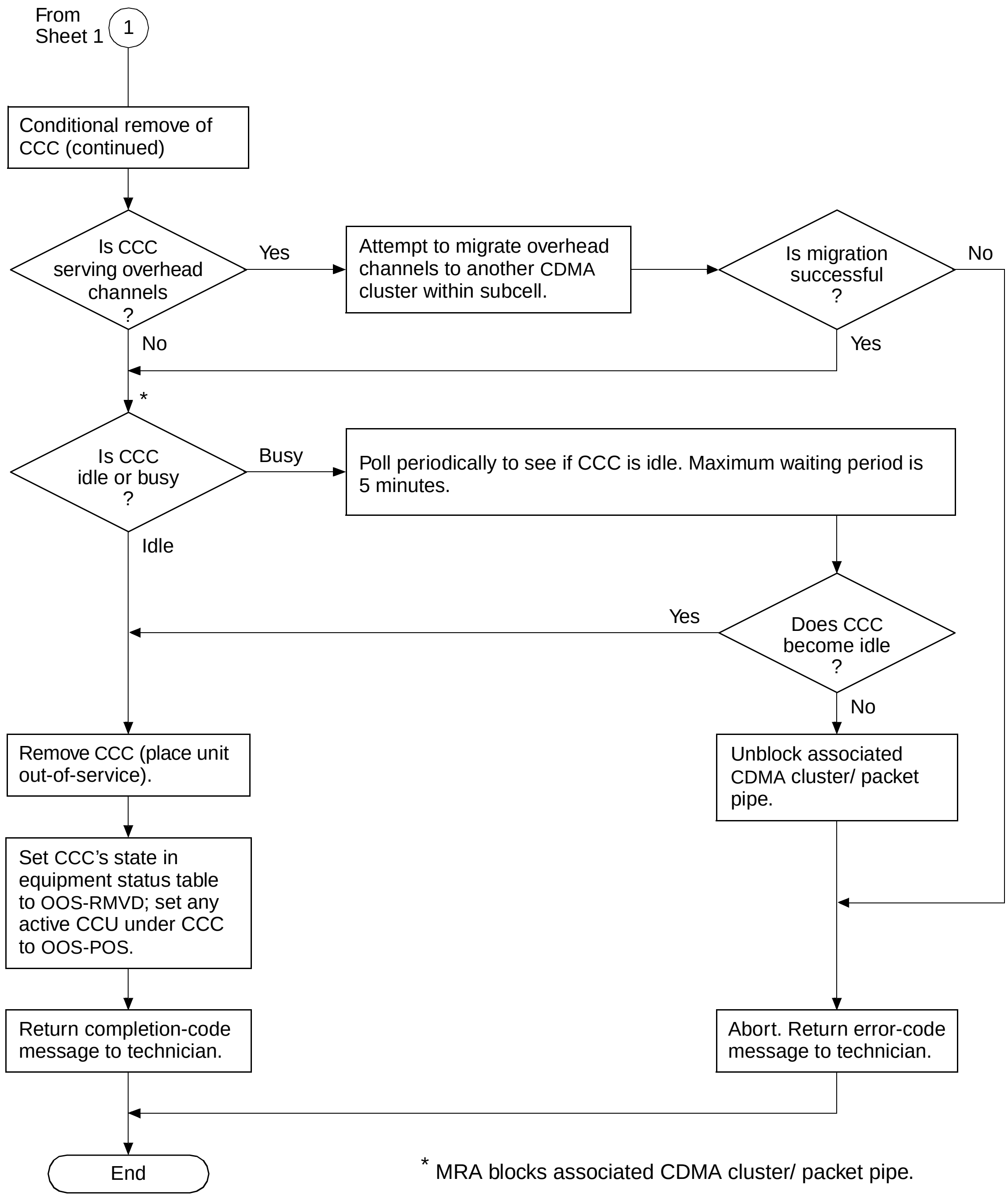

Figure 15-5. Remove Flow of CCC (Sheet 2 of 3)

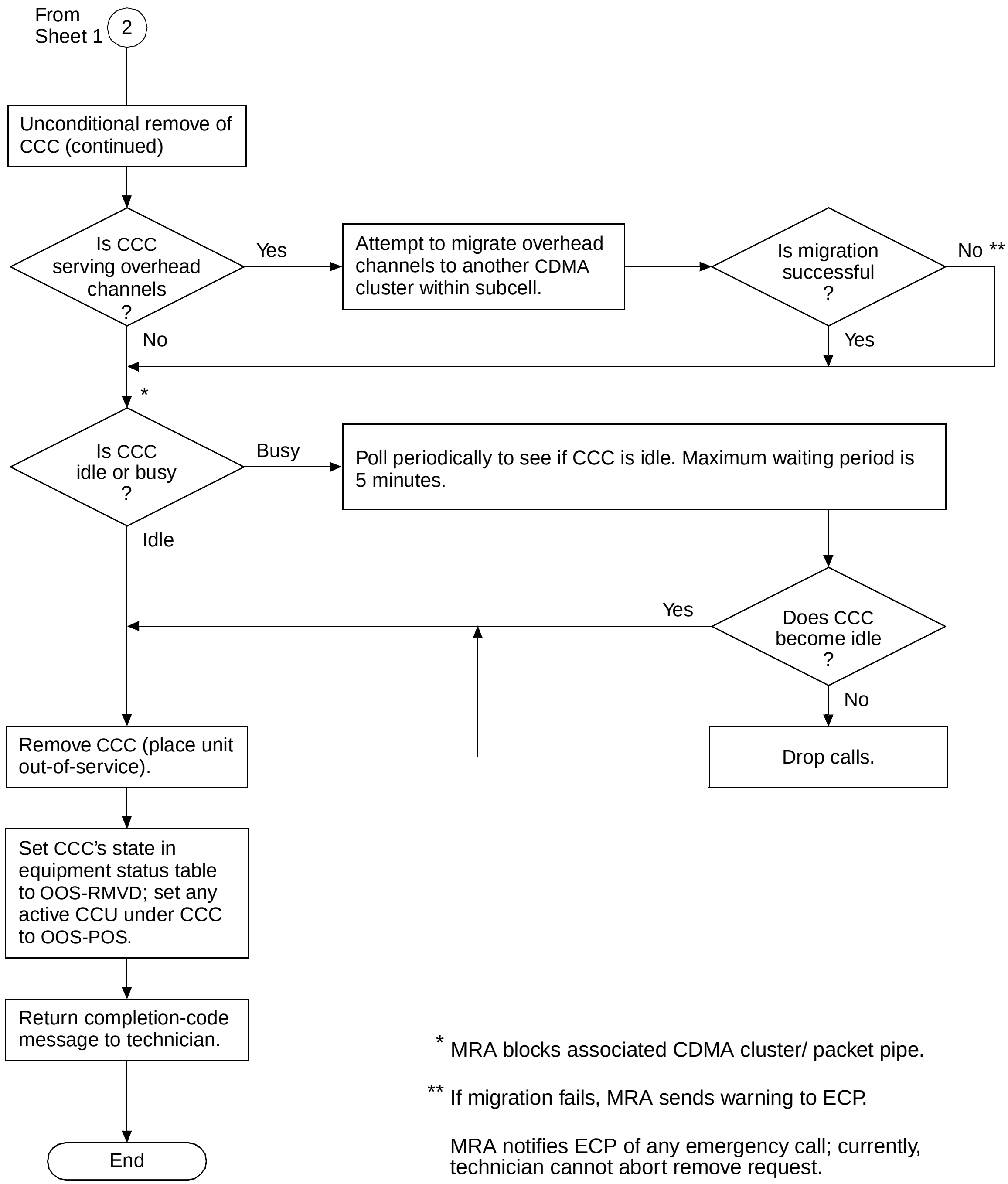

Figure 15-6. Remove Flow of CCC (Sheet 3 of 3)

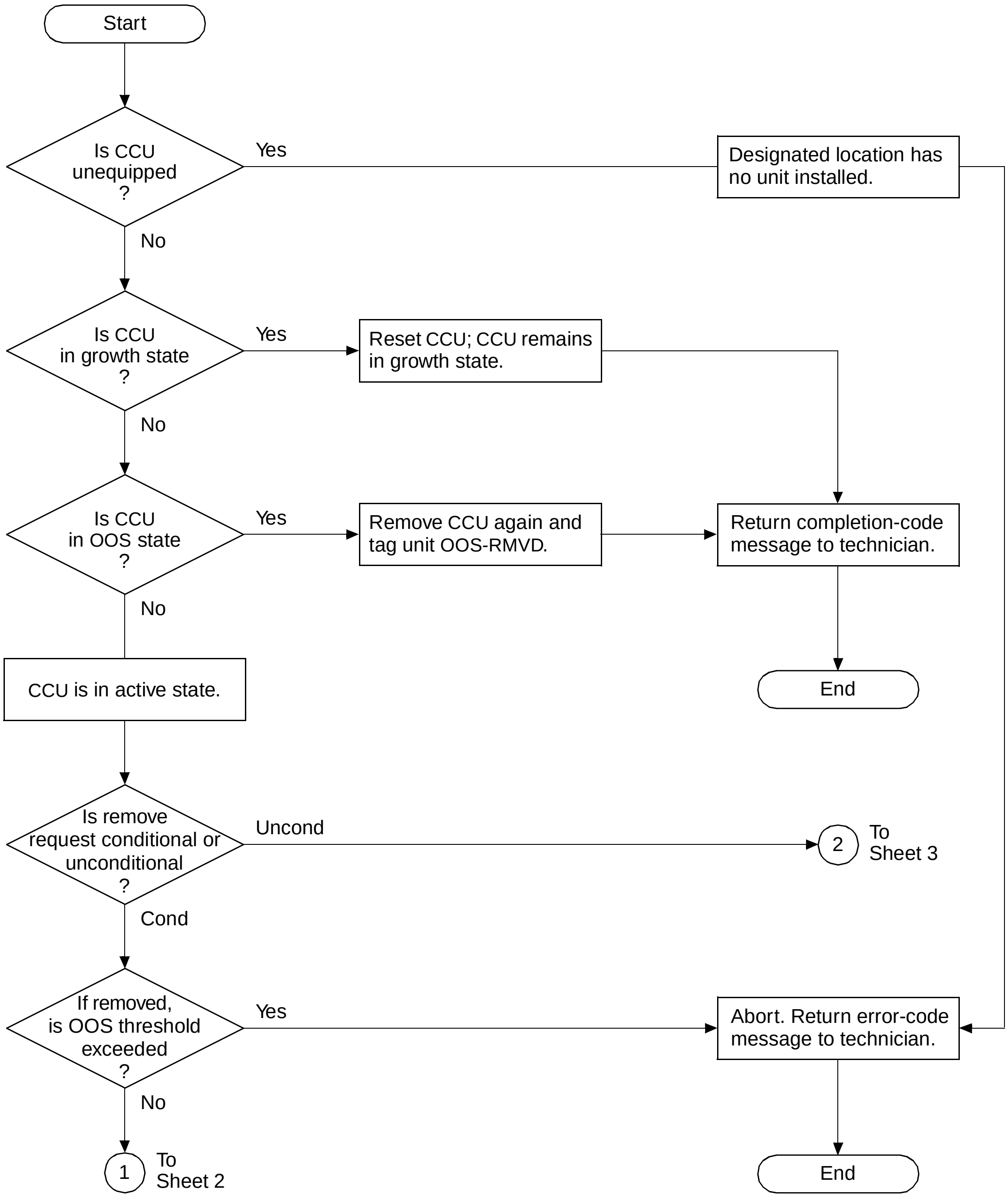

Figure 15-7. Remove Flow of CCU (Sheet 1 of 3)

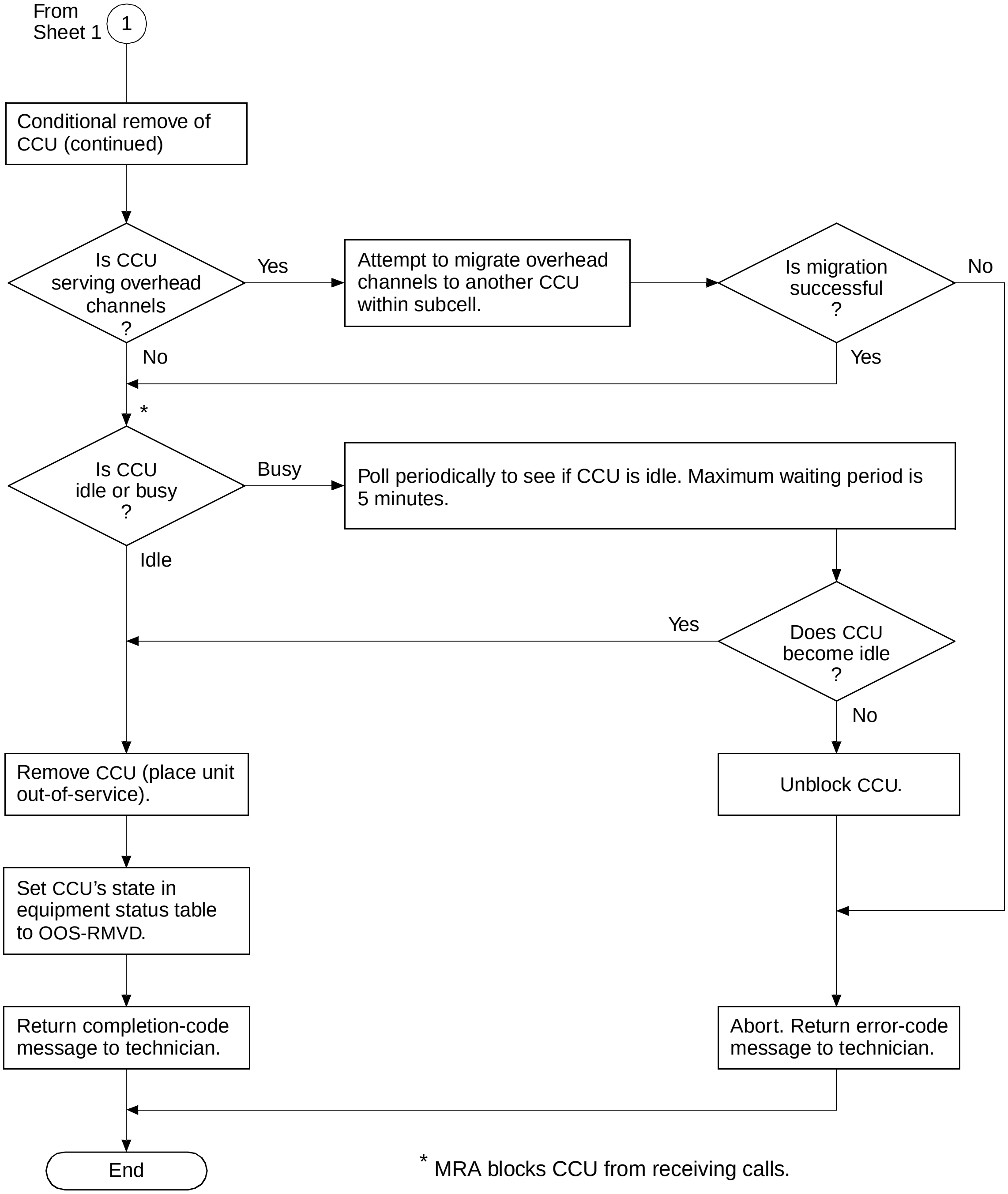

Figure 15-8. Remove Flow of CCU (Sheet 2 of 3)

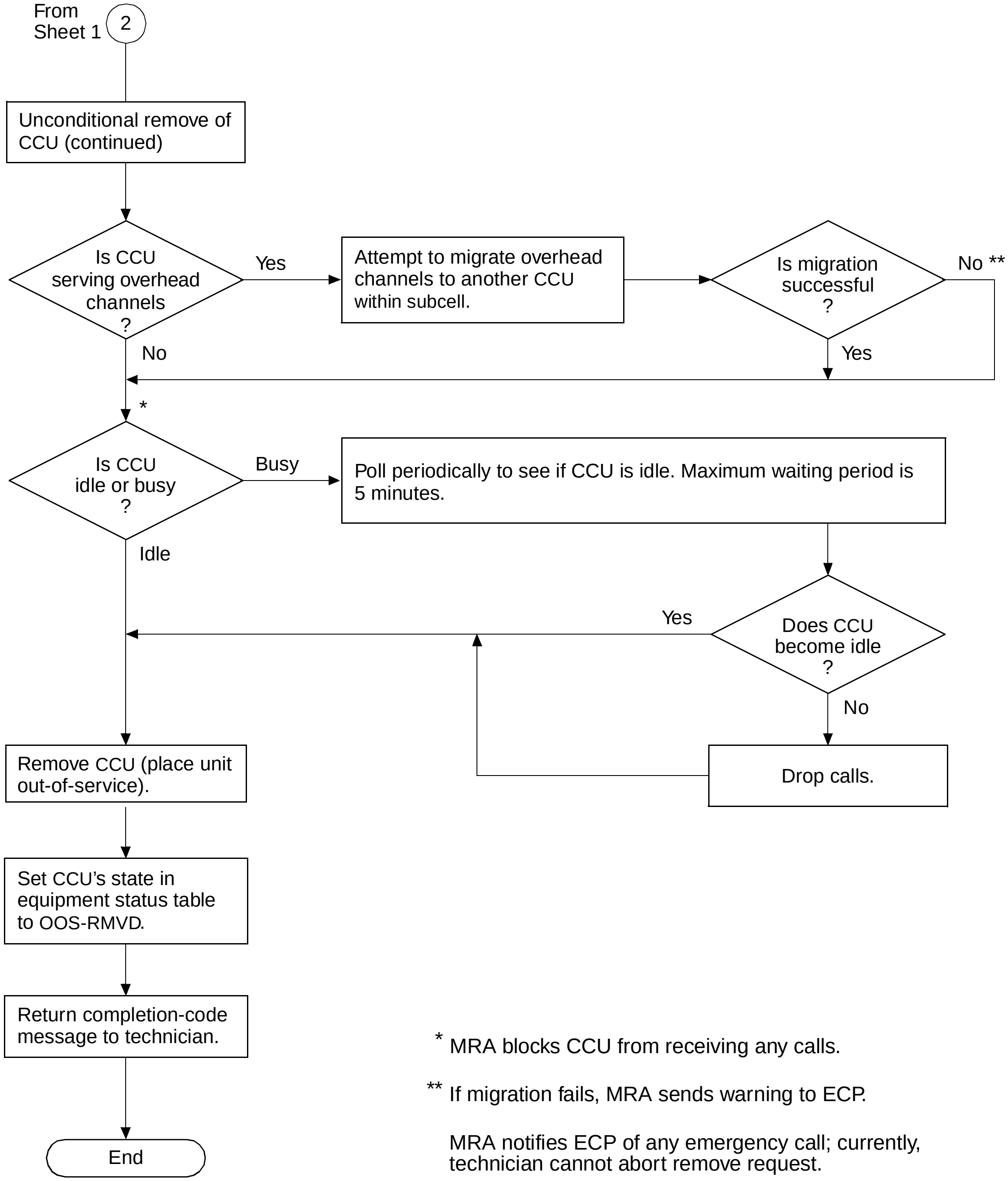

Figure 15-9. Remove Flow of CCU (Sheet 3 of 3)

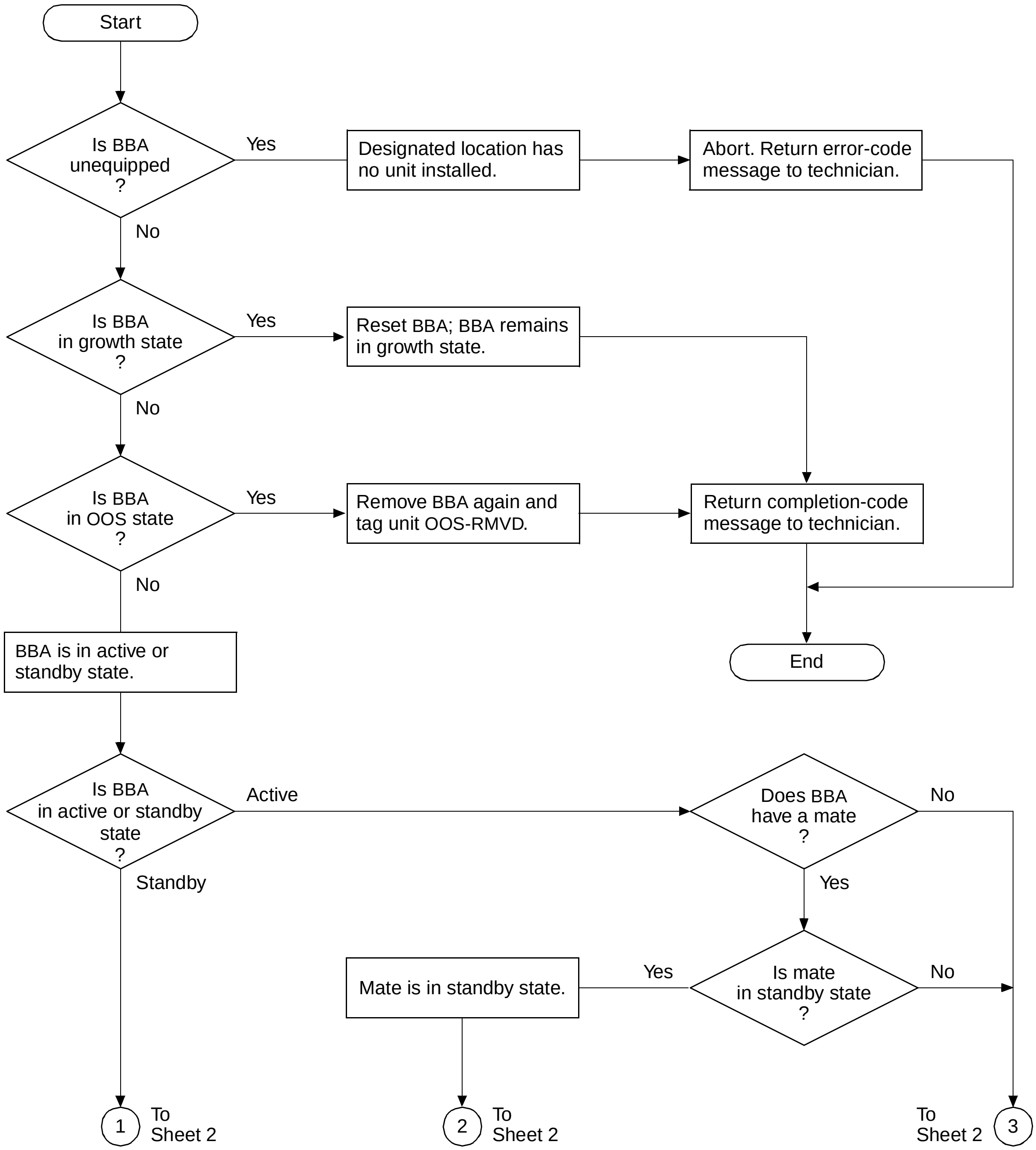

Figure 15-10. Remove Flow of BBA (Sheet 1 of 3)

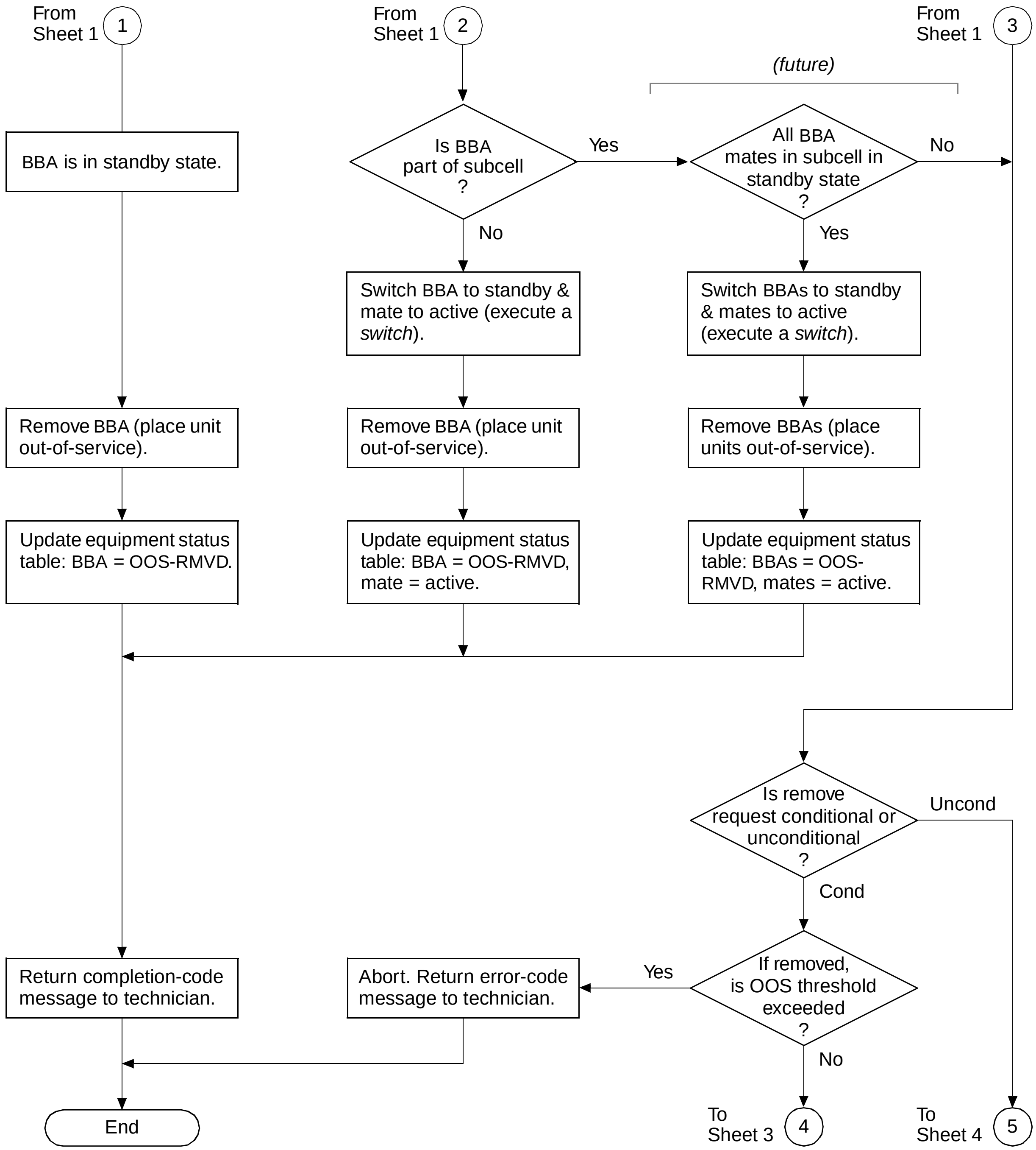

Figure 15-11. Remove Flow of BBA (Sheet 2 of 3)