



SHL-028

MDS entraNET 220 Phase V Primer

Version 1.1

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1 Summary of Differences from Phase IV

In Phase IV, slot assignments were static and required the RCL vendor equipment to set the time slot. In Phase V DCM, slots are dynamically changed every second to avoid long-term collisions with other systems, and assigned explicitly by repeaters in CCM.

In DCM, the sequence of slots and channels employed by a given RCL system is pseudorandom based on the RCL system ID. This prevents multiple systems from interfering with each other across multiple transmissions. They may interfere during one transmission, but they will not interfere thereafter. Further, each unit transmits twice per second making it very likely that each second's message will get through. There are 15 slot groups and two channels employed.

In CCM, an LCU will request a slot that is indicated as free in the repeater beacon information. The radio system handles this process without intervention from the RCL vendor equipment. Setting the timeslot is meaningless in Phase V.

With regard to mode switching, in Phase IV each OCR listened for messages transmitted directly from the LCR as well as messages repeated by the infrastructure. There was no real mode change for OCRs. In Phase V, there is a distinct difference between DCM and CCM mode. OCRs and LCRs transition between modes together. Mode changes are "make before break" so that no data is lost.

In Phase V, the LCU must contain an entraNET 220 Access Point in addition to the Packaged Radio Module already there. Connection between these two units is detailed in SHL-021.

Further, the LCU must configure the OCU (and the OCU must configure the OCR) to use the correct frequencies for Channels 3 and 4. This is described below.

2 BSP Logging

The customer payload logging capabilities of the entraNET 200 Access Point (within either a Repeater or an LCU) include:

1. Logging BSP traffic via UDP to a server over a network link
2. Writing the data in a human readable form to any USB flash drive.

For logging to a USB flash drive formatted with a FAT filesystem, create a file on the device named "dologging". Once the device is plugged into the USB port on the Access Point, the AP will check for the file named "dologging". If the file is found, the AP will create a file called bsplog_YY_MM_DD_HH_MM_SS.txt, where the letters stand for the full data and time the file was created.

Some USB flash drives will be detected properly on a power cycle and logging will begin without user intervention. Other drives require removal and reinsertion of the drive to resume logging after a power cycle.

With BSP logging enabled, the Access Point will log any BSP messages received or transmitted to the BSP log file.

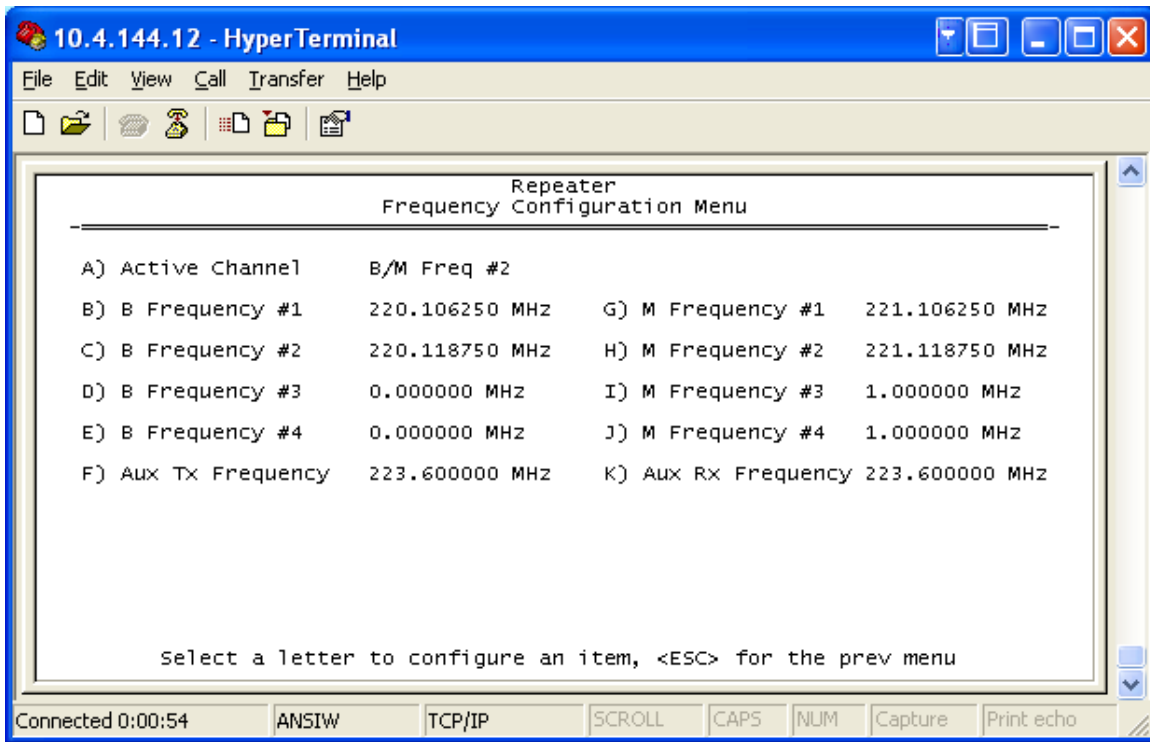
To enable BSP logging on an Access Point, use the System Configuration->BSP Logging menu to change BSP Logging to Enabled. At a Repeater or an LCU, the hardware must be properly connected as per SHL-021. In the Repeater COM1 through COM3 must be connected to the three Radio Modules. In the LCU, COM2 of the AP must connect to COM1 of the Radio Module via the correct RJ-45 to RJ-12 cable (or other customer cables for the DB-25 versions of these units). You will also need to set the mode of COM1 on the LCU Radio Module to DATA and the baud rate to 115200.

3 Repeater Setup

As usual, all setup for a repeater is done through the Repeater's Access Point. The additional channels available as well as yard center and dimensions must be set.

3.1 Frequency Configuration

The Frequency Configuration Menu allows you to configure the parameters related to the configuration of all frequencies used in a yard.



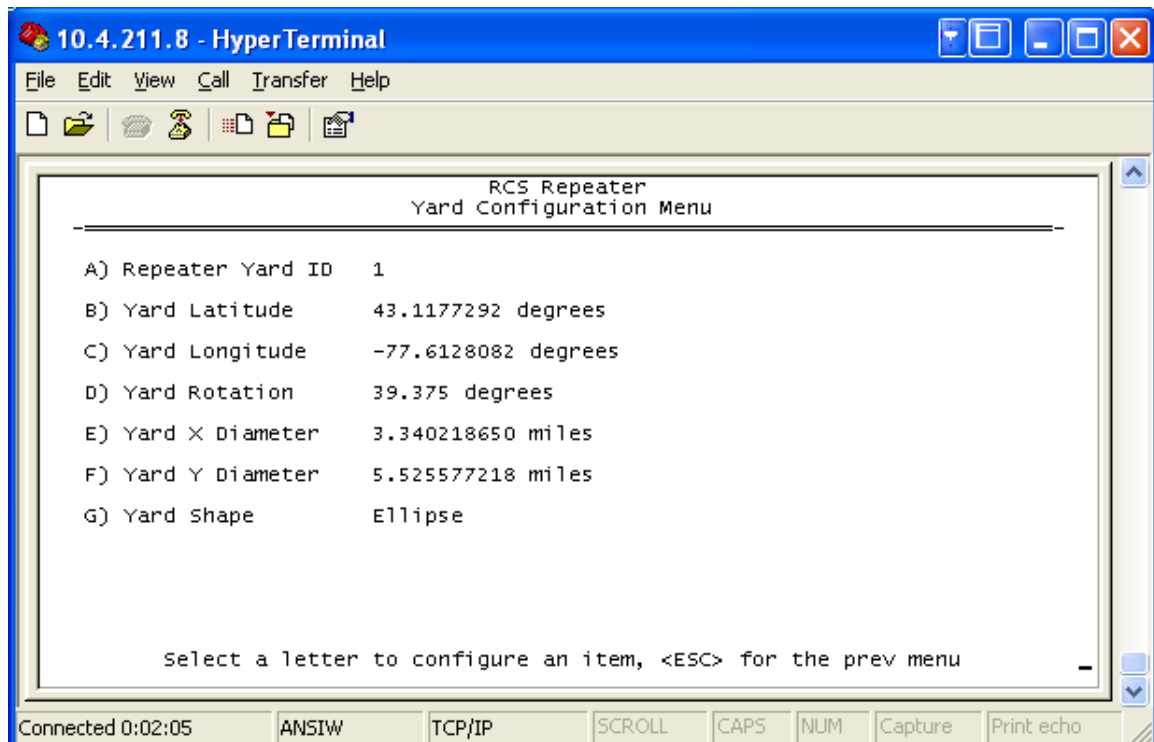
- Active Channel:** The active transmit and receive frequency pair. This value defaults to B/M Freq #1 and can be set to any of the four (4) frequency pairs.
- B Frequency #1:** The Base Frequency on Channel #1. This value defaults to 220.106250 MHz and has a range from 220.006250 MHz to 221.956250 MHz. All values must be divisible by 1250 Hz.
- B Frequency #2:** The Base Frequency on Channel #2. This value defaults to 220.118750 MHz and has a range from 220.006250 MHz to 221.956250 MHz. All values must be divisible by 1250 Hz.
- B Frequency #3:** The Base Frequency on Channel #3. This value defaults to 0.000000 MHz and has a range from 220.006250 MHz to 221.956250 MHz. All values must be divisible by 1250 Hz. A value of 0.000000 MHz denotes that this frequency is not in use in the yard.
- B Frequency #4:** The Base Frequency on Channel #4. This value defaults to 0.000000 MHz and has a range from 220.006250 MHz to 221.956250 MHz. All

values must be divisible by 1250 Hz. A value of 0.000000 MHz denotes that this frequency is not in use in the yard.

- M Frequency #1: The Mobile Frequency on Channel #1. This value defaults to 221.106250 MHz and has a range from 220.006250 MHz to 221.956250 MHz. All values must be divisible by 1250 Hz.
- M Frequency #2: The Mobile Frequency on Channel #2. This value defaults to 221.118750 MHz and has a range from 220.006250 MHz to 221.956250 MHz. All values must be divisible by 1250 Hz.
- M Frequency #3: The Mobile Frequency on Channel #3. This value is calculated based on the difference between M Frequency #1 and B Frequency #1 added to the value of B Frequency #3.
- M Frequency #4: The Mobile Frequency on Channel #4. This value is calculated based on the difference between M Frequency #1 and B Frequency #1 added to the value of B Frequency #4.
- Aux Tx Frequency: The Auxiliary Transmit Frequency. This value defaults to 223.6 MHz and has a range of 200.000000 MHz to 240.000000 MHz.
- Aux Rx Frequency: The Auxiliary Receive Frequency. This value defaults to 223.6 MHz and has a range of 200.000000 MHz to 240.000000 MHz.

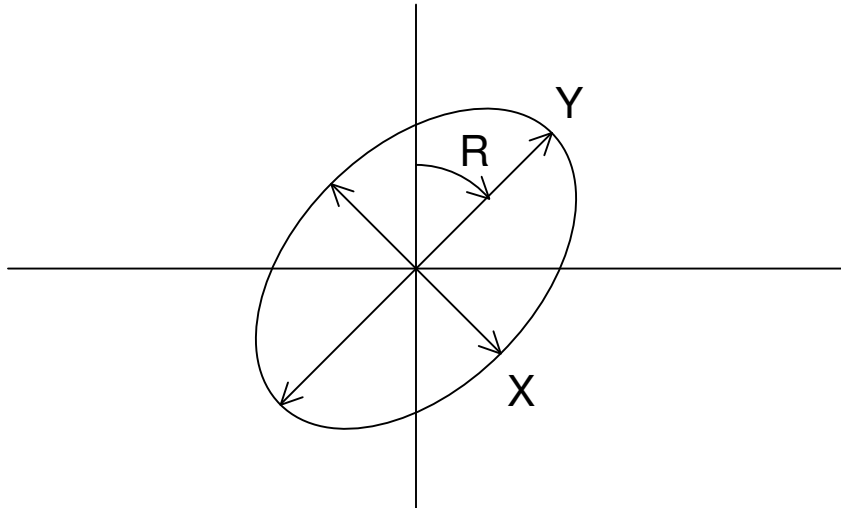
3.2 Yard Configuration

The Yard Configuration Menu allows you to configure the parameters related to the configuration of the yard in which the repeater is installed. Below is a screen capture of the Yard Configuration Menu as it may appear on a repeater configured as an RCS. For satellite repeaters, only the Repeater Yard ID will be configurable.

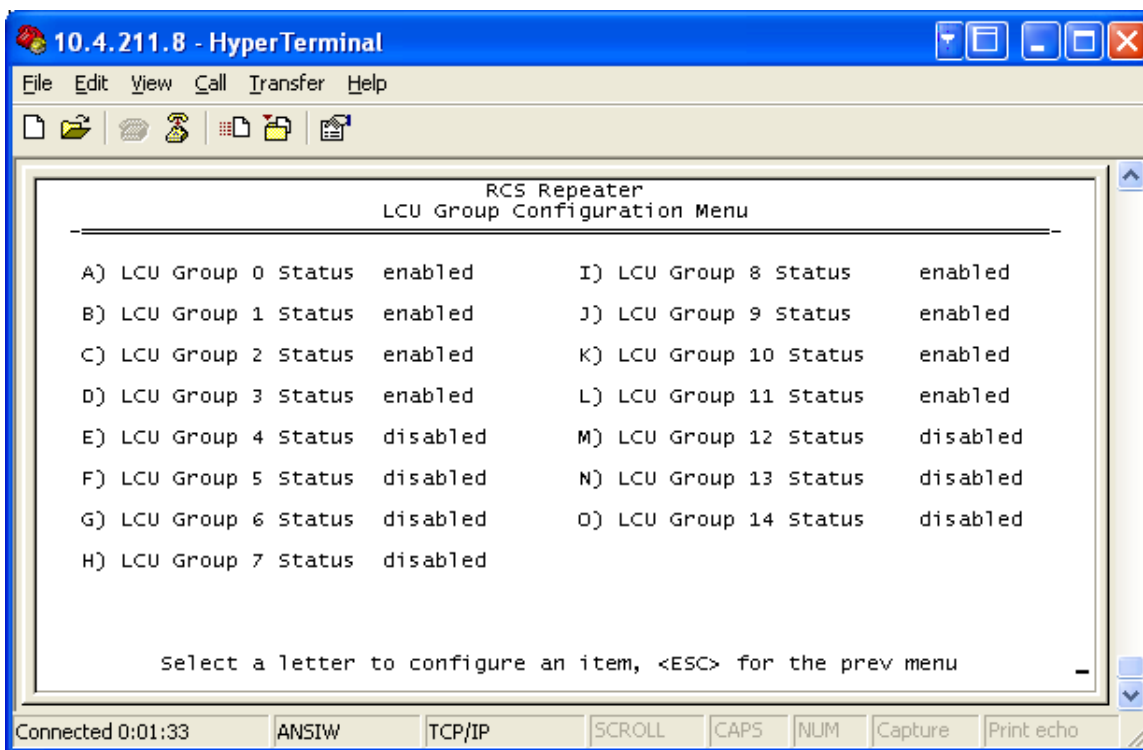


- Repeater Yard ID: The fixed yard ID used by the repeater. This value defaults to zero (0) and must be set to a valid value from 1 to 15. A given RCS and all of its satellite repeaters should all be configured with the same Repeater Yard ID.
- Yard Latitude: The latitude of the yard center. This value defaults to zero (0) degrees and has a range from -90.0000000 to 90.0000000 degrees.
- Yard Longitude: The longitude of the yard center. This value defaults to zero (0) degrees and has a range from -180.0000000 to 180.0000000 degrees.
- Yard Rotation: The degrees of rotation about the yard center. This value defaults to 0.000 degrees and has a valid range of 0 to 84.375 in steps of 5.625 degrees.
- Yard X Diameter: The X diameter of the yard in miles. This value has a default value of 1.000000000 miles.
- Yard Y Diameter: The Y diameter of the yard in miles. This value has a default value of 1.000000000 miles.
- Yard Shape: The geometric shape of the yard. This value defaults to Ellipse.

In the figure below, R is the Yard Rotation, X is the Yard X Diameter, and Y is the Yard Y Diameter.



3.3 LCU Group Configuration



The LCU Group Configuration Menu allows you to configure the availability of the fifteen (15) LCU Groups at an RCS. All fifteen (15) groups are enabled by default, and can be individually set to disabled to prevent RCL systems from operating in those slots.

4 Locomotive Setup

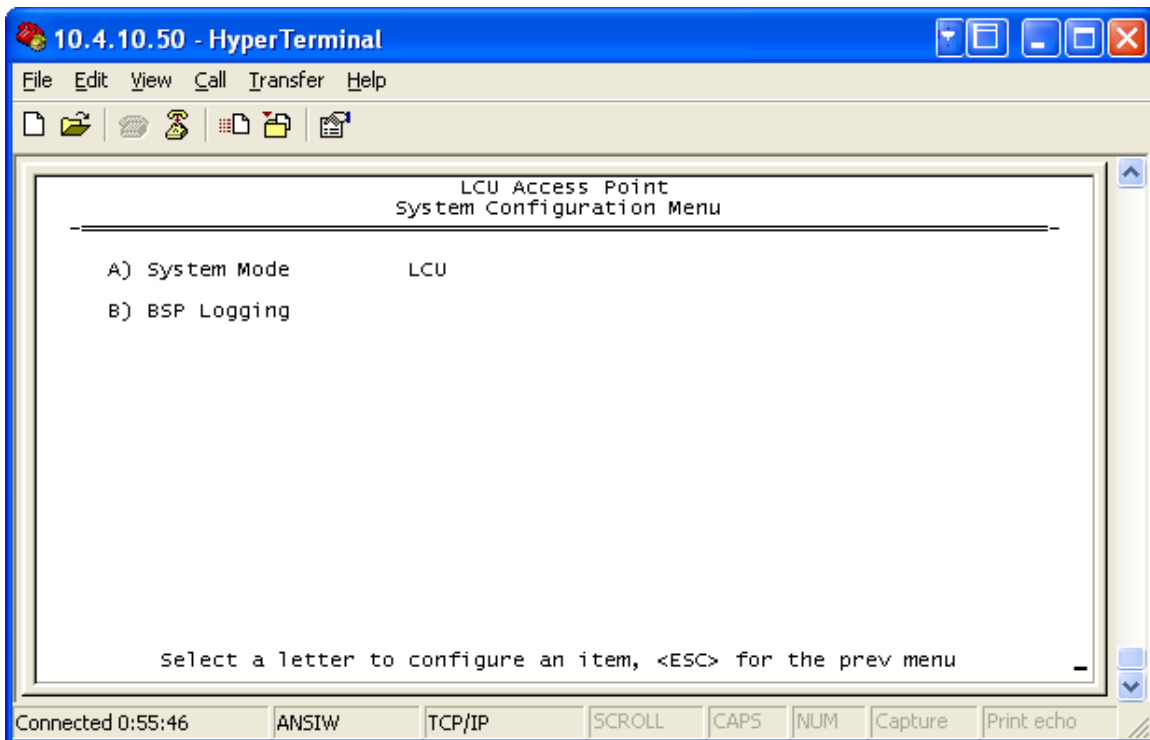
IMPORTANT

In Phase V, COM1 of the locomotive's Access Point must be connected to the NMEA data output from the GPS receiver in the locomotive as described in SHL-021. This permits the LCR to decide whether it is within the geographical boundary of a given yard. Further, the RSSI threshold must be set. These two parameters let the LCR know when it should attempt to get a slot assignment for a given yard.

Note also that to upgrade a Radio Module within an LCU, the AP should be upgraded. If you wish, you may upgrade the Radio Module via its serial port before rebooting the Access Point to its new firmware. If necessary, the Access Point will upgrade the Radio Module itself when it first boots to a new firmware version, and this can take several minutes.

4.1 Locomotive Access Point Setup

The Access Point in the locomotive must be configured for LCU mode as shown below. BSP logging may also be configured if desired. BSP logging must be enabled for logging with a USB memory stick to work properly.



4.2 Radio Module Command Line Differences

entraNET> radio ?

usage: RADIO [optional arguments as follows]...

```
<action>
  NONE ;
  COMMITCHANS ;Update ROR channels 3/4 with last RCL Sync
  UNITADDR=<integer> Current Radio RCL Unit Address
  MODE=<choices>
    NORMAL ;Normal TDMA mode
    MAINT ;Low Power no TDMA Mode
    CAL ;Calibration no TDMA Mode
    TEST ;Low Power TDMA Mode
    TRAFFIC ;Traffic TDMA Mode
  COORDMODE=<choices>
    CCM ;Centralized Coordination Mode
    DCM ;Distributed Coordination Mode
  TXKEY=<choices>
    OFF ;RF Transmitter Key OFF
    ON ;RF Transmitter Key ON
  BFREQ1=<XXX.XXXXXX MHz> ;Primary Radio B(Repeater) Frequency
    220006250 ;Min Frequency (Hz)
    221956250 ;Max Frequency (Hz)
    1250 ;Frequency Step-Size/BW (Hz)
  MFREQ1=<XXX.XXXXXX MHz> ;Primary Radio M(Mobile) Frequency
    220006250 ;Min Frequency (Hz)
    221956250 ;Max Frequency (Hz)
    1250 ;Frequency Step-Size/BW (Hz)
  BFREQ2=<XXX.XXXXXX MHz> ;Secondary Radio B(Repeater) Frequency
    220006250 ;Min Frequency (Hz)
    221956250 ;Max Frequency (Hz)
    1250 ;Frequency Step-Size/BW (Hz)
  MFREQ2=<XXX.XXXXXX MHz> ;Secondary Radio M(Mobile) Frequency
    220006250 ;Min Frequency (Hz)
    221956250 ;Max Frequency (Hz)
    1250 ;Frequency Step-Size/BW (Hz)
  BFREQ3=<XXX.XXXXXX MHz> ;3rd Radio B(Repeater) Frequency
    220006250 ;Min Frequency (Hz)
    221956250 ;Max Frequency (Hz)
    1250 ;Frequency Step-Size/BW (Hz)
  MFREQ3=<XXX.XXXXXX MHz> ;3rd Radio M(Mobile) Frequency
    220006250 ;Min Frequency (Hz)
    221956250 ;Max Frequency (Hz)
    1250 ;Frequency Step-Size/BW (Hz)
  BFREQ4=<XXX.XXXXXX MHz> ;4th Radio B(Repeater) Frequency
    220006250 ;Min Frequency (Hz)
    221956250 ;Max Frequency (Hz)
    1250 ;Frequency Step-Size/BW (Hz)
  MFREQ4=<XXX.XXXXXX MHz> ;4th Radio M(Mobile) Frequency
    220006250 ;Min Frequency (Hz)
    221956250 ;Max Frequency (Hz)
    1250 ;Frequency Step-Size/BW (Hz)
  AUXTX=<XXX.XXXXXX MHz> ;Auxillary Transmit Frequency
```

```

200000000          ;Min Frequency (Hz)
240000000          ;Max Frequency (Hz)
1                  ;Frequency Step-Size (Hz)
AUXRX=<XXX.XXXXXX MHz> ;Auxillary Receive Frequency
200000000          ;Min Frequency (Hz)
240000000          ;Max Frequency (Hz)
1                  ;Frequency Step-Size (Hz)
TIMESLOT=<range integer> ;Timeslot to use in fixed DCM system
0                  ;Minimum timeslot value
14                 ;Maximum timeslot value
RSSI=<+|->         Most recent RSSI value in dBm
YARDRSSI=<8bits integer> Minimum in-yard RSSI value in dBm
TXSTART=<range integer> ;Seconds to timeout before transmit at boot-
up
0                  ;Minimum - never start transmit
30                 ;Maximum - wait 30 seconds
CMD=<0|1>          dump command line format

```

```

entraNET> radio
UNITADDR=8192
MODE=Calibration no TDMA Mode
COORDMODE=Centralized Coordination Mode
TXKEY=RF Transmitter Key OFF
BFREQ1= 220.106250 MHz
MFREQ1= 221.106250 MHz
BFREQ2= 220.118750 MHz
MFREQ2= 221.118750 MHz
BFREQ3= 0.000000 MHz
MFREQ3= 0.000000 MHz
BFREQ4= 0.000000 MHz
MFREQ4= 0.000000 MHz
AUTX= 223.600000 MHz
AUXRX= 223.600000 MHz
TIMESLOT=0
RSSI=-120
YARDRSSI=-90
TXSTART=0

```

Many of the parameters above are similar to those at the repeater Access Point. There are some exceptions.

IMPORTANT

RADIO COMMITCHANS will commit the frequencies for Channels 3 and 4 to enable the LCR to command the OCRs to change to those frequencies upon entering CCM. The steps required are:

1. At IR Link Time, the LCU queries the LCR for BFREQ3, BFREQ4 MFREQ3, and MFREQ4. If the BFREQs are set to zero, it means that Channels 3 and 4 are not available in the current yard.
2. During the phase where the LCU passes information to the OCUs, the LCU passes these frequencies.
3. The OCU sets these parameters in the OCR.
4. Once the LCU is sure that both OCUs have the correct information for Channels 3 and 4, the LCU issues the RADIO COMMITCHANS command to the LCR.
5. After this point, the LCR and OCRs may employ Channels 3 and 4.

If the frequencies for Channels 3 and 4 change because the locomotive associates with a different repeater community with different frequencies for these channels, the LCR will only command the OCRs to use Channels 1 and 2 in Infrastructure Mode until RADIO COMMITCHANS is performed again. If the LCR associates with another community using the same frequencies for Channels 3 and 4, there is no need for this step to be performed for the radios to employ these channels.

Radio Modes are described in more detail in SHL-021, and have not changed since Phase IV. TXSTART must be set to zero, and RADIO MODE=NORMAL must be issued when the LCR is fully configured.

The YARDRSSI value specifies an RSSI threshold above which repeater beacons must be received for the LCR to request a timeslot from the infrastructure. If the RSSI is below this value or the LCR is outside the geographical boundary specified in the repeater beacons, it will not attempt to enter CCM.

```
entraNET> yard ?
usage: YARD [optional arguments as follows]...

<indexed-function>
  CLEAR                ;Clear the Yard Info Cache
  SHOW                ;Show the Yard Info Cache
MODE=<choices>
  NORMAL              ;Normal Operation
  IN                  ;Forced In-Yard
  OUT                 ;Forced Out-Of-Yard
  CMD=<0|1>           dump command line format
Cache is Empty.
```

YARD MODE=IN can be used to simulate being within a yard without GPS NMEA data passed through the AP to the LCR.

4.3 Locomotive Checkout

To verify whether or not the AP and LCR are interoperating properly, view the AP's Starting Information Screen. If the Status is "Initializing", the AP is either establishing communications with the Radio Module, or upgrading the Radio Module, which takes several minutes. If the Status is "Alarmed", there is an issue. Consult the alarm menu to identify the problem. If the Status is "Operational", this means the AP and Radio Module are communicating properly.

For more information, consult the Access Point's Alarm list. Some alarms that may occur are listed below:

Alarm	Possible Causes
Radio Initialization Failed	The Radio Module is either unpowered or the cable between the AP and the Radio Module is incorrectly connected.
No PPS	The Radio Module is not receiving the 1 Pulse Per Second Signal.
Inverted PPS	The Radio Module has detected cross-wiring of the PPS input.
Not Calibrated	The Radio Module has not been factory calibrated.
Synth Out of Lock	The Radio Module's synthesizer is out of lock.
NMEA Data Lost	The Radio Module is not receiving GPS position data.
Entered Yard	The LCU has entered a repeater community.