Fusion 700UCAWSMIMO HP RAU Operation Description

1.1 Tri-Band Remote Antenna Unit Definition

The Tri-Band Remote Antenna Unit (TBR) shown in Figure 1 is part of the Fusion LS System. The TBR support three frequency bands; each band consists of a downlink band (DL1, DL2, and DL3) and an uplink band (UL1, UL2, and UL3). The TBR's main function is to receive and transmits signals from and to the mobiles.

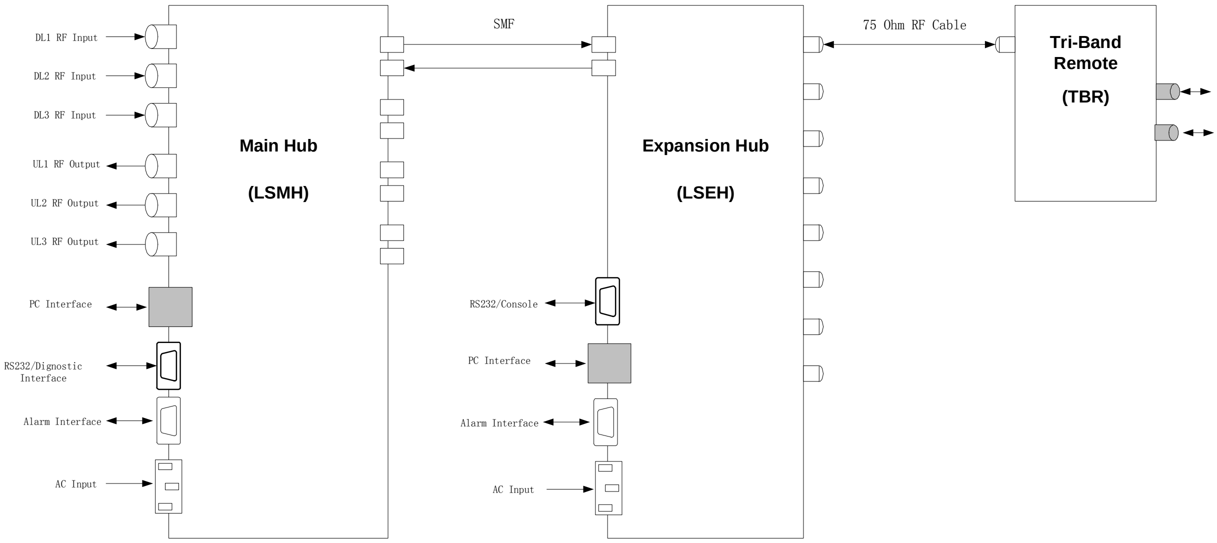

Figure-1: Fusion LS Interface Block Diagram

In the uplink path, the TBR receives the RF signals from an antenna where the signals are filtered, down-converted to IF frequencies and transmitted along with an uplink pilot and FSK via different lengths of coax cable to the Fusion Expansion Hub. At downlink path, the TBR receives the IF signals along with downlink pilot, clock, FSK and DC power from the Fusion Expansion Hub via the same coax cable. The downlink IF signals are filtered and up-converted to RF signals then filtered through a RF filter and two diplexers before the signals are transmitted to the mobiles via an antenna. RS-232 connector is a standard interface to get alarm information and system configuration information.

700ABCAWSMIMO system can support three frequency bands, as below,

Band	Downlink frequency	Uplink frequency	Down link Output power
AWS1	2110-2155(MHz)	1710-1755(MHz)	23.0dBm
AWS2	2110-2155(MHz)	1710-1755(MHz)	23.0dBm
700UC	746-757(MHz)	776-787(MHz)	18.0dBm

Table 1 frequency table and output power

The system don’t need a special antenna configuration, generally, 3dBi gain Omni antennas is used.

1.2 Tri-Band RAU Functional Block Diagram

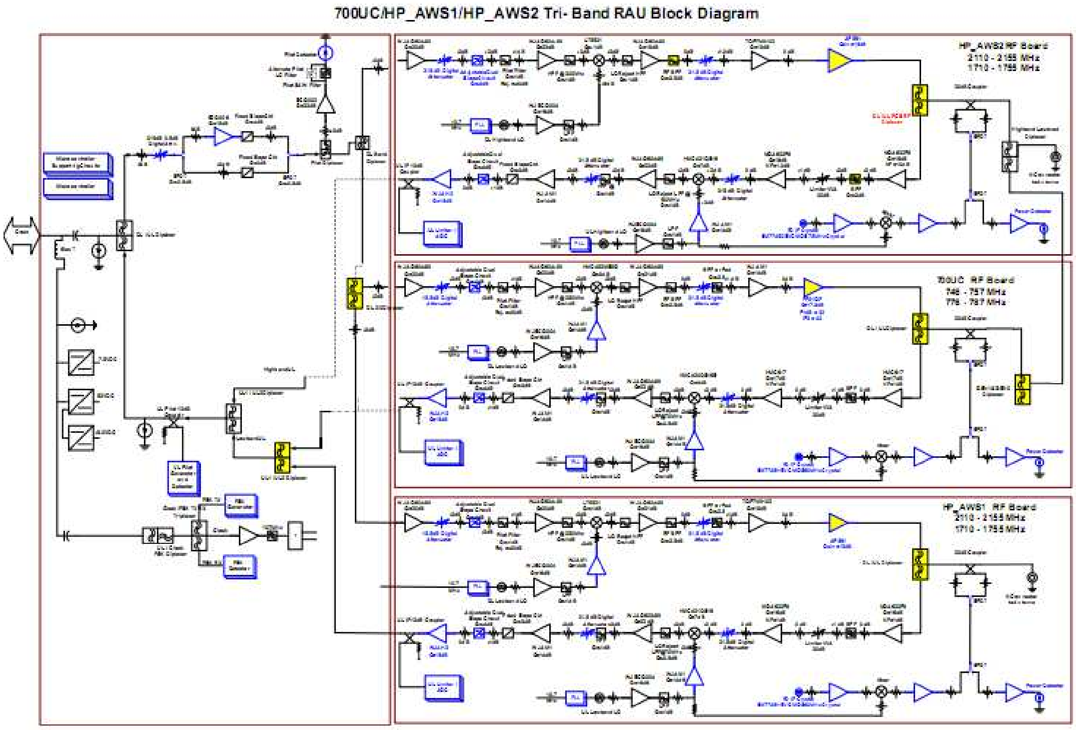

Figure -2: TBR Functional Block Diagram

1.3 Tri-Band RAU Gain Control

The Tri-Band System is required to maintain constant gain even though different cable lengths can be used between the Fusion Expansion Hub and TBR. The TBR will automatically adjust its gain to accommodate for cable loss in the downlink direction. The downlink gain in the Fusion Expansion Hub is fixed, excepting adjustments for unit-to-unit variations and user/operator manual gain controls. In the uplink direction, the converse is true. The Fusion Expansion Hub will compensate for uplink cable loss while the TBR maintains fixed uplink gain (again, except for unit adjustment and user gain controls).

1.3.1 Downlink Gain control

Figure -3 shows a simplified block diagram for downlink gain control. The TBR can be thought of as having two main sections for gain/slope adjustment. The section outlined in red is the common AGC circuit. In this portion of the TBR, gain is adjusted to compensate for the cable loss. Adjustments in this area affect gain for both bands 1, 2. After the AGC circuit, gain and slope are adjusted separately for the two different bands.

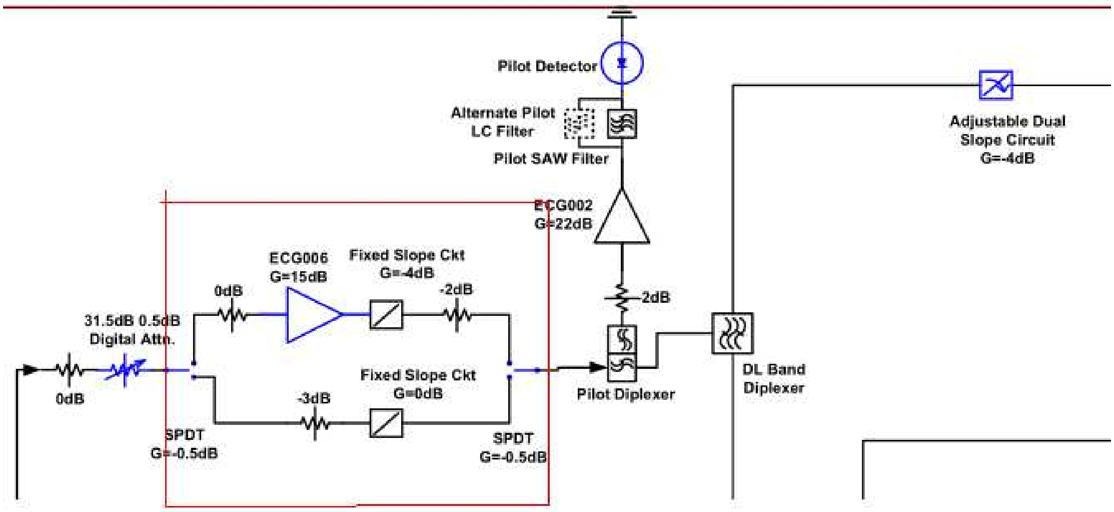

Figure -3: Downlink Gain Control Block Diagram.

A downlink IF pilot is transmitted from the Fusion Expansion Hub via coax cable to the TBR. The level of the pilot signal is a fixed value at the output of the Fusion Expansion Hub. This pilot is used as a reference signal for setting downlink gain in the TBR. It is not passed through the entire signal path of the TBR, but is filtered out before the main signal path is up-converted to RF. Based on the detected level of the pilot signal, the TBR adjusts its DGA to remove the loss introduced by the cable. Slope and gain settings in the TBR are mapped to the received pilot level by making use of a pilot table that is generated during ATE.

1.3.1.1 IF Gain Paths

The front end of the TBR has two different paths, either of which can be selected using an RF switch. The purpose of the two paths is to reduce the required range of the AGC slope circuit and attenuator as well as the dynamic range of the pilot detector.

1.3.1.2 Downlink AGC Gain Adjustment

The signal loss due to the coaxial cable is removed by adjusting the AGC attenuator.

1.3.1.3 Downlink AGC Slope Circuit

The AGC slope circuit is used to remove the IF slope introduced by the coaxial cable.

1.3.1.4 Downlink IF Gain Adjustment

The downlink IF attenuator is primarily used to compensate for unit-to-unit gain variation in the IF path. One IF attenuator has been combined to RFIC chip which exists per band. This attenuator is also used for gain adjustments to compensate for temperature drift.

1.3.1.5 Downlink IF Slope Circuit

The downlink IF Slope circuit in the TBR is used to compensate for unit level slope due to roll off in the downlink IF and RF filters, diplexers and gain stages. As with the IF attenuator, there are three IF slope circuits per TBR: one for each band.

1.3.1.6 Downlink RF Gain Adjustment

The main function of the downlink RF attenuator is to provide user gain adjustment.

Since the Fusion EH has no per-port gain adjustment in the downlink, some gain differences can be expected between ports. If a port has high gain, it will also have a correspondingly high pilot signal. Since the gain and pilot scale together in the hub, most of the per-port gain variation is removed for the system at the TBR. For instance, a TBR that receives a higher-than-expected pilot signal would act as though a shorter-than-expected cable was connected, and would compensate by setting a lower gain. The pilot loss and IF signal loss, however, are not exactly the same on the cable since they are at different frequencies. If the gain and pilot for a particular Fusion EH port were both 1 dB high, the corresponding TBR would compensate by lowering its gain only 0.8 dB, resulting in a system gain error of 0.2 dB for that gain path.

1.3.1.7 Other Downlink circuits:

For other downlink circuits, please see the detail RAU block diagram, for the detail function, please see the table below:

Circuit	Function
Amplifier	Amplify signal
Pilot filter	Reject pilot signal
Mixer	Convert IF signal to be RF signal, base on the RFIC chip
PLL	Supply LO for mixer, base on the RFIC chip
RF BPF	Reject output band spurious
RF diplexer	Isolate downlink and uplink signal
IF diplexer	Split IF signals

Table 2 other circuit

1.3.2 Uplink Path

Figure-4 shows the block diagram of the basic components for uplink gain control. The functions of each block are described below.

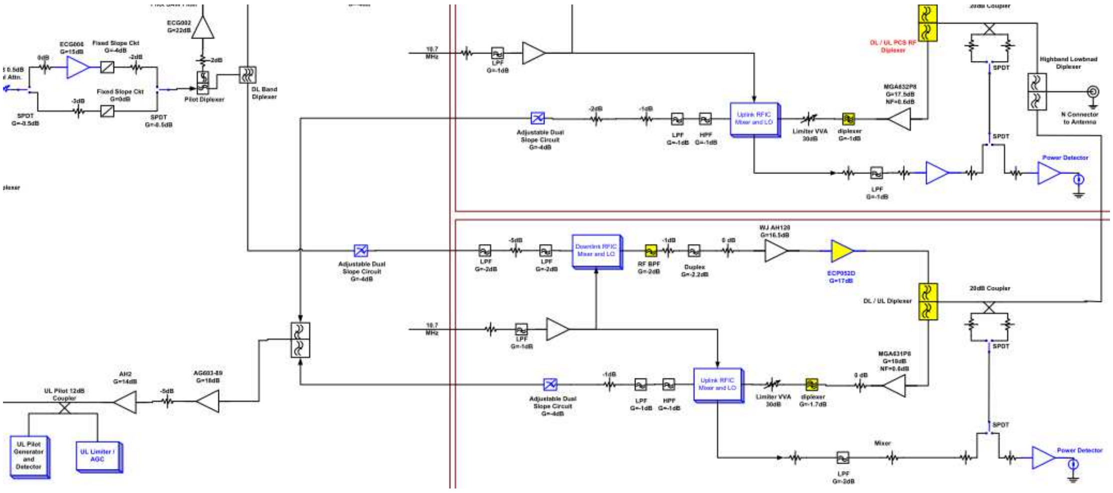

Figure-4: Uplink Gain Control Block Diagram

UL Limiter

The limiter is used to control the maximum uplink input signal level to prevent the system from being overdriven. The uplink signal level is continuously monitored at the UL detector (after the IF slope adjust circuit). If the signal level at the detector exceeds a pre-determined threshold, the UL limiter attenuator will automatically lower the incoming level.

1.3.2.1 Uplink RF Gain Adjustment

The RF attenuator is used primarily to set user gain in the uplink path. It is also used to compensate for unit-to-unit gain variations in the uplink RF path including gain block, mixer, limiter and other component variations.

1.3.2.2 Uplink IF Slope Circuit

The Uplink IF slope circuit is used to compensate for unit-to-unit gain variations in the IF path. No pre-compensation for the slope introduced by the coaxial cable is performed.

1.3.2.3 Uplink IF Gain Adjustment

The Uplink IF attenuator is used to compensate for unit-to-unit gain variations in the IF path. It is also used to correct uplink gain drift due to temperature.

1.3.2.4 Uplink Pilot

A pilot signal is injected into the uplink path after the uplink signals for all three bands have been combined. The pilot is used by the Fusion EH as a reference signal to compensate for gain and slope changes introduced by the coaxial cable.

1.3.2.5 Other uplink circuits:

For other uplink circuits, please see the detail RAU block diagram, for the detail function, please see the table below:

Circuit	Function
Amplifier	Amplify signal

LO reject filter	Reject LO signal
Mixer	Convert RF signal to be IF signal,
PLL	Supply LO for mixer,
RF BPF	Reject output band spurious
Diplexer	Isolate downlink and uplink signal
IF diplexer	Combine IF signal

Table 3 function part

1.3.3 Other circuits:

Except downlink and uplink circuits, there are other common circuits for downlink and uplink, please see the table below:

LO reject filter	Reject LO signal
Micro controller	Control uplink and downlink gain, LO frequency, detects current and alarm signals
Micro controller support circuits	Just used to support micro controller like expands the port of controller.
DC-DC	Convert input 54V DC power to be 7.5v,5.2V and 3V for other circuits of RAU
FSK circuit	Generate FSK signal for Expansion HUB and receive FSK signal from Expansion HUB
DL/UL diplexer	Split downlink and uplink IF signals

Table 4 function circuit

About the DC voltage and current for RAU list as below table,

Voltage	Current	Description
54 voltage	0.70Amp	RAU total dissipation
12voltage	1.2 Amp	For three downlink PA
7.5voltage	2.8Amp	For IF/RF amplifier
5.0voltage	0.2Amp	For MCU, Mixer and PLL
3.3voltage	0.2Amp	PLL and digital circuit

Table 5 DC voltage and current

1.4 BW supported for LTE:

AWS band can support all BWs of LTE which includes 1.4MHz, 3MHz, 5MHz, 10MHz.