ERICSSON

Radio Dot System

Baseband Radio Node

Feature Description

224/221 04-LZA 701 6014/1 Uen S2B

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Contents

1 Introduction

This document describes the Radio Dot System feature and its main benefits and impacts in the LTE RAN and WCDMA RAN.

1.1 Basic Characteristics

Table 1 Basic Characteristics

Feature name:	Radio Dot System
Product identity:	LTE: FAJ 121 4162 WCDMA: FAJ 121 4125
Replaces:	N/A
Dependencies:	See Associated Features and Affected Functions on page 27 for more information.
Licensing:	Licensed feature. One RDS license is required for every 5 MHz sector carrier for both LTE and WCDMA.
Feature activation MO:	RadioDotSystem

1.2 Radio Dot System Summary

As the indoor traffic is increased, the major benefit of the Radio Dot System (RDS) feature is to provide mobile broadband coverage for medium to large indoor areas in a cost-effective way.

This benefit is obtained as a result of the following:

— A high-capacity indoor small-cell solution:

- Scalable to meet current and future service and device needs
- Flexible and simple to add frequency, capacity, and other technologies
- Macro cell-based architecture with pooled baseband resources enables optimal capacity distribution

— Quick and easy deployment:

- Uses Radio Dot (RD), which is ultra-compact and simple installation with minimal visual impact

- Uses standard Local Area Network (LAN) cabling, which reduces cost, complexity, and power consumption
- Enables one network with extension of the existing network and simplified RF design

— Feature parity and evolution with Ericsson leading radio portfolio:

- An indoor solution fully coordinated with an outdoor network in terms of features, functions, and interoperability

Figure 1 shows the different preferred deployments depending on building size. It highlights a large opportunity for medium-large buildings, venues ideal for the RDS solution.

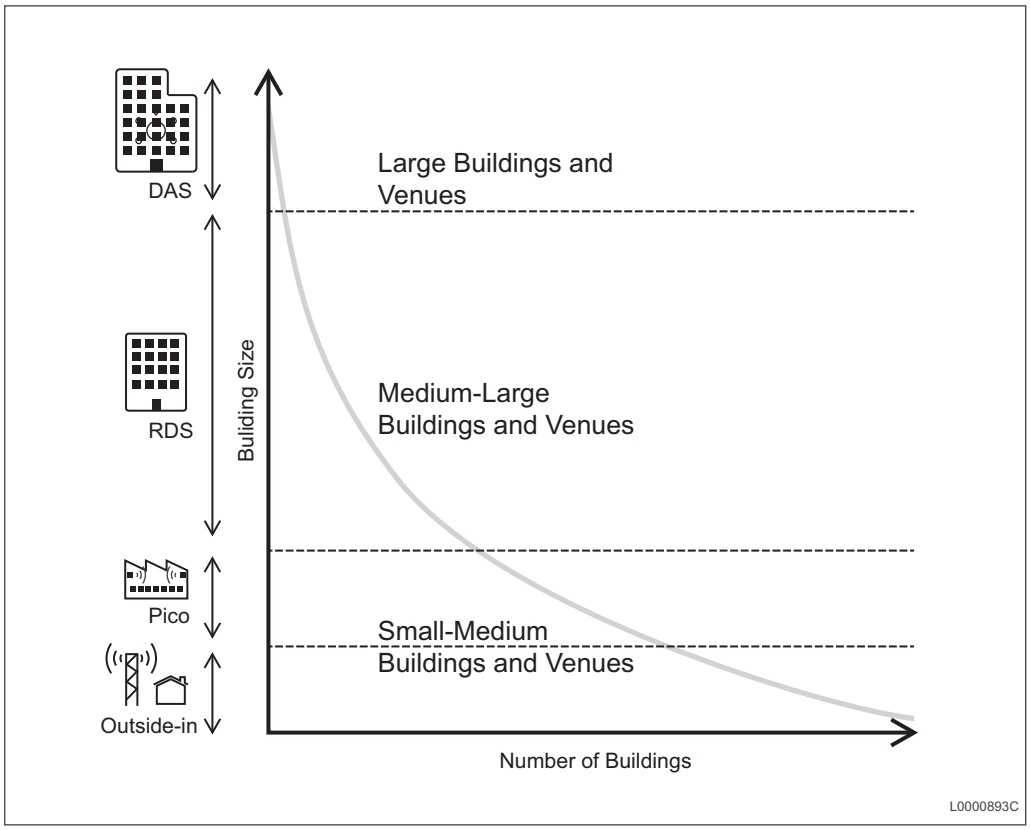

Figure 1 Indoor Network Deployment Options

1.3 Additional Information

More information about this feature can be found in the RDI Cabling Guidelines 56/1553-LZA 701 6009/1 (site library) and the following documents:

— Indoor Radio Unit Description

- Install Radio Dot
- Non-RF Connections
- Radio Dot Description
- Replace Indoor Radio Units

2 Feature Operation

The RDS is an indoor, low-power radio system that consists of Baseband units, Indoor Radio Units (IRUs), and RDs.

Figure 2 shows an example of an RDS deployment.

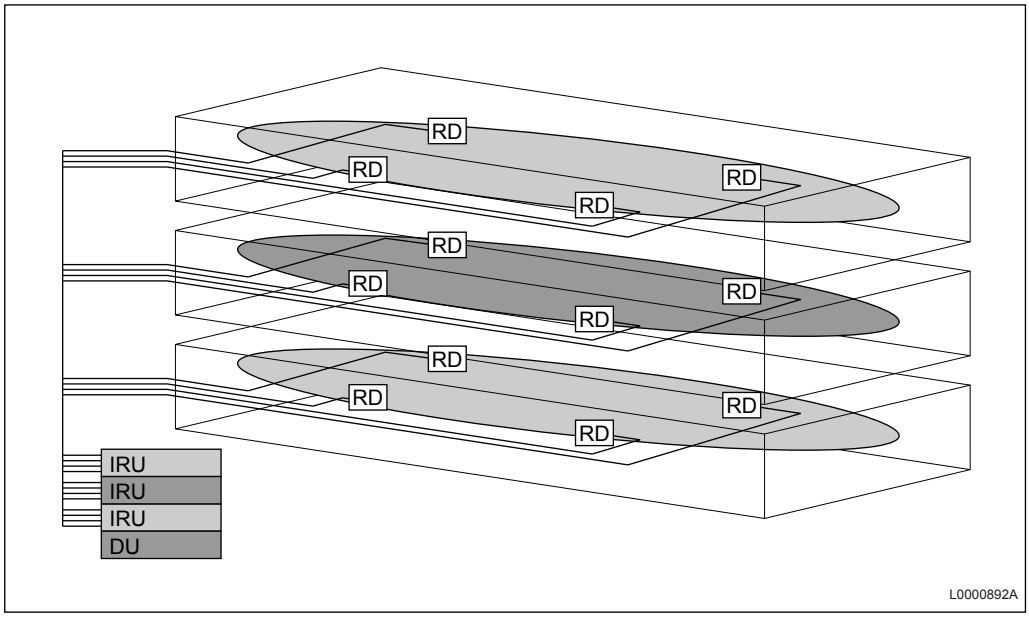

Figure 2 Example of an RDS Deployment.

A macro cell that implements RDS consists of an RBS 6202 or RBS 6601 cabinet including a Baseband connected to one or more IRUs.

The RD supports two antenna branches, and it is used for frequency conversion, carrier transmission and amplification. The RD is represented by the `FieldReplaceableUnit` MO for RD.

The IRU distributes the carriers to the RDs and supplies power to the RDs through the Radio Dot Interface (RDI). The IRU is represented by the `FieldReplaceableUnit` MO for IRU.

The MOs representing not installed RDs have the `availabilityStatus` attribute set to `NOT_INSTALLED`, and no alarms are raised on these MOs. After the RD is connected to the IRU for the first time fault supervision is started and alarms are raised on the MO until the RD is either locked or unistalled using `resetUnitInstallation` MO action.

The RDS supports WCDMA Single Mode, LTE Frequency Division Duplex (FDD) Single Mode and LTE Time Division Duplex (TDD) Single Mode technologies only.

RDS Deployment

The RD supports two antenna branches, and it is used for frequency conversion, carrier transmission and amplification.

The IRU distributes the carriers to the RDs and supplies power to the RDs through the Radio Dot Interface (RDI).

The RDI is used for power and signal transmission between the IRU and the RD. The RDI is represented by the `RdiPort` MO.

Figure 3 describes the MO connections for the RDS. The `rfBranchRef` attribute in the `SectorEquipmentFunction` MO is set to refer to the `MulticastAntennaBranch` MO. The `transceiverRef` attribute in the `MulticastAntennaBranch` MO is set to refer to the `Transceiver` MO. All RDs (`Transceiver` MOs) connected to an IRU must be referenced to both `MulticastAntennaBranch` MOs.

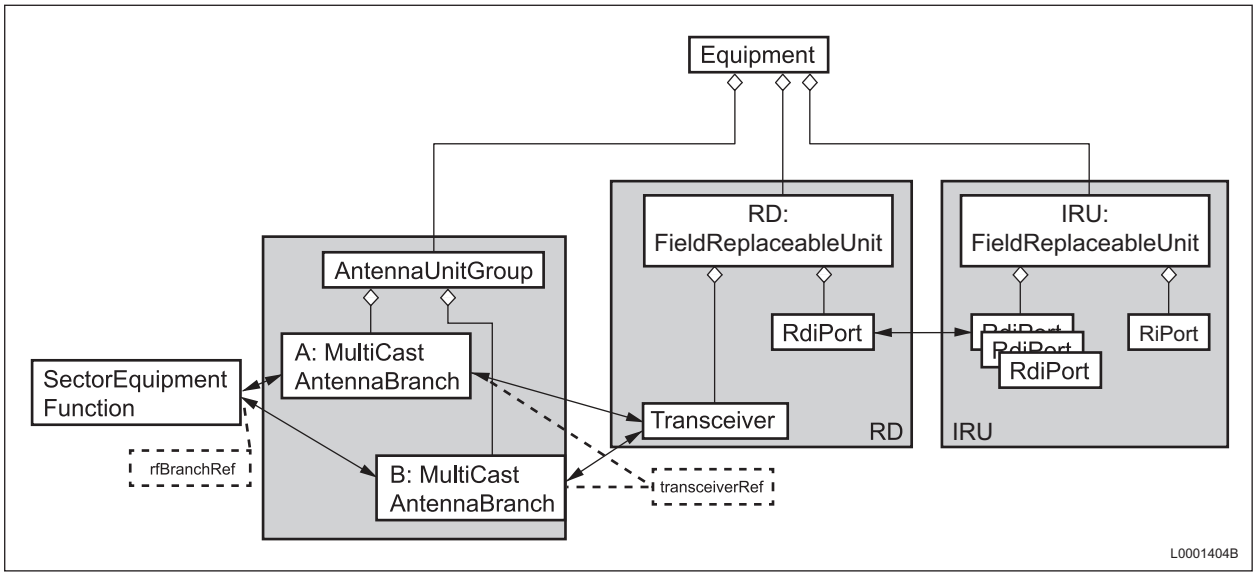

Figure 3 RDS MO Relations

The carriers generated by the Baseband are converted to a modulated signal by the IRU and distributed to the RDs over regular LAN network cables.

2.1 Network Requirements

This feature has no prerequisite network configuration requirements.

2.2 Radio Dot System Feature Configurations

The RDS has standard configurations supported for LTE and WCDMA RAN.

For specifications on all supported configurations, refer to RBS Configurations.

Note: LTE Only: 7-12 cells on one Baseband is dependent on 7-12 Cell Support and 6 Cell Support. 19-24 cells on one Baseband is dependent on 19-24 Cell Support, 13-18 Cell Support, 7-12 Cell Support and 6 Cell Support.

Figure 4 and Figure 5 show examples of Baseband configurations for RDS.

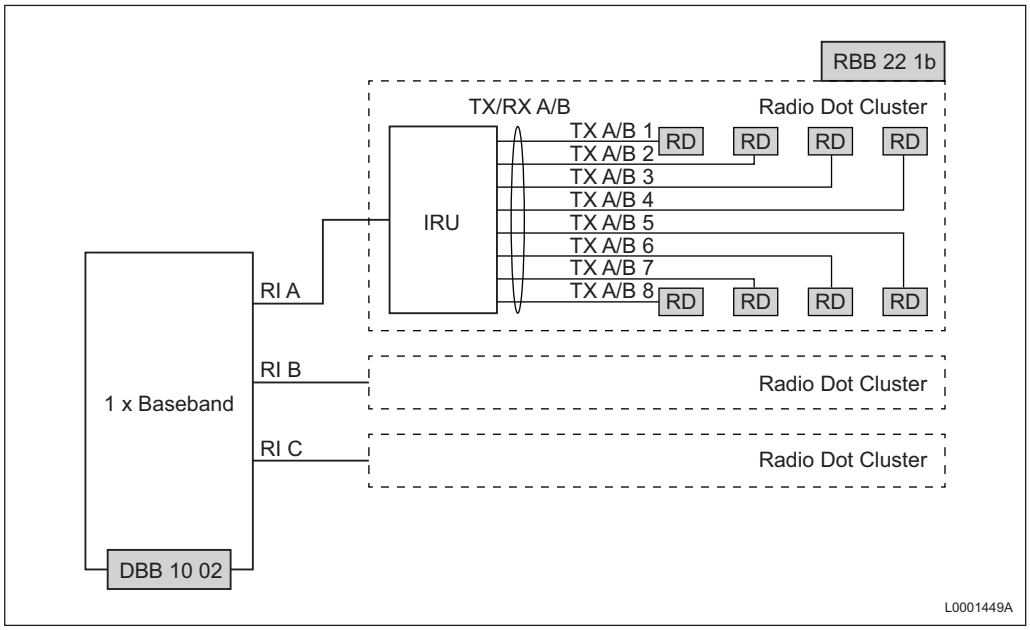

Figure 4 Example: One Baseband Unit and Three IRUs

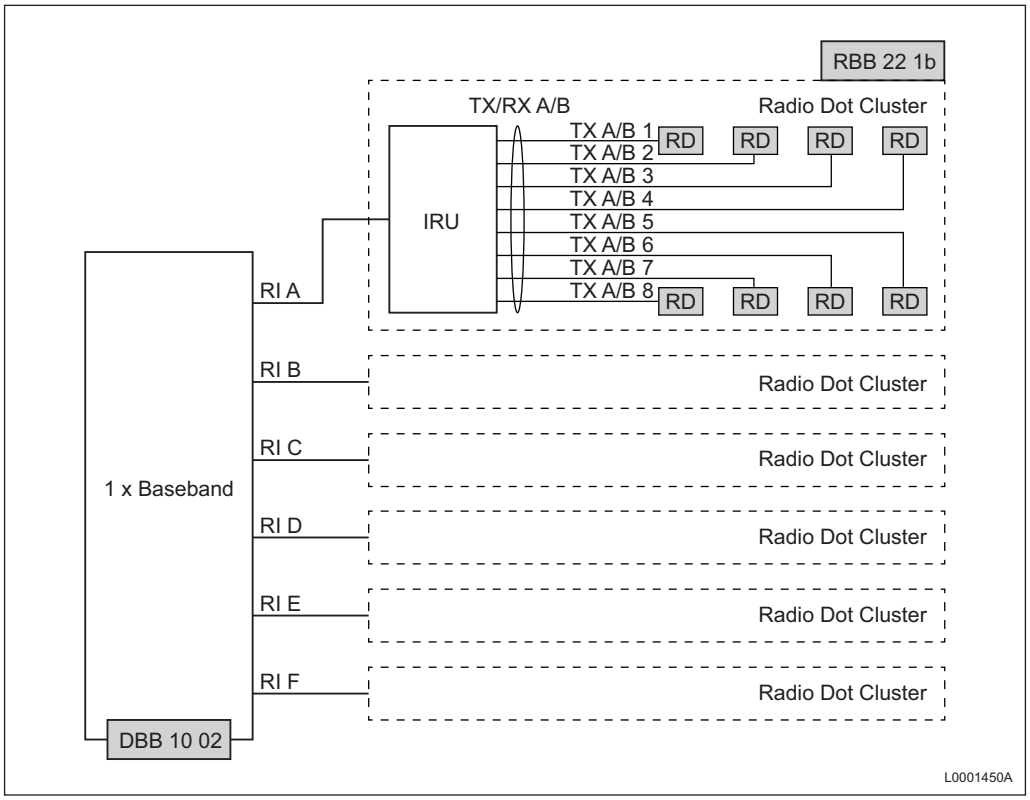

Figure 5 Example: One Baseband Unit and Six IRUs

2.2.1 12 Cell Support

For a support of greater than 6 cells, the 7-12 Cell support feature needs to be procured.

The figure below shows an example of a dual DUSBaseband configuration with 7-12 IRUs within one RBS 6202 cabinet.

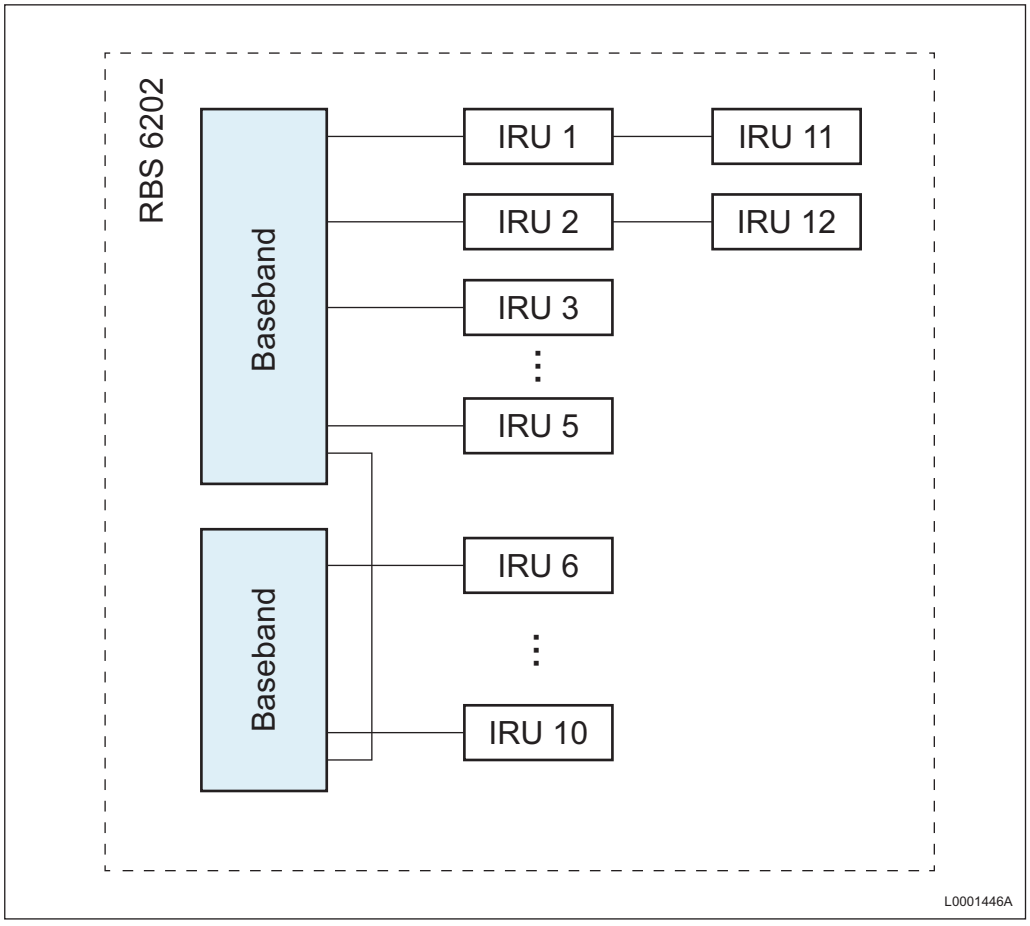

Figure 6 Example: Dual DUS/Baseband with 12 IRU Configuration

The following figure shows an example of single baseband with 12 IRUs.

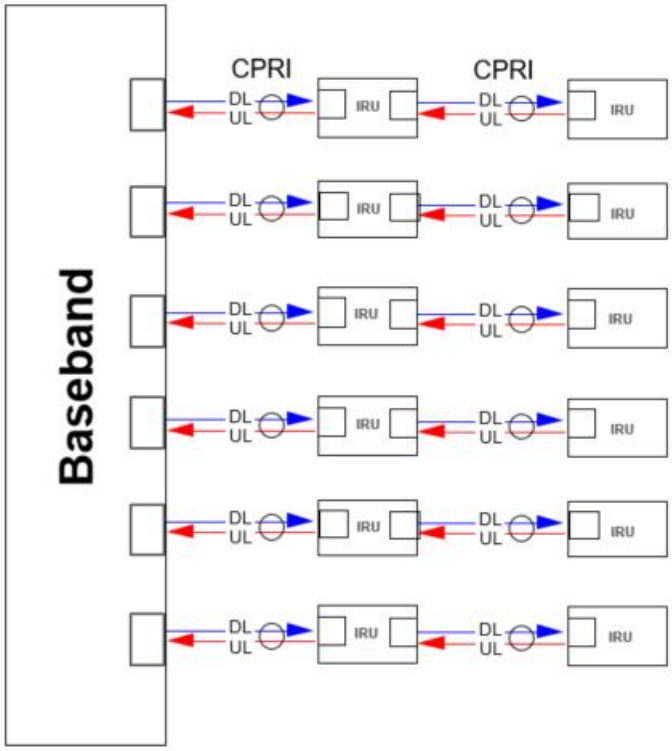

Figure 7 Example: Single Baseband with 12 IRU Configuration

2.2.2 18 Cells Support with One Baseband

The 18 Cells Support with one Baseband only applies to LTE. The 18 Cells Support configuration supports up to 18 IRUs on one LTE Baseband 5216 or Baseband 6630 with or without one Baseband R503. In a cascaded configuration, the first IRU in the cascaded chain must be an Enhanced IRU (E-IRU). The speed of the aggregated CPRI is entirely dependent on the capability of the baseband and the carrier bandwidth used. For more information on cascaded IRU configuration, refer to RDS Configuration Options, 1/1551-FGB 101 0308/1 and RBS Configurations, 24/1551-LZA 701 6001/1.

Note: Baseband R503 is an optional hardware unit that increases connectivity for new and existing radio units in large radio system configurations. It is a platform for CPRI rearrangement, for instance, multiplexing / de-multiplexing as well as media conversion (electrical to and from optical).

The following features must be enabled for 18 Cells Support:

— 6 Cell Support, FAJ 121 1821

For information on this feature, refer to 6 Cell Support.

— 7-12 Cell Support, FAJ 121 3020

  For information on this feature, refer to 7-12 Cell Support, 171/221 04-LZA 701 6014/1.

— 13-18 Cell Support, FAJ 121 4242

  For information on this feature, refer to 13-18 Cell Support, 4/221 04-LZA 701 6014/1.

The following figures are examples of 18 IRU Support configuration:

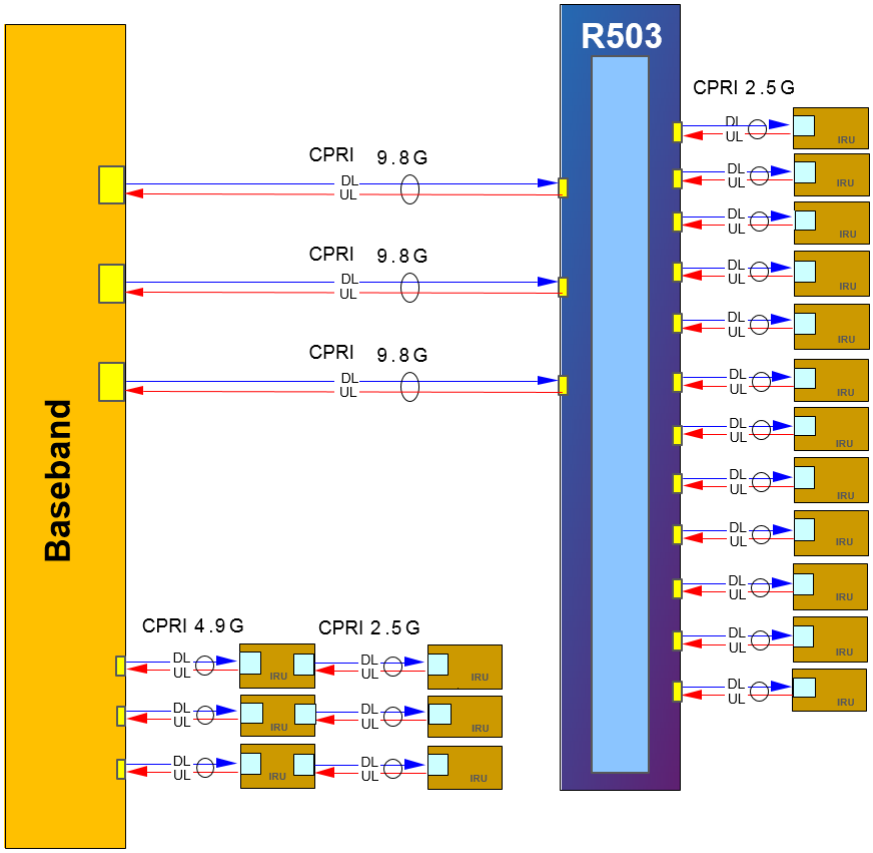

Figure 8 18 Cells Support with Baseband R503

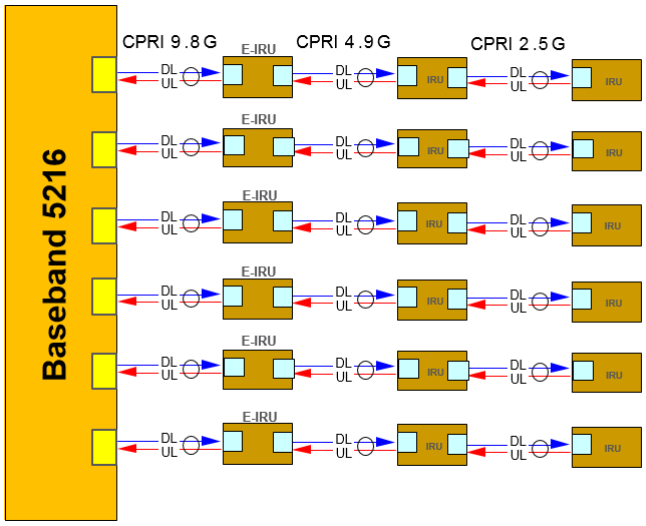

Figure 9 18 Cells Support with Baseband 5216 and Cascaded IRU

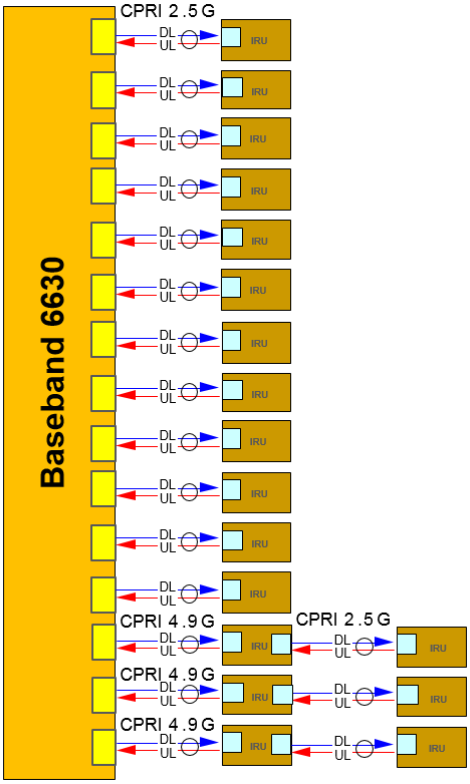

Figure 10 18 Cells Support with Baseband 6630

2.2.3 24 Cell Support with One Baseband

The 24 Cells Support with one Baseband only applies to LTE. The 24 Cells Support configuration supports up to 24 IRUs on one LTE Baseband 5216 or

Baseband 6630 with or without one Baseband R503. In a cascaded configuration, the first IRU in the cascaded chain must be an Enhanced IRU (E-IRU). The speed of the aggregated CPRI is entirely dependent on the capability of the baseband and the carrier bandwidth used. For more information on cascaded IRU configuration, refer to RDS Configuration Options, 1/1551-FGB 101 0308/1 and RBS Configurations, 24/1551-LZA 701 6001/1.

Note: Baseband R503 is an optional hardware unit that increases connectivity for new and existing radio units in large radio system configurations. It is a platform for CPRI rearrangement, for instance, multiplexing / de-multiplexing as well as media conversion (electrical to and from optical).

The following features must be enabled for 18 Cells Support:

— 6 Cell Support, FAJ 121 1821

  For information on this feature, refer to 6 Cell Support.

— 7-12 Cell Support, FAJ 121 3020

  For information on this feature, refer to 7-12 Cell Support, 171/221 04-LZA 701 6014/1.

— 13-18 Cell Support, FAJ 121 4242

  For information on this feature, refer to 13-18 Cell Support, 4/221 04-LZA 701 6014/1.

— 19-24 Cell Support, FAJ 121 4426

  For information on this feature, refer to 19-24 Cell Support, 347/221 04-LZA 701 6014/1.

The following figures are examples of 24 IRU Support configuration:

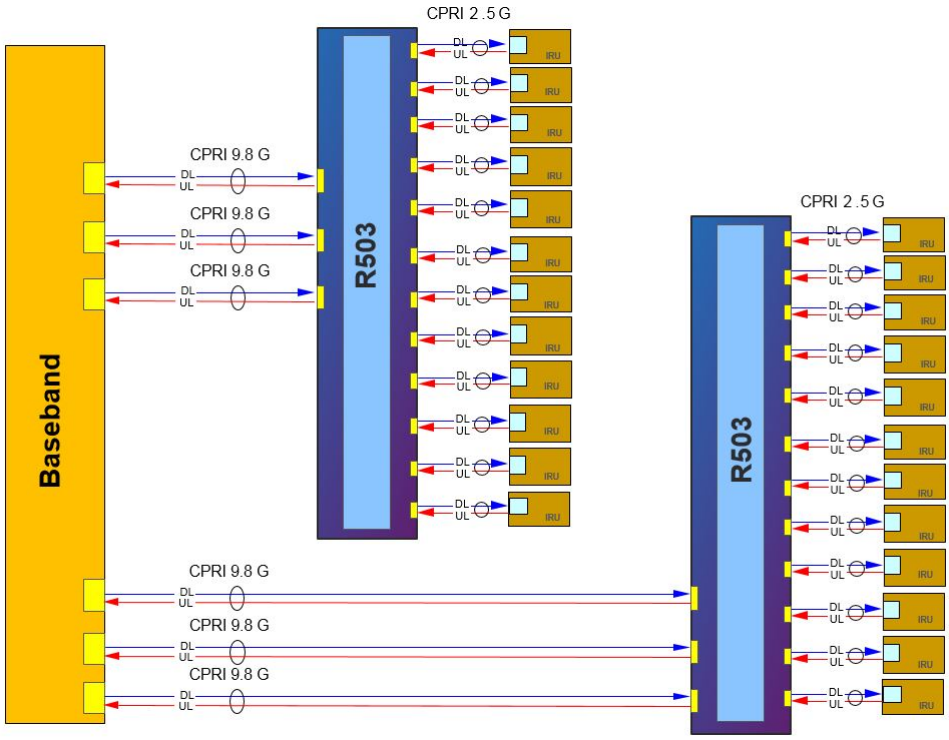

Figure 11 24 Cells Support with Baseband R503

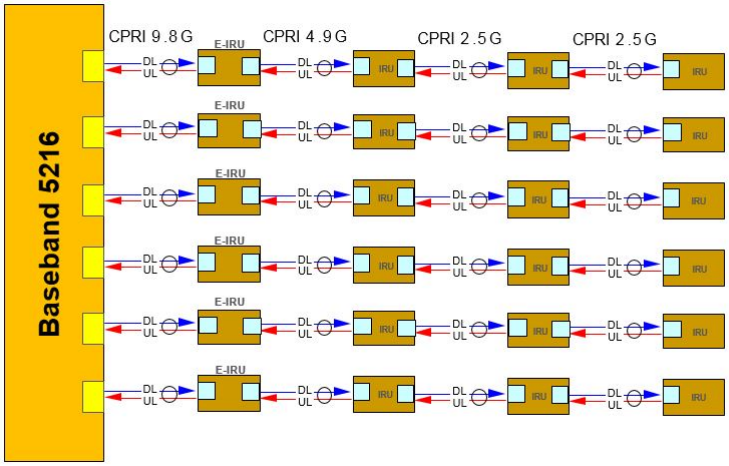

Figure 12 24 Cells Support with Baseband 5216 and Cascaded IRU

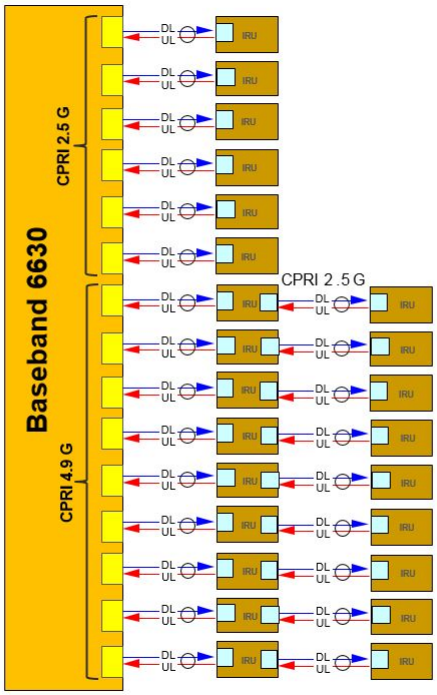

Figure 13 24 Cells Support with Baseband 6630

2.2.4 Multi-Standard Managed Element (MSME) Baseband

A Multi-Standard Managed Element (MSME) is a Baseband radio node ME which runs two Radio Access Technologies (RATs) simultaneously, using a single Baseband unit (Baseband 5216 or Baseband 6630). It is possible to use a combination of single mode and mixed mode IRUs. The IRU can be shared with two different RATs or a single IRU can have a single RAT.

The feature license and activation of the feature Mixed Mode Baseband is required for each RAT to operate a mixed mode ME:

— Mixed Mode Baseband LTE, FAJ 121 4565

— Mixed Mode Baseband WCDMA, FAJ 121 4566

The feature license and activation of the feature Mixed Mode Radio is required for each RAT for sharing radio units.

— Mixed Mode Radio LTE, FAJ 121 0906

— Mixed Mode Radio WCDMA, FAJ 121 1553

The feature license and activation of the feature 7-12, 13-18 or 19-24 Cell Support is required when the configuration exceeds six cells.

A maximum number of 12 IRUs can be connected to one MSME Baseband.

The maximum capacity for an MSME Baseband 5216 or an MSME Baseband 6630 is:

— LTE: 12 cells with 20 MHz carrier

— WCDMA: 12 cell carrier with 5 MHz carrier

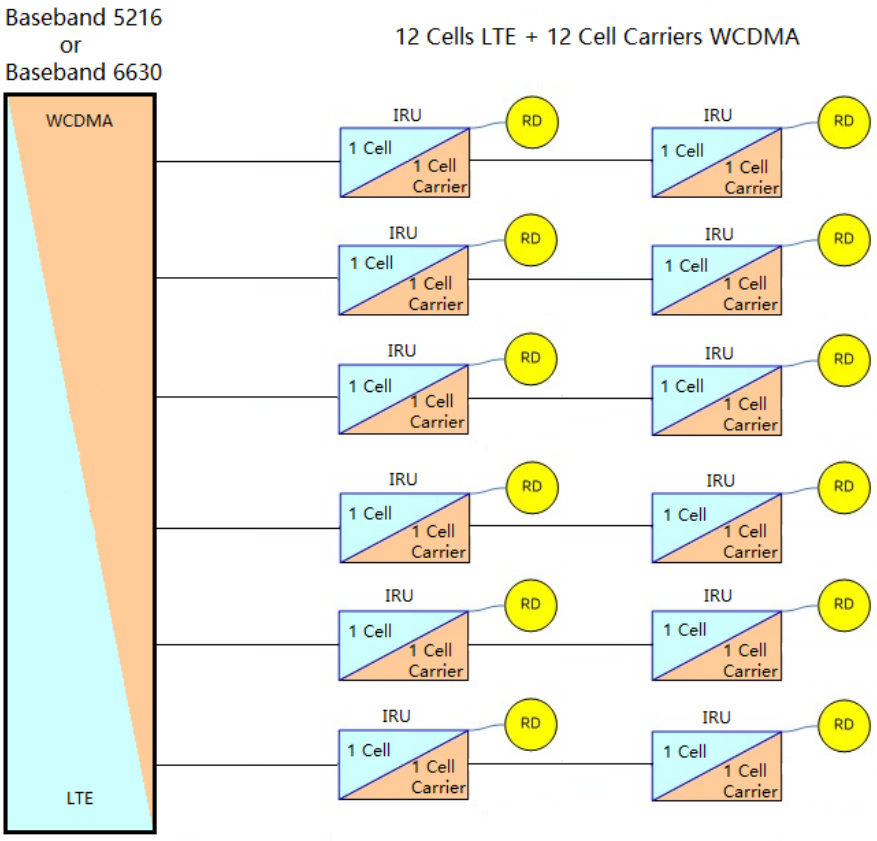

Figure 14 MSME Baseband - LTE and WCDMA

For more information on managing Mixed Mode Managed Element and Mixed Mode Radio, refer to the following documents:

— Manage Mixed Mode Managed Element, 63/1553-LZA 701 6014/1

— Manage Mixed Mode Radio, 53/1553-LZA 701 6014/1

2.2.5 Multi-Operator RAN Configuration, LTE Only

Each node in a Multi-Operator RAN configuration has a separate radio configuration, although the radios are shared. IRUs in Multi-Operator RAN are configured with a Radio Building Block (RBB) that supports a shared radio. The IRUs must also be configured as using mixed mode.

The following figure shows an example of a Multi-Operator RAN configuration where both nodes share IRUs.

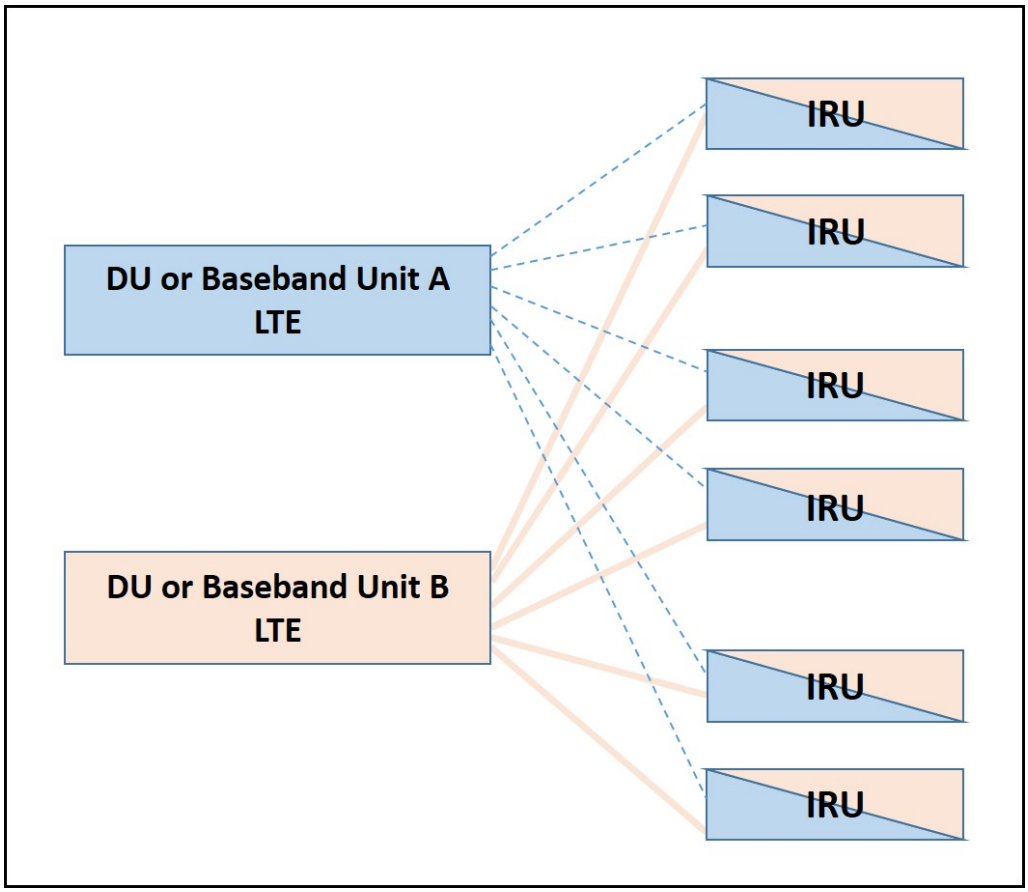

Figure 15 Multi-Operator RAN Configuration Example

The supported radio configurations and carrier allocations are defined in *RBS Configurations,* 24/1551-LZA 701 6001/1.

The output power is limited to the maximum transmit power of the total RD power. Each carrier added must equally share the total available power per antenna branch. If the maximum available power is exceeded, the cells are not enabled.

For more information on the Multi-Operator RAN in the RDS, refer to *Multi-Operator RAN*, 14/1553-FGB 101 0308/1.

2.2.6 Distributed IRU Configuration, LTE Only

This section describes the configuration of the LTE nodes for the distributed deployment that provides a longer distance between the Baseband and the IRUs. The distributed IRU configuration is a multiple cabinet solution where the Baseband is placed in one cabinet and 1–2 IRUs in other cabinets remotely.

The multicabinet control feature is used to control the support system in the remote cabinets. For more information about the multicabinet control feature, refer Multicabinet Control. For more information about configuring the support system, refer to Manage Hardware Equipment.

Typical configuration examples for LTE nodes are as follows:

— One cabinet with Baseband and IRUs used as the main unit with two remote RBS 6601 cabinets housing 1–2 IRUs without a Baseband as shown in Figure 16.

  For information about how the IRUs can be cascaded, refer to Cascadable Radio Units.

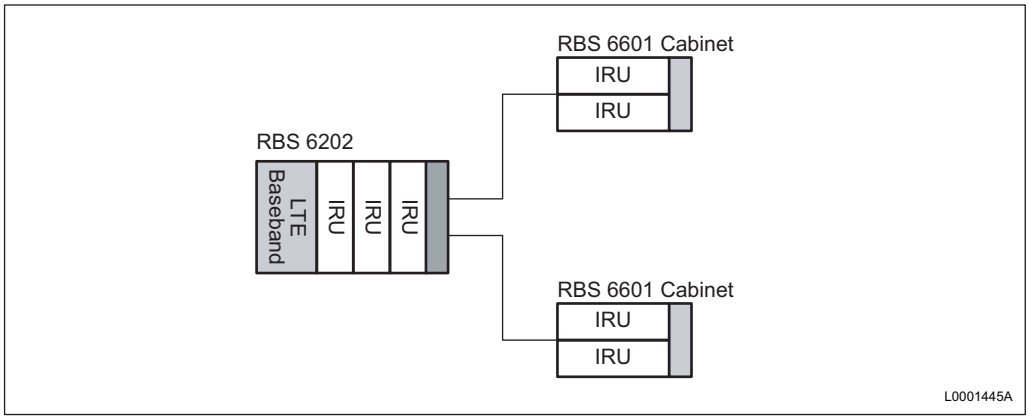

Figure 16 Remote Cabinets Housing IRUs without Baseband, Example 1

— One cabinet with Baseband used as the main unit with up to six remote RBS 6601 cabinets housing IRUs without a Baseband as shown in Figure 17.

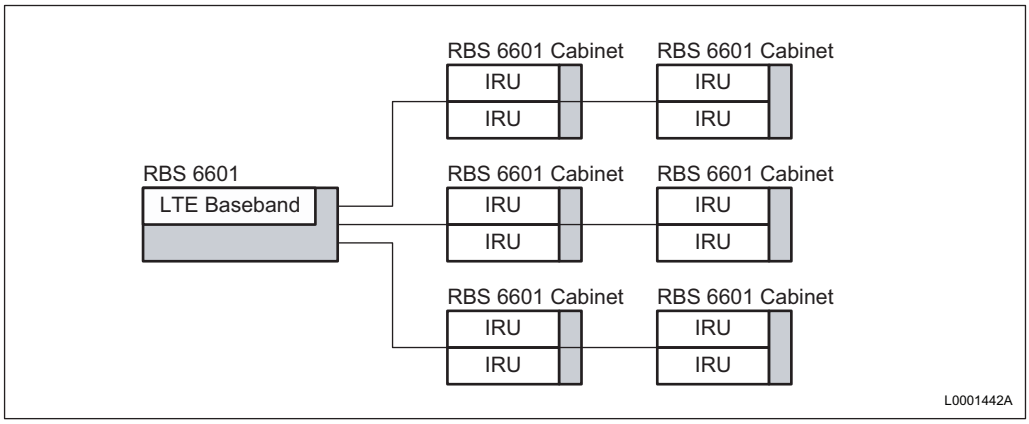

Figure 17 Remote Cabinets Housing IRUs without Baseband, Example 2

2.2.7 Distributed IRU Configuration, WCDMA Only

This section describes the configuration of the WCDMA nodes for the distributed deployment that provides a longer distance between the Baseband and the IRUs. The distributed IRU configuration is a multiple cabinet solution where the Baseband is placed in one cabinet and 1–2 IRUs in remote cabinets.

The multicabinet control feature is required to control the support system in the remote cabinets. For more information about the multicabinet control feature, see Multicabinet Control. For more information about configuring the support system, see Support System.

WCDMA supports a maximum of 12 IRUs.

Each cabinet controls climate, power, and external alarms individually. For configuration details, refer to RBS Configurations and RBS Configuration Rules.

Typical example configurations for the WCDMA node are as follows:

— One cabinet with Baseband and IRUs used as the main unit with two remote RBS 6601 cabinets housing IRUs without a Baseband as shown in Figure 18.

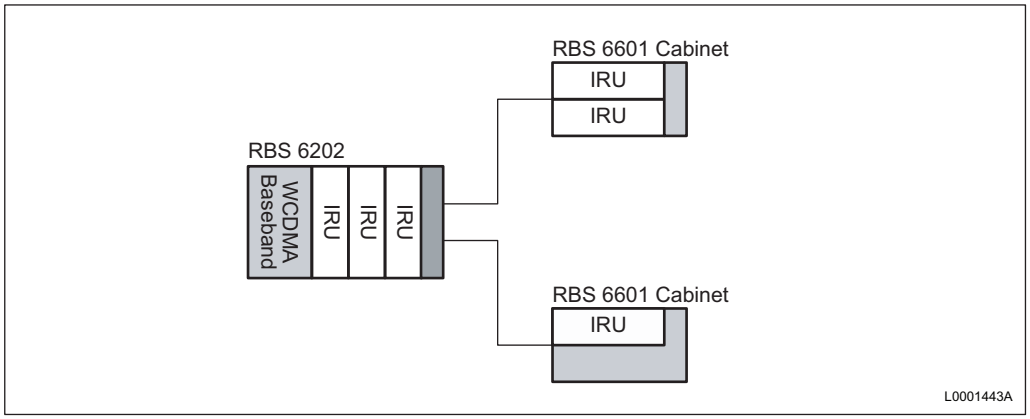

Figure 18 Remote Cabinets Housing IRUs without Baseband

— One cabinet with Baseband used as the main unit with up to six remote RBS 6601 cabinets housing IRUs without a Baseband as shown in Figure 19.

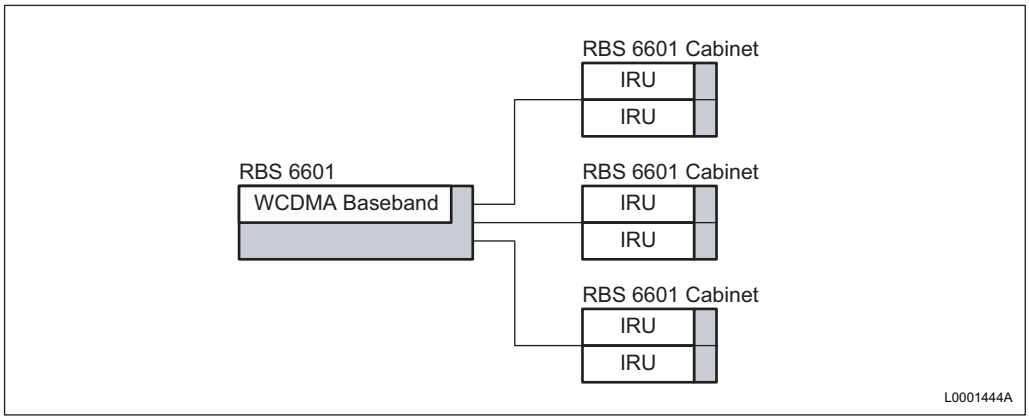

Figure 19 Remote Cabinets Housing IRUs without Baseband

2.2.8 Distributed IRU Using Remote IRU Enclosure 2242

The Remote IRU Enclosure is not a cabinet but offers the possibility to use AC power to feed the enclosure and the IRU housed in it. Each enclosure hosts one IRU. A maximum of 12 enclosures can be deployed per Digital Unit or Baseband.

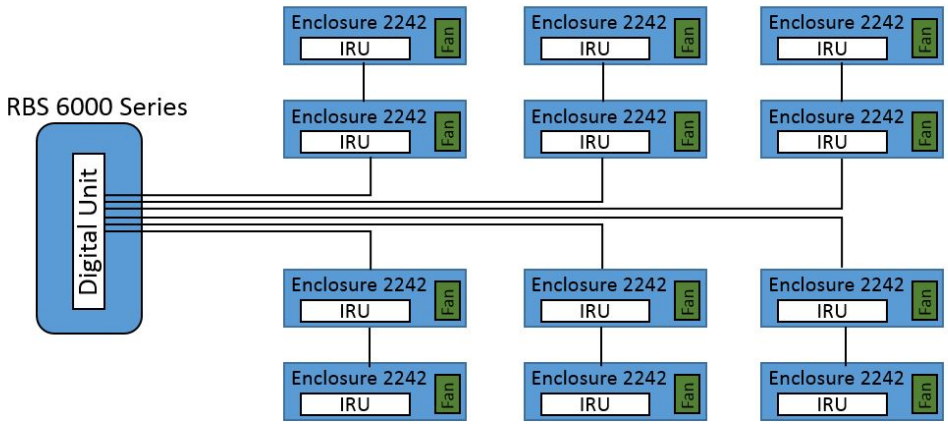

Figure 20 Distributed IRU Using Remote IRU Enclosure 2242

For more information on the Remote IRU Enclosure 2242, refer to Remote IRU Enclosure 2242 Description 2/1551-FGB 101 0308/1.

2.2.9 4x4 MIMO on RDs Configuration, LTE Only

A 2x2 MIMO network configuration consists of one IRU with up to 8 RDs installed. To support 4x4 MIMO and achieve stable performance, the RDS requires a second IRU with additional RDs (up to eight) installed. These additional RDs are co-located in close proximity to the RDs connected in the first

IRU or distributed throughout the landscape. The two IRUs are configured in the same cell.

Typical RDS 4x4 MIMO greenfield network deployments for Co-Located and Distributed RDs using single band or dual band RDs are shown in the following figures. The connectivity is common to both Co-Located and Distributed RD deployments, but the difference is the placement and distribution of the RDs in the landscape.

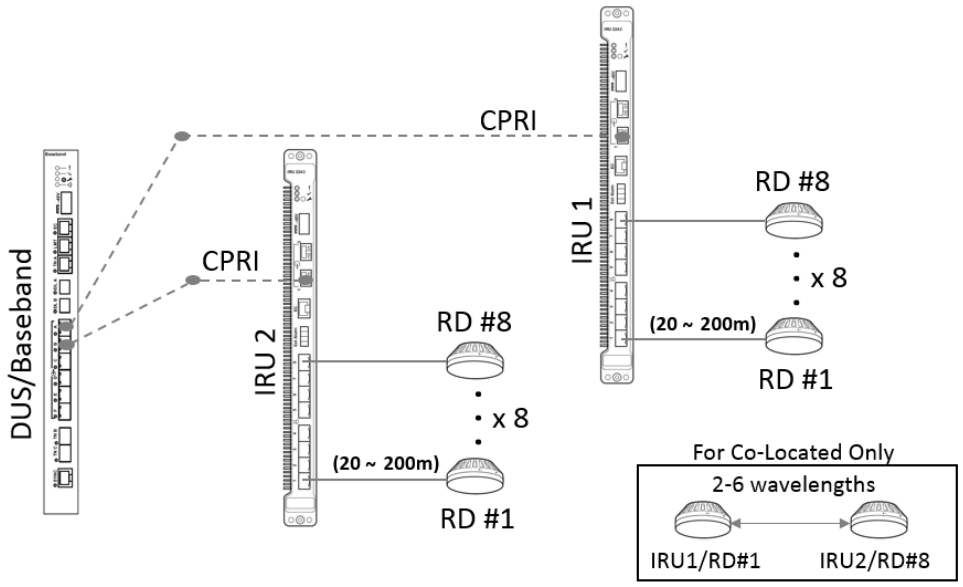

Figure 21 Co-Located and Distributed 4x4 MIMO Configuration (Single Band RDs)

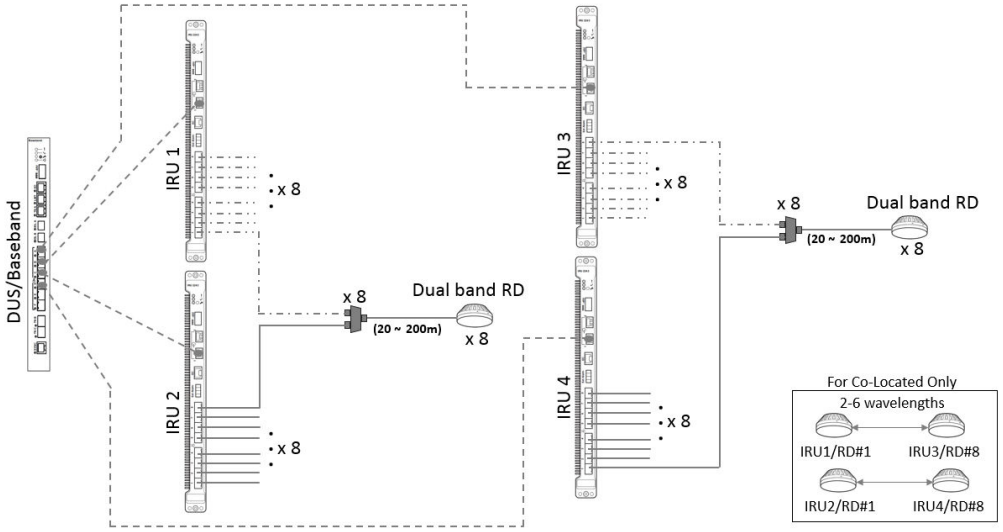

Figure 22 Co-Located and Distributed 4x4 MIMO Configuration (Dual Band RDs)

An existing 2x2 MIMO deployment using single band RDs can be migrated to a Distributed 4x4 MIMO deployment using single band RDs as shown in the following figure. In this case, the existing network requires an additional IRU for each IRU deployed and a re-distribution of the RDs to different IRUs.

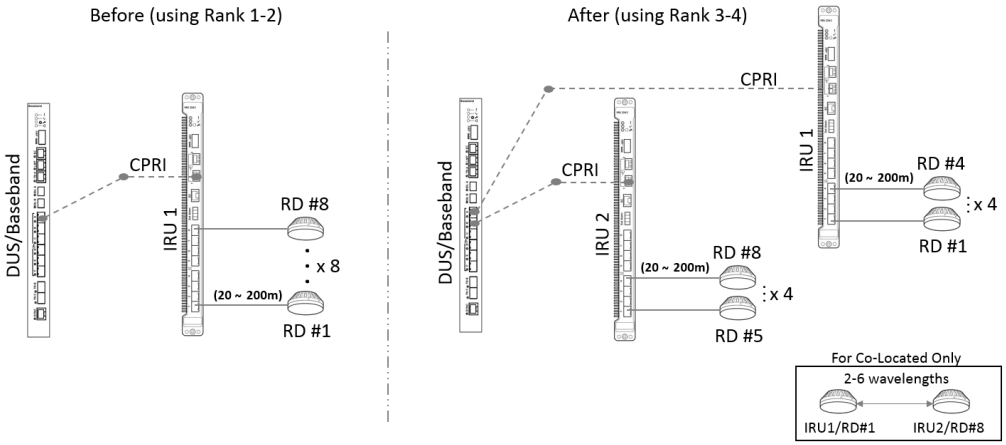

Figure 23 2x2 MIMO (Single Band RDs) Migration to Distributed 4x4 MIMO

For detailed information on 4x4 MIMO, refer to 4x4 MIMO on Radio Dots (RDs), 12/1553-FGB 101 0308/1.

2.3 Radio Dot System Power and Bandwidth Configuration

The RDS consists of RDs with the same output power, connected to an IRU.

For LTE FDD the maximum output power for each RD is 100 mW (2 × 50 mW) with a minimum output power of 16 mW (2 × 8 mW) for each carrier.

For LTE TDD the maximum output power for each RD is 100 mW (2 × 50 mW) with a minimum output power of 50 mW (2 × 25 mW) for each carrier. The maximum output power for each RD 2243 B40A or B41 is 250 mW (2 x 125 mW).

Note: For RDS in LTE RAN, this is no longer the sum of the power for all the antennas used by the sector. It is the power for each RD.

For WCDMA the maximum output power for each RD is 100 mW (2 × 50 mW) with a minimum output power of 16.7 mW (2 × 8.3 mW) for each carrier.

In LTE RAN, the power settings are handled using the SectorCarrier::configuredMaxTxPower attribute.

In WCDMA RAN, the power settings are handled using the NodeBSectorCarrier::configuredMaxTxPower attribute.

Maximum 4 × 5 MHz WCDMA carriers, or up to 2 × 20 MHz LTE carriers can be configured individually on a single IRU on the same radio band.

Note: LTE bandwidth configurations of 1.4 MHz and 3 MHz are not supported by the Radio Dot System.

3 Parameters

3.1 Feature Configuration Parameters

The following parameters are used to configure this feature:

- `altitude`
- `geoDatum`
- `latitude`
- `longitude`
- `remoteRdiPortRef`
- `rfBranchRef`
- `transceiverRef`

3.2 Affected Parameters

Table 2 lists the parameters affected by this feature.

Table 2 Affected Parameters in LTE RAN

Parameter	Description
`SectorCarrier::configuredMaxTxPower`	In the RDS, this is the power for each RD. The power is limited in RDS to a maximum of 100mW.
`EUtranCellFDD::pZeroNominalPucch`	The nominal component of the UE transmit power for Physical Uplink Control Channel (PUCCH). The default value (−117 dBm) does not work for RDS. Recommended value for RDS: −96 dBm.
`EUtranCellFDD::pZeroNominalPusch`	The nominal component of the UE transmit power for Physical Uplink Shared Channel (PUSCH). The default value (−103 dBm) does not work for RDS. Recommended value for RDS: −80 dBm.
`EUtranCellFDD::preambleInitialReceivedTargetPower`	Initial preamble power value in dBm, according to 3GPP specification 36.331 and 36.321. The default value (−110 dBm) does not work for RDS. Recommended value for RDS: −90 dBm.

Table 3 lists the parameters affected by this feature.

Table 3 Affected Parameters in WCDMA RAN

Parameter	Description
`NodeBSectorCarrier::eulThermalLevelPrior`	The anticipated uplink noise floor of the unloaded macro cell, including feeder and TMA contributions.

Parameter	Description
	The default value (−104 dBm) does not work for RDS. Recommended value for RDS: −69 dBm.
SectorCarrier::maximumTransmissionPower	The maximum power for all downlink channels that are allowed to be used simultaneously in a cell, added together. The default value of 43 dBm does not work for RDS. The highest possible value to set is 20 dBm corresponding to 100 mW. The maximumTransmissionPower depends the number of carriers defined for each IRU. As an example, two carriers for each IRU give a maximumTransmissionPower of 17 dBm for each carrier (50 mW).

4 Network Impact

4.1 Capacity

Adding an RDS to the mobile network improves its capacity. However, the RDS capacity depends on that the Baseband type, configuration, and bandwidth remains the same as the capacity of the macro cell.

The Baseband capacity can be shared between the IRU and other radio units. This is supported both for Single Mode and Mixed Mode configurations.

4.2 Coverage

The coverage depends on the deployment strategy of the RDS. Because of the lower power, the coverage of a single RD is generally far smaller than that of a regular macro cell.

To achieve good performance when extending an existing network with a small cell indoor system such as the RDS, it is important to manage the large differences in output power compared to the macro layer in different deployment scenarios.

WCDMA only: For more information about network issues, see WCDMA Heterogeneous Network Deployment Guidelines and Understanding RSSI Values in RDS Deployments.

4.3 Hardware

The following hardware is used for an RDS:

— RBS 6202 and RBS 6601 (examples, see also RBS Configurations)

— Baseband 5212, Baseband 5216, Baseband 6620, Baseband 6630, IDU 5205, or IDU 5209

— IRU

— RD

For detailed cabling information, see the RDI Guidelines.

4.4 Inter-Node Interface, WCDMA Only

No feature-specific information is identified.

4.5 Other Network Elements, WCDMA Only

No feature-specific information is identified.

5 Associated Features and Affected Functions

5.1 Prerequisite Features

This feature has no prerequisite features. The following features are prerequisite features under specific requirements, which must be active prior to introducing the Radio Dot System feature:

— LTE only: 7-12 Cell Support if more than six cells up to and including 12 cells are required on an LTE Baseband.

— LTE only: 13-18 Cell Support if more than 12 cells up to and including 18 cells are required on an LTE Baseband.

— LTE only: 19-24 Cell Support if more than 18 cells up to and including 24 cells are required on an LTE Baseband.

5.2 Affected Features

LTE only: Table 4 lists features that are affected by the Radio Dot System feature.

Table 4 Affected Features in LTE RAN

Feature	Description
LPPa-based OTDOA Support	If the Radio Dot System feature is activated, the LPPa-based OTDOA Support feature cannot be activated.
OTDOA Control Plane Location Support	If the Radio Dot System feature is activated, the OTDOA Control Plane Location Support feature cannot be activated.
OTDOA PRS Management	If the Radio Dot System feature is activated, the OTDOA PRS Management feature cannot be activated.
OTDOA User Plane Location Support	If the Radio Dot System feature is activated, the OTDOA User Plane Location Support feature cannot be activated.
Inter-Frequency OTDOA	If the Radio Dot System feature is activated, the Inter-Frequency OTDOA feature cannot be activated.

WCDMA only: Table 5 lists features that are affected by the Radio Dot System feature.

Table 5 Affected Features in WCDMA RAN

Feature	Description
4-Way Receiver Diversity	If the Radio Dot System feature is activated, the 4-Way Receiver Diversity feature cannot be enabled.
Extended Range	If the Radio Dot System feature is activated, the Extended Cell Range feature cannot be activated.
Narrowband Interference Rejection	If the Radio Dot System feature is activated, the Narrowband Interference Rejection feature cannot be enabled.
PSiCoverage	If the Radio Dot System feature is activated, the PSI Coverage feature cannot be enabled.

Feature	Description
RTT Positioning	If the Radio Dot System feature is activated, the RTT Positioning feature cannot be enabled.

5.3 Related Features

LTE only: This feature is not related to any other feature.

WCDMA only: Table 6 lists features that are related to the Radio Dot System feature.

Table 6 Related Features in WCDMA RAN

Feature	Description
Precoder for Power Balancing	The Precoder for Power Balancing feature ensures good use of the power when MIMO is activated in the cell.

5.4 Affected System Functions

This feature affects no system functions.

6 Performance

6.1 Key Performance Indicators

This feature has no associated Key Performance Indicators (KPIs).

6.2 Counters

LTE only: This feature has no directly associated counters.

WCDMA only: The following counters are associated with this feature:

- `Carrier::pmAverageRssiHigh`
- `EDchResources::pmNoiseFloorHighRes`

WCDMA only: More information about counters can be found in Managed Object Model RNC and Managed Object Model RBS.

6.3 PM Events

This feature has no associated PM events.

7 Feature Activation and Deactivation

Activating the feature requires that a sufficient number of RDS licenses are installed.

Feature activation and deactivation are described in Manage Licenses (LTE) and Licenses and Hardware Activation Codes (WCDMA).

For information about engineering guidelines, see WCDMA Heterogeneous Network Deployment Guideline.