Transport Network Configuration

MSRBS-V1

USER DESCRIPTION

177/1553-HSC 105 50/1-V1 Uen E

Contents

1 Introduction

This document describes the configuration of transport network-related parameters for MSRBS-V1 managed elements in the LTE RAN.

The RBS Autointegration feature reduces the amount of data that must be entered on site when configuring an RBS. A description of how to configure IP transport network functions in an RBS using autointegration can be found in *RBS Autointegration*.

The IP Security feature provides a security solution for S1 and X2 user and control plane traffic, including protection of traffic for Synchronization over IP (SoIP). A description of how to configure transport networks with security can be found in the document *IP Security*. Configuration examples for different transport network configuration variants can be found in the document *IP Transport*.

2 LTE RAN Transport Overview

This section provides an overview of the LTE RAN architecture and the IP-based transport network. Further information can be found in *Transport Network Functions*.

The LTE RAN transport network provides connectivity between the RBSs and the RBS and the core network using the X2 and S1 interfaces. Figure 1 shows the LTE RAN architecture.

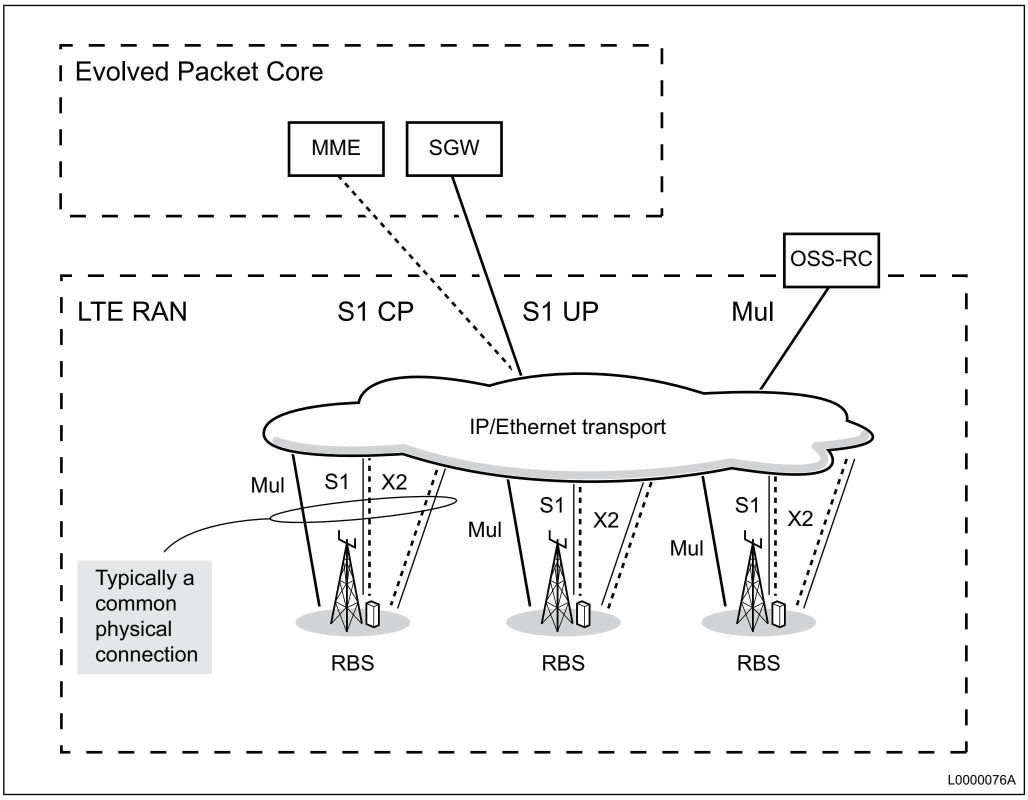

Figure 1 LTE RAN Architecture

The basic transport network options for transporting S1 and X2 traffic are Layer 2 and Layer 3 topologies. A mix of basic topologies can be used to build the transport network.

3 Layer 2 Networks

In a Layer 2 network, all nodes are connected to one another without the use of Layer 3 routers. The Layer 2 technology predominantly used in LTE networks is Ethernet. In an Ethernet network, all nodes share the same Ethernet broadcast domain in this topology variant, so the broadcast domain can be quite large.

One way to reduce the broadcast domain size is to configure separate VLANs for a group of RBSs. Broadcast domain size should be considered when determining the number of RBSs in a Layer 2 topology. Figure 2 shows an example of a Layer 2 network.

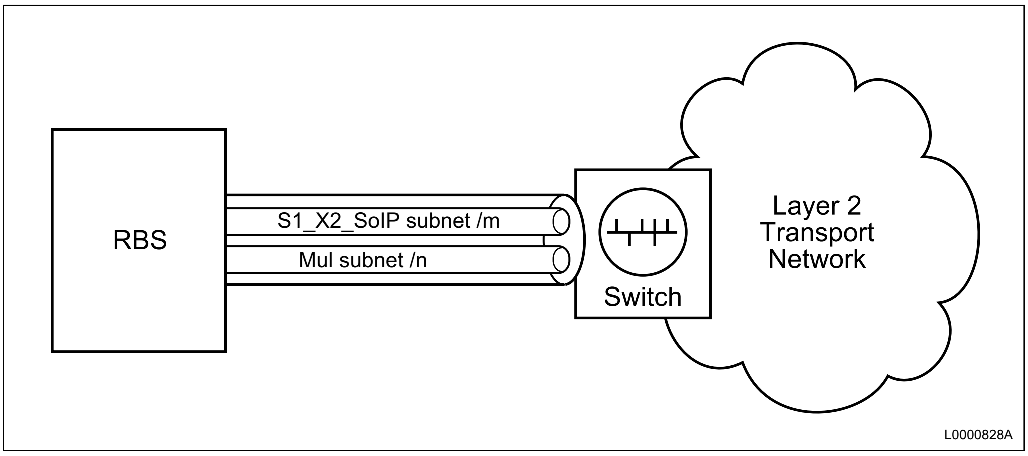

Figure 2 RBS Connectivity to Layer 2 Transport Network

Ethernet Services, such as E-Line, E-LAN, and E-Tree services as defined by Metro Ethernet Forum (MEF), can also be used to provide Layer 2 connectivity between LTE sites without the need for the network to be a pure Ethernet network.

4 Layer 3 Networks

Layer 3 topologies are another option for LTE RAN transport networks. Layer 3 routers are used in this topology variant, which allows the use of a separate sub-network for each RBS. The transport network used should support Layer 3 routing between the RBS and the core network.

A Layer 3 router is found at each site or at a hub site servicing a number of RBSs. Virtual Local Area Network (VLAN) tagging may be used to separate S1, X2, and SoIP traffic onto one VLAN and Operation and Maintenance (O&M) traffic onto a separate VLAN. If VLANs are used, VLAN separation must be supported over Layer 3 hops in the transport network.

A number of RBSs can be grouped in the same, larger sub-network. This configuration has an impact on the VLAN configuration and sub-network size. Figure 3 shows an example of a Layer 3 network.

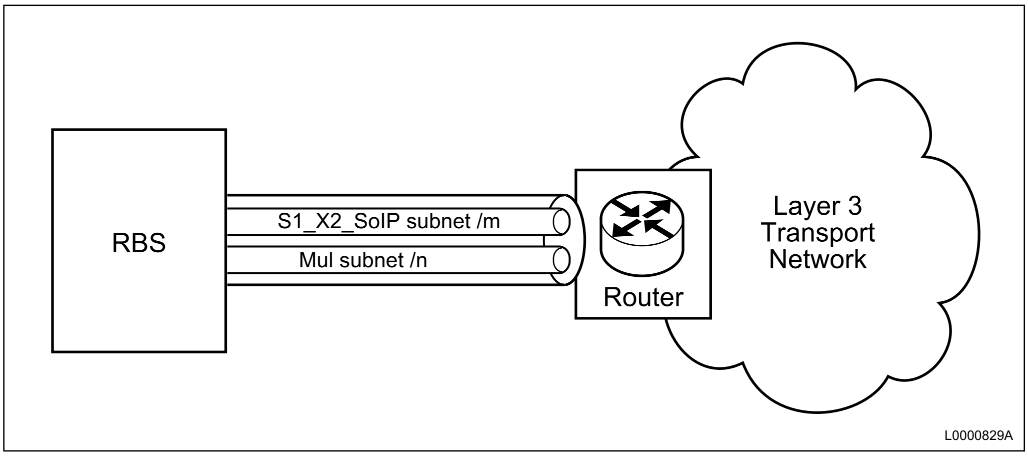

Figure 3 RBS Connectivity to Layer 3 Transport Network

5 O&M IP Networks

O&M traffic is carried over the Mul interface that shares a common physical link with S1 and X2 traffic in the RBS. A separate VLAN can be configured for O&M. The O&M traffic can be routed to the Operation and Support System - Radio and Core (OSS-RC).

6 Managed Object Model

A list of MOs used for IP transport can be found in *IP Transport*. Full details of the MOM structure can be found in the *Managed Object Model (MOM) User Guide*.

7 QoS

Quality of Service (QoS) configuration is described in several documents. QoS for data transport over the air interface is described in *Radio Bearer and Quality of Service*. This section describes QoS configuration in the RBS for S1, X2 and Mul traffic.

QoS for the LTE RAN is based on the use of Differentiated Services Code Point (DSCP) and priority bits (p-bits) that enable the intermediate transport network to prioritize traffic. This is especially important when the capacity in the transport network is limited.

7.1 Layer 3 QoS, DSCP

Egress IP packets from the RBS are tagged with DSCP values. A DSCP value defines a Per-Hop Behavior (PHB) that will be given to an IP packet, that is, a set of packet forwarding properties when the packet is transported through a network.

User plane traffic is transported over the S1 and X2 interfaces through E-UTRAN Radio Access Bearers (E-RABs). Each E-RAB has a QoS Class Identifier (QCI) assigned to it when the E-RAB is set up with S1-AP or X2-AP signaling. The QCI defines QoS characteristics for data transported over the E-RAB. It is possible to define DSCP values to use for each QCI by configuration. This is done using the `QciProfilePredefined` MO. The QCI value is then specified using the `qci` attribute, and the corresponding DSCP value is specified using the `dscp` attribute.

There are no QCI values for control plane traffic. Instead DSCP values can be configured using the MOs for configuration of the control plane.

MOs for configuring DSCP values for control plane traffic include the following:

- SCTP association endpoint is configured using the `dscp` attribute in the `SctpProfile` MO
- IP sync is configured using the `dscp` attribute in the `Synchronization` MO

DSCP values for O&M traffic is not configurable. Simple Network Management Protocol (SNMP) is hardcoded to DSCP=32, other O&M traffic is hardcoded to DSCP=16.

The recommended DSCP values for different traffic types are listed in Table 1.

Note: The recommended DSCP values may differ from the default values in the used MOs.

Table 1 Recommended QCI, PHB and DSCP Values

Traffic Type	PHB	DSCP(1)
Network Synchronization	LU	54 (46)
QCI1 - GBR Conversational Voice	EF	46
QCI2 - GBR Conversational Voice (Live Streaming)	AF42	36
QCI3 - GBR Real Time Gaming	AF41	34
QCI4 - GBR Non-Conversational Video (Buffered Streaming)	AF43	38
QCI5 - IMS Signaling	CS5	40
QCI6 - Non-GBR TCP Specific Services	AF31	26
QCI7 - Non-GBR Voice/Video/Interactive Gaming	AF11	10
QCI8 - Non-GBR TCP Premium Bearer	AF12	12
QCI9 - Non-GBR TCP Default Bearer	AF13	14
S1AP/X2AP - Inter-Node Signaling	CS5	40
O&M Access (including O&M Bulk Data)(2)	CS2	16

(1) Default decimal values are shown in parentheses.
(2) Currently, O&M Bulk Data cannot be separated from general O&M Access. Otherwise, O&M Bulk Data should be given lower priority.

The DSCP values set in outgoing IP packets are used for mapping to egress queues and to Layer 2 p-bit values in the RBS. They may also be used by any Layer 3 equipment in the intermediate transport network.

Ericsson does not foresee issues with recommended mapping due to capacity limitations when the transport connectivity is over-dimensioned. However, it is important to ensure that QoS marking is implemented and that the transport network supports separation and prioritization when capacity bottlenecks occur.

QCI-to-DSCP mapping in the RBS can be configured. DSCP-to-egress queue mapping is fixed.

The mapping of DSCP values to egress queues depends on the selected `trafficShapingProfile` attribute in the `TrafficScheduler` MO as listed in Table 2.

Table 2 DSCP to Egress Queue Mapping

Queue	DSCP mapping in `PROFILE1`	DSCP mapping in `PROFILE2`	DSCP mapping in `PROFILE3`
Q1	51, 54	51, 54	51, 54

Queue	DSCP mapping in `PROFILE1`	DSCP mapping in `PROFILE2`	DSCP mapping in `PROFILE3`
Q2	24, 32, 34, 36, 38, 40, 46, 48	24, 32, 36, 34, 38, 40, 46, 48	32, 40, 48
Q3	8, 16, 18, 20, 22, 26, 28	8, 16, 18, 20, 22, 26, 28	24, 34, 36, 38, 46
Q4	10, 12, 14	10, 12, 14	8, 16, 26, 28
Q5	All others	All others	18, 20, 22
Q6			10, 12, 14
Q7			All others

7.2 Layer 2 QoS, p-bit

The DSCP to p-bit mapping is hardcoded in accordance with *IEEE 802.1q*. Recommended mappings between DSCP values and p-bits are shown in Table 3. DSCP values for which no mapping is configured will get p-bit 0.

The p-bit value that shall be used for the layer two Address Resolution Protocol (ARP) and gratuitous ARP messages is hardcoded to p-bit = 4.

Table 3 Recommended DSCP to p-bit Mapping

DSCP	p-bit
0	1
10, 12, 14	2
18, 20, 22	3
8, 16, 26, 28	4
34, 36, 38, 46	5
24, 32, 40, 48	6
51, 54	7

7.3 Egress Mapping Process

A marker sets DSCP values in outgoing IP packets. For user plane traffic (E-RABs), the marker uses QCI values to select DSCP values as described in *Radio Bearer and Quality of Service*. For control plane and O&M traffic, the marker uses the DSCP values defined by configuration. The classifier sorts the marked packets into egress queues, based on the DSCP values. The queues are using strict priority scheme or Deficit Weighted Round Robin (DWRR) depending on the selected `trafficShapingProfile` in the `TrafficScheduler` MO. For more information, see *Egress IP Traffic Shaping*.

The p-bit is set after queuing. The setting is independent of the queues from which the packet came. The p-bit does not affect packet handling in the RBS. The p-bit is meant to be used only by the backhaul nodes.

The flow from QCI to p-bit is shown in Figure 4.

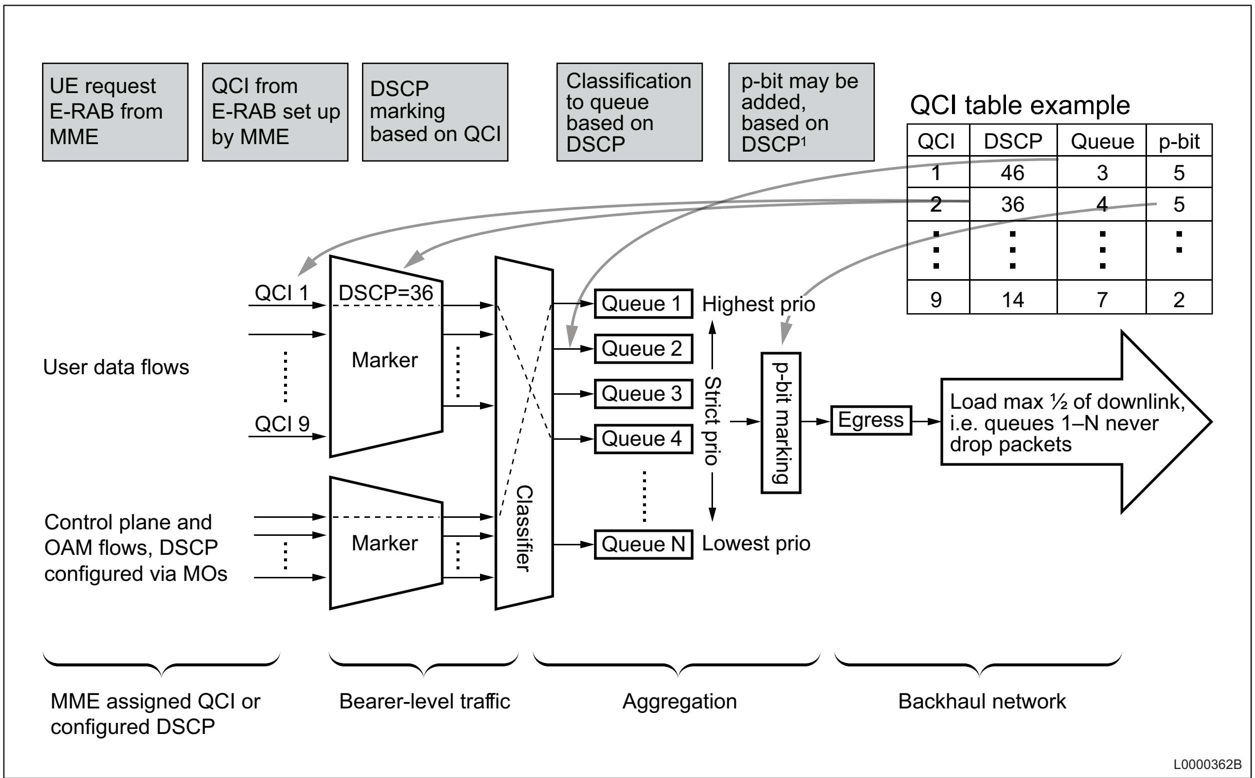

Figure 4 Egress QoS Process in RBS

8 MTU

The size of the largest Protocol Data Unit (PDU) that can be sent over a transport protocol is called the Maximum Transmission Unit (MTU). Figure 5 shows MTUs for different protocol layers that are used for user data transport through the LTE RAN. There is an end-user IP packet MTU for IP packets that are transported between the UE and the application server. There are also IP packet MTUs for IP transport between the Packet Data Network Gateway (PDN-GW) and the Serving Gateway (SGW), and between the SGW and the RBS. Further, there are Ethernet frame MTUs for Ethernet transport between the PDN-GW and the SGW, and between the SGW and the RBS.

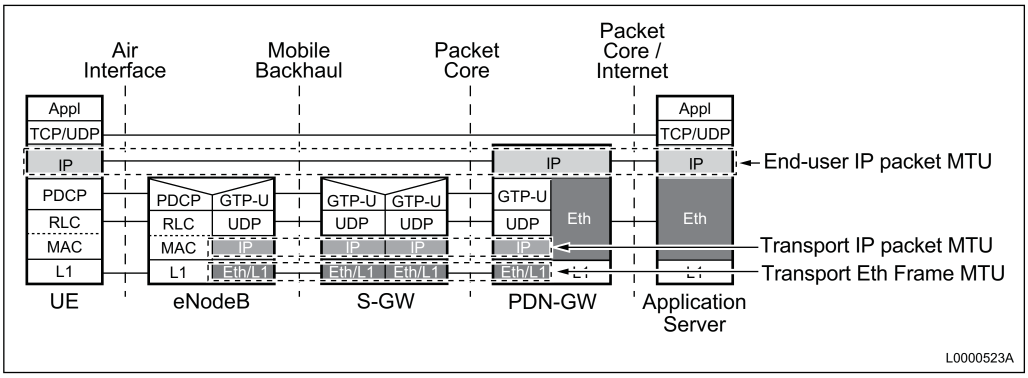

Figure 5 Transport Network MTU

To send IP packets that exceed the Ethernet MTU, the IP layer must first fragment the packets to align with the Ethernet MTU. Fragments are buffered by the receiving node until all fragments have arrived, after which the fragments are arranged in order and reassembled. Fragmentation of packets has a negative impact on network performance since it introduces delays. These delays will impact the maximum throughput that can be achieved as well as potentially impacting the quality of experience for delay sensitive applications.

When using IPsec a Security Gateway (SEG) is located between the RBS and the SGW. IPsec tunnels with double IP packets, for the inner and outer IP hosts, are used between the RBS and the SEG. Both IP packets may be fragmented. If the outer IP packet is fragmented, the reassembly burden in the uplink direction lies with the SEG. If the inner IP packet is fragmented the reassembly burden in the uplink direction lies with the SGW. In the downlink direction, the MTU of the PDN-GW could be set to account for IPsec overhead and therefore reassembly at the RBS is avoided. If the IPsec overhead is not considered, the SEG fragments either outer or inner IP packets.

Note: The MSRBS-V1 managed element type never fragments the outer IP packet for user plane traffic.

The Ethernet MTU depends on the type of frames that are used by Layer 2. For Ethernet 802.3 frames the MTU is 1492 bytes. For Ethernet v2 the MTU is 1500 bytes. For Ethernet Jumbo frames RBS supports the MTU 2000 bytes. Jumbo frame support in the LTE RAN nodes and transport network is recommended as a long-term solution as a means to avoid fragmentation. For jumbo frames to work, support is required from all LTE RAN nodes and the transport network.

The Ethernet MTU size for an IP interface can be configured via the attribute *mtu* in the MO class *EthernetPort*. The actual MTU used can be lower than the configured MTU depending on what frame types the DU hardware supports.

9 SCTP

Some of the SCTP parameters are hardcoded in the current release. For more information, see *SCTP*.

10 IP Addressing

The IP address plan is based on a number of factors including the following:

- Number of nodes in the sub-network
- VLAN separation
- Future expansion

IP addressing in a transport network based on IPv4 is described in Table 4.

Table 4 RBS IP Addressing for the NO VLAN/single VLAN case

Traffic Type	Number of IP Addresses	Comment
User plane Control plane Network synchronization, if applicable	1	IP address for network synchronization only applies if the NTP-based solution is used.
O&M	1	At least one IP address must be defined for O&M connectivity. Additional IP addresses can be allocated for Site LAN.
Default Gateway	1	

10.1 Layer 2 Considerations

In a Layer 2 topology, large sub-networks are typically configured. The sub-network size depends on the number of RBSs in the same sub-network or VLAN. Sub-network and broadcast addresses are shared by all RBSs in a sub-network. Similarly, the same default gateways can be used for all RBSs in the sub-network. With a large sub-network size the amount of broadcast traffic in the sub-network becomes large, which should be considered.

10.2 Layer 3 Considerations

Layer 3 topologies allow a separate sub-network to be allocated for each node when the node connects to a Layer 3 device, such as a router. This allows each RBS to have a dedicated sub-network. Each RBS then requires a unique sub-network and broadcast address. To keep down the number of addresses used it is recommended to let several RBSs share the same subnetwork.

10.3 O&M Considerations

When a separate VLAN is used for O&M, a sub-network is also required for the O&M related IP addresses for the RBS.

11 S1, X2 and MuI Configurations

See *IP Transport* for more information on configuration variants and MO settings of the S1, X2 and MuI interfaces.