DragonWave

Harmony Lite, R1.1

Product Description

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1 Preface

1.1 What's New in This Release?

- 3 GHz support;
- Tx/Rx ratio: 70/30;
- Co-site synchronization;
- PM of radio interface;
- LLDP.

1.2 Changes History

The changes history is shown below:

Revision	Updates	Update date
1	1st revision.	September, 2014

Table 1 Changes History

1.3 Scope of The Document

This document provides the technical description and the technical specifications of Harmony Lite (also referred to as Lite in the following context) system.

This document only concerns Lite system release 1.1 without specific statements in the context.

1.4 Intended Audience

This document is intended for the radio network planners and technicians who are responsible for the system planning and management.

Persons handling this equipment may be exposed to hazards which could result in physical injury! It is therefore mandatory to carefully read and understand this document.

This is the text in French:

Les personnes qui manipulent cet équipement peuvent être exposés à des risques qui pourraient entraîner des blessures graves! il est donc impératif de lire attentivement et de comprendre ce document.

1.5 FCC & IC RF Exposure Warnings

To satisfy FCC & IC RF exposure requirements for RF transmitting devices, the following distances should be maintained between the antenna of this device and persons during device operation:

Equipment	Separation Distance
Lite 5 GHz	39.03 cm (~ 15.37 in) or more
Lite 3 GHz	80.40 cm (~ 31.51 in) or more

Table 2 FCC & IC RF Recommended Safe Separation Distances

To ensure compliance, operation at closer than these distances is not recommended. The antenna used for this transmitter must not be collocated in conjunction with any other antenna or transmitter.

1.6 Waste Electrical and Electronic Equipment (WEEE)

All waste electrical and electronic products must be disposed of separately from the municipal waste stream via designated collection facilities appointed by the government or the local authorities. The WEEE label (see Figure 1) is applied to all such devices.

Figure 1 WEEE Label

The correct disposal and separate collection of waste equipment will help prevent potential negative consequences for the environment and human health. It is a precondition for reuse and recycling of used electrical and electronic equipment.

For more detailed information about disposal of such equipment, please contact DragonWave Inc.

The above statements are fully valid only for equipment installed in the countries of the European Union and is covered by the directive 2002/96/EC. Countries outside the European Union may have other regulations regarding the disposal of electrical and electronic equipment.

1.7 RoHS Compliance

This product complies with the European Union RoHS Directive 2011/65/EU on the restriction of use of certain hazardous substances in electrical and electronic equipment.

The directive applies to the use of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenylethers (PBDE) in electrical and electronic equipment put on the market after 1 July 2006.

Materials usage information on DragonWave Inc. Electronic Information Products imported or sold in the People's Republic of China

This product complies with the Chinese standard SJ/T 11364-2006 on the restriction of the use of certain hazardous substances in electrical and electronic equipment. The standard applies to the use of lead, mercury, cadmium, hexavalent chromium, polybro-

minated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE) in electrical and electronic equipment put on the market after 1 March 2007.

1.8 CE Statement

The CE conformity declaration for the product is fulfilled when the system is built and cabled in line with the information given in the manual and the documentation specified within it, such as installation instructions, cable lists or the like. Where necessary project-specific documentation should be taken into consideration. Deviations from the specifications or independent modifications to the layout, such as use of cable types with lower screening values for example, can lead to violation of the CE protection requirements. In such cases the conformity declaration is invalidated. The responsibility for any problems which subsequently arise rests with the party responsible for deviating from the installation specifications.

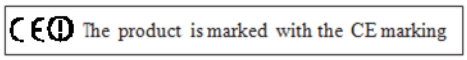


Figure 2 CE Mark

2 Overview

Lite is a complete sub-6 GHz microwave system housed within a single outdoor weatherproof enclosure. The system has standard Ethernet interfaces and the antenna can be integrated or separated. The system is an integrated, zoning-friendly, packet microwave solution, optimized for the urban environment.

Figure 3 Equipment Appearance

Lite provides a host of benefits, including:

- Non-line-of-sight (NLOS) support across both licensed and unlicensed TDD spectrum;
- Complete scalability, supporting 20/40 MHz channel bandwidth;
- Advanced interference avoidance features including site synchronization;
- Flexible network architecture options.

In addition, Lite has the following advantages:

- support of adaptive coding and modulation (ACM);
- support of transition power control (TCP);
- support of 2x2 multiple-input and multiple-output (2x2 MIMO);
- support of dynamic frequency selection (DFS);
- support of dynamic channel selection (DCS);
- support of retransmission;
- support of configurable uplink/downlink ratio;
- support of QoS (advanced quality of service with 8 queues);
- support of power over Ethernet (P+E, PoE+);
- support of synchronization;
- support of co-site synchronization;
- support of OFDM modulation;
- support of low-density parity check (LDPC) encoding;
- software upgradable to support SyncE and 1588v2 transparent clock;
- support of up to 230 Mbit/s aggregate capacity;
- support of small cell optimized backhaul for NLOS applications;
- performance with very low delay;
- support of licensed or unlicensed spectrum;
- requirement of simple installation as an integrated outdoor unit;

- requirement of minimized footprint and power consumption (under 17 W) with green design;
- support of adaptive noise immunity (ANI).

2.1 Available Bandwidth and Modulation

Lite product family supports the following frequency bands:

- 4.9 ~ 5.8 GHz (5 GHz);
- 3.4 ~ 3.8 GHz (3 GHz);
- 2.3 ~ 2.7 GHz (2 GHz).

Lite supports modulation schema BPSK, QPSK, 16 QAM and forwards error correction coding with rates of 1/2, 2/3, 3/4 and 5/6. 20 MHz and 40 MHz channel spacings are supported. See 7.2.

2.2 Applications

2.2.1 Small Cell Backhaul in Non-line-of-sight (NLOS) Environment

Many types of radio transmission depend, to varying degrees, on line of sight (LOS) between the transmitter and receiver. Small cell backhaul is changing this rule of game. Most small cells are installed of light poles of on the walls of buildings in urban areas and inevitably encounter obstructions such as trees, street curves and buildings between the endpoints of the backhaul links.The non-line-of-sight (NLOS) capability of Lite ideally suites itself in this environment because it operates at the frequency lower than 6 GHz. Furthermore, by supporting both licensed and unlicensed spectrum, Lite allows operators to select a spectrum strategy that best meets their requirements.

This wireless backhaul solution delivers significant total cost of ownership (TCO) improvements over existing macro-cell backhaul solutions, allowing operators to expand their networks cost-effectively.

Lite can be deployed using a tree topology (Figure 4), with macro-cell traffic aggregation points on rooftops, and tail, chain or small hub microsites at street level. This architecture provides:

- Less network interference than point-to-multipoint system due to the use of directive antennas;
- Simple network connectivity and reliable path planning.
- An evolution path towards protected network architecture.

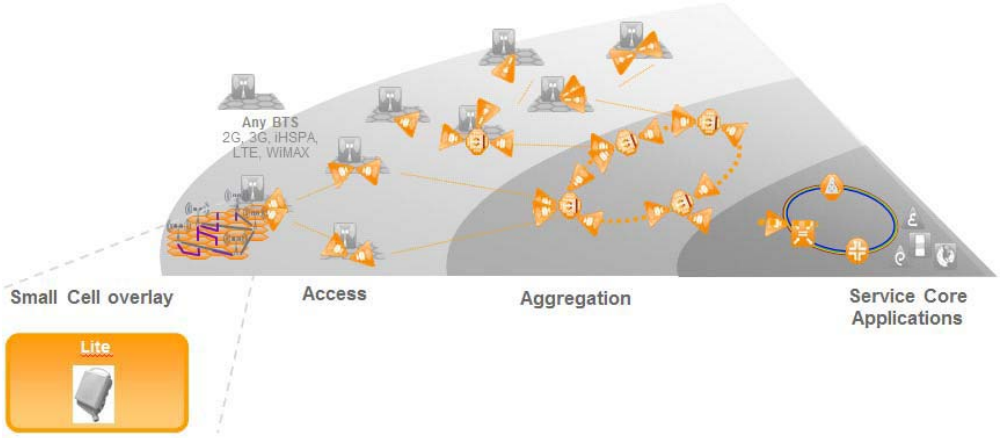


Figure 4 NLOS Application

2.2.2 Rural Backhaul

The need for extending cellular phone and data network to rural areas requires a backhaul solution that achieves the lowest TCO while meeting the stringent link throughput and distance requirements. Lite provides a cost-effective solution that supports long ling-of-sight distance (> 20 km) using licensed and unlicensed frequency bands and achieves high throughput and low latency.

2.2.3 Public Safety and Vertical Applications

Lite can also be used to build secure, reliable and cost effective transport for first responders (police, fire and medical), video surveillance and sensor network backhauling along motorways, sea ports, electricity grid, oil and gas pipelines and border security fence, etc.

2.3 Environmental Standards

In normal operation condition, the working temperature range for Lite is from -40 ºC to +55 ºC. For the detailed information, refer to the document of *Environmental Product Declaration*.

3 Features

3.1 Main Features

Lite embraces the following features:

- Adaptive Coding and Modulation (ACM)
- Transmit Power Control (TPC)
- 2x2 Multiple-input and Multiple-output (2x2 MIMO)
- Dynamic Frequency Selection (DFS)
- Dynamic Channel Selection (DCS)
- Retransmission
- Configurable Uplink/Downlink Ratio
- Quality of Service (QoS)
- Power over Ethernet
- Synchronization
- Co-site Synchronization
- OFDM Modulation
- Low-density Parity Check (LDPC) Encoding
- LLDP
- Radio Port Performance Monitoring
- Adaptive Noise Immunity (ANI)

3.2 Adaptive Coding and Modulation (ACM)

ACM allows the user to improve link utilization by making high capacity data transmission reliable. ACM changes code and modulation according to the link quality in the same channel bandwidth.

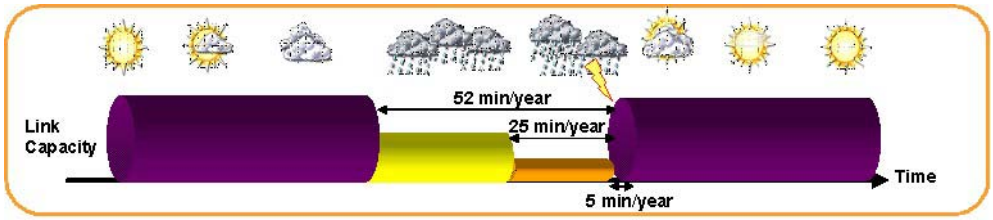


Figure 5 ACM for Traffic Growing

ACM refers to the automatic modulation adjustment that a wireless system can perform to prevent weather related fading from disrupting communication on the link.

When server weather condition, such as a heavy rain, affects the transmission and reception of data over a wireless network, the radio system automatically changes the modulation, so that non-real-time data-based applications may be affected by signal degradation, but real-time applications will run smoothly and continuously.

Since communication signals are modulated, higher modulation levels increase the number of bits that are transferred per signal, thus enabling higher throughputs, or better spectral efficiencies. It should be noted that, when using a higher modulation technique, better signal-to-noise ratios (SNR) are needed to overcome interference and maintain a tolerable bit error ratio (BER) level.

Lite measures the receiving signal quality by calculating the receiving EVM at any time. ACM allows the system to choose the best modulation in order to overcome fading and other interference.

The algorithm uses the highest possible modulation in accordance with link quality degradation.

The switch between modulation depends on the receiving signal quality.

For example, on a clear day, using 64 QAM modulation, the transmit and receive data capacity can be 120 Mbit/s. When the weather becomes overcast and stormy, the ACM algorithm changes the modulation to 32 QAM and the system transmits at 100 Mbit/s.

Switchover has the ability to step up or down through all the modulation schemes between BPSK and 64 QAM. This guarantees that the link will operate at the highest possible modulation scheme at any time.

3.3 Transmit Power Control (TPC)

TPC controls the far-end transmit power level in order to keep the received signal level above a certain user-defined threshold, in accordance with the particular modulation method and capacity being used.

TPC allows traffic to transmit at a low power level while enough SNR is maintained. It is a green design which reduces the interference to other system and power consumption.

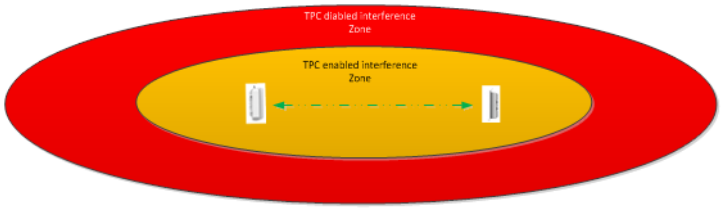


Figure 6 TPC Design

User can define target power for the local site and Lite will measure the difference between the RSSI and target power, and feedback to remote site so that the remote site can adjust the transmit power accordingly.

TPC feature provides the customer with more flexibility in network design.

3.4 2x2 Multiple-input and Multiple-output (2x2 MIMO)

In radio, MIMO is the use of multiple antennas at both the transmitter and receiver to improve communication performance. It is one of several forms of smart antenna technology.

MIMO technology offers significant increases in data throughput without additional bandwidth. It achieves this goal by spreading the same total transmit power over the antennas to achieve an array gain that improves the spectral efficiency (more bits per second per hertz of bandwidth) or to achieve a diversity gain ghat improves the link reliability.

By using a dual polarized (cross polarization) antenna, Lite supports 2x2 MIMO with a single antenna.

3.5 Dynamic Frequency Selection (DFS)

Radar detection is required when Lite operates on channels that have a nominal bandwidth falling partly, or completely, within the frequency range from 5250 MHz to 5350 MHz, or 5470 MHz to 5725 MHz.

Furthermore, Lite does not share the channel with other device, so beside radar signal, once Lite detected other equipment operating on the same channel, it will automatically switch to another channel.

Lite implements DFS according to EN 301 893, EN 302 502, FCC 47CFR part 15 operating as a master.

Accordingly, the operational behavior and individual DFS requirement that are associated with Lite are as follows:

- At installation (or re-installation), it is assumed to have no available channels within the 5250 MHz to 5350 MHz band and/or the 5470 MHz and 5725 MHz band. In such a case, before starting operations on one of those channels, the equipment performs a channel availability check (CAC) to ensure that there is no radar operating on the channel. If no radar has been detected, the channel becomes an available channel and remains as is until a radar signal is detected during the in-service monitoring. There will be no transmissions by Lite within the channel being checked during this process.
- Once Lite has started operations on an available channel, that channel becomes the operating channel. During normal operation, the operating channel will be monitored (in-service monitoring) to ensure that there is no radar operating on the channel.
- If a radar signal or signal from other device is detected during in-service monitoring, Lite devices in the link will stop transmitting on this channel which becomes an unavailable channel.
- An unavailable channel becomes a usable channel after the non-occupancy period. A new CAC is required to verify that there is no radar operating on the channel, before it may be used again. If no radar is detected, the channel becomes an available channel once again.

3.6 Dynamic Channel Selection (DCS)

Besides DFS required by regulation, Lite also implements DCS to dynamically select the working channel according to the interference level, because the interference from co-channel and adjacent channels may affect the performance of Lite.

- Spectrum scan
  Before occupying a channel, Lite must scan the current band and select the best channel as the operation channel.
  After the spectrum scan, Lite will give a graphic report of the interference level of each 20 MHz channel.
- In-service monitoring
  After occupying a channel, Lite executes in-service monitoring to detect if there is interference from co-channel or adjacent channel.
  By monitoring the errors on the physical layer, Lite can count the PHY error, channel utilization ratio and packet error rate to determine whether to change to another channel.

- Channel shutdown
  When interference signal detected in operation channel exceeds the threshold, Lite will notify the remote site and switch to another channel.

3.7 Retransmission

At unlicensed frequency band, especially in urban areas, the interference is not predictable due to the complicated and dynamically changing environment. The sporadic burst of interference may result in packet loss (defective packet is also dropped by the receiver).

Lite implements dynamic packet retransmission mechanism by which the corrupted or lost packet is retransmitted until it is received correctly or the timeout reaches.

The retransmission function implements a negative acknowledgement (NACK) method. The receiver explicitly notifies the sender when packets, messages, or segments were received incorrectly and thus may need to be retransmitted, and the transmitter will buffer the recent transmitted packets and retransmit the requested packets.

3.8 Configurable Uplink/Downlink Ratio

To meet the different market data model requirements, Lite supports configurable uplink/downlink ratio to better utilize the radio bandwidth.

Lite downlink/uplink ratio can be set to 50:50, 70:30 or 30:70 which can improve the bandwidth utilization for different scenarios. E.g., uplink and downlink traffic are not usually balanced, the download traffic usually being much more than the uplink traffic. In this case, 30:70 ratio can be used to improve bandwidth utilization.

3.9 Quality of Service (QoS)

Figure 7 shows the QoS architecture of Lite with the following main components.

- Priority determination (classification)
- Scheduling
- CoS queue and egress port rate limiting (shaping).

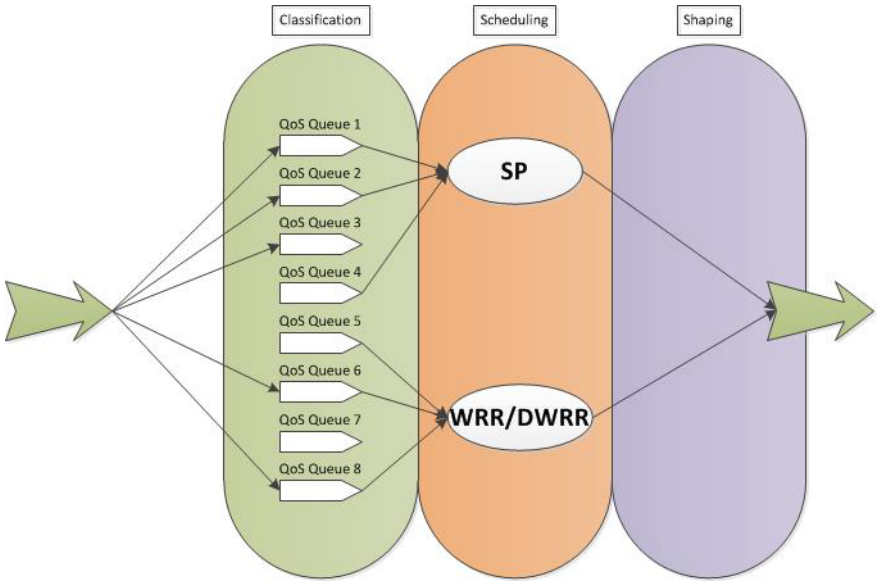


Figure 7 QoS Architecture

3.9.1 Priority Determination (Classification)

Lite supports service priority determination based on the 802.1p byte/DSCP. Depending on the priority determination of the data, the system will direct the data into different queues.

3.9.2 Scheduling

Lite supports 8 queues on each port, each queue corresponding to one priority, from the highest CoS7 to the lowest CoS0. The following scheduling methods are supported by Lite:

- Strict priority (SP)
  The SP mothod schedules access to the egress port between the QoS queues, from the highest QoS queue index to the lowest. The purpose is to provide a lower latency service to the higher QoS class of traffic.
  Traffic in higher priority queues is scheduled first until all demand is met or until all available bandwidth is used.
  Strict priority queues have no limit or CIR so it will get all the bandwidth required if it is available, before bandwidth is offered to other queues.

- Weighted round robin (WRR)
  WRR is used to allocate a bandwidth per queue to ensure that each queue gets the amount of bandwidth determined by the weighing assigned.
  The available bandwidth is distributed to the queues in need of bandwidth proportional to the assigned weight.
  Once every WRR minimum bandwidth per queue has been satisfied, excess bandwidth is allocated in proportion to the weights of the queues competing for the excess bandwidth.
  The weight of each queue can be configurable from 1 to 127.
- Deficit Weighted Round Robin (DWRR)
  An inherent limitation of WRR mode is that the actual bandwidth allocated to a queue depends on the frame size, but as frame sizes are not known to the scheduler, it is hard to control the bandwidth allocated to a queue.
  To address this issue, DWRR is invented. It is a modified version of WRR.
  DWRR has two parameters, credit counter (also called deficit counter) and quantum. DWRR serves the frames at the head of every non-empty queue whose credit counter is greater than the frame's size. If the credit counter is lower, the queue is skipped and its credit is increased by a given value called quantum. Hence, the function of quantum is somewhat like weight but is in bytes. This increased value is used to calculate the credit counter the next time around when the scheduler examines this queue for serving its head-of-line frame. If the queue is served, the credit is decremented by the size of frame being served.
- SP + WRR/DWRR
  The combination of SP and WRR/DWRR method is supported. In this method, a certain number of CoS queues (out of 8) on an egress port work in SP mode, while the rest of the queues on the same port work in WRR/DWRR mode. it is possible to enable all CoS queues either in SP or WRR/DWRR mode, or some with SP and the rest with WRR/DWRR. However, the queues configured for SP mode must have a higher index value than those for WRR/DWRR mode. The SP mode iindices must also be consecutive.
  Up to 8 queues (starting from Q8) can be configured for strict priority queues (see Table 3). SP queues use SP based on CoS values to assign bandwidth ahead of other WRR or DWRR queues.

Number of SP Queues Configured	Corresponding SP Queues
1	Q8
2	Q7, Q8
3	Q6, Q7, Q8
4	Q5, Q6, Q7, Q8
5	Q4, Q5, Q6, Q7, Q8
6	Q3, Q4, Q5, Q6, Q7, Q8
7	Q2,Q3, Q4, Q5, Q6, Q7, Q8
8	Q1, Q2,Q3, Q4, Q5, Q6, Q7, Q8

Table 3 SP Queues Configuration

3.9.3 CoS Queue and Egress Port Rate Limiting (Shaping)

Traffic shaping is supported across each egress port.

Lite supports port rate limiting by L1 and L2.

3.10 Power over Ethernet

To be size/cost optimized, there is no dedicated external power supply interface to Lite. The power supply feed to Lite is provided over Ethernet interface.

Both standard PoE+ (IEEE 802.3at) and P+E solutions are supported.

Lite is available in 2 hardware versions, one supporting both PoE+ and P+E, another supporting only P+E. Refer to 4.2 for the mechanism. Refer to the document of *Order Codes Reference* for the order codes of the 2 versions.

The system's rated voltage is -48 VDC, rated current 1.0 A.

P+E is a proprietary power over Ethernet solution that supports at least 60 W of power output. Lite also supports one P+E output which facilitates powering an additional Lite.

The PoE+ and P+E circuits are independent.

3.10.1 P+E

The functionality of the P+E feature is shown is Figure 8.

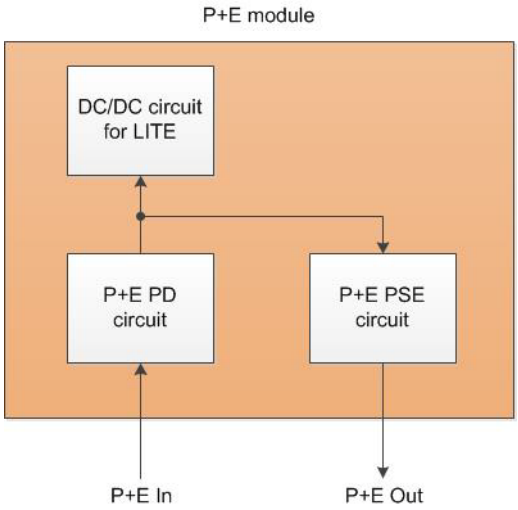


Figure 8 P+E functionality

- The P+E In interface works as a P+E PD (powered device) port. Lite can be fed by a P+E PSE (power source equipment) via this port. This interface can be connected to the following systems:
  - IDU such as Hub 800 (with order code T555800MB.01) or First Mile 200i;
  - AC/DC or DC/DC proprietary Power Injector;
  - Base station with P+E functionality.
- The P+E Out interface works as P+E PSE port and can be used to feed another Lite at the same location (chain site).

Figure 9 shows the scenario where a P+E device is powering two Lites.

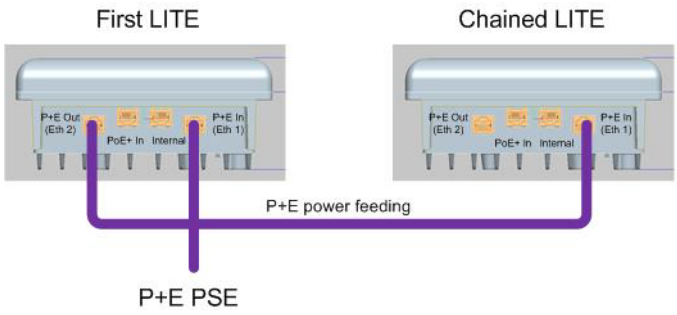


Figure 9 Power Feeding Two Lites with P+E PSE Equipment at A Chain Site

3.10.2 PoE+

The functionality of the PoE+ feature is shown in Figure 10.

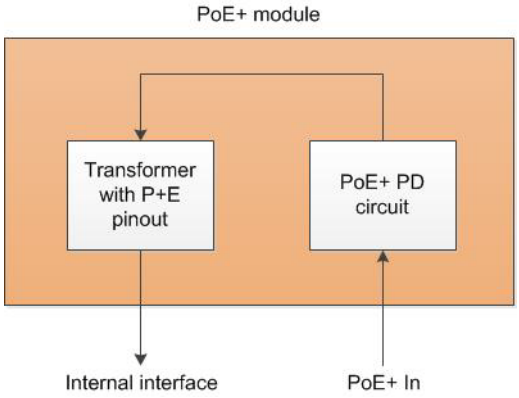


Figure 10 PoE+ functionality schema

- The PoE+ In interface works as a PoE + PD port. Lite can be powered by a standard PoE+ PSE via this port. This interface can be connected to the following systems:
  - Generic IDU that uses PoE+ modality;
  - Base station with PoE+ functionality
  - PoE+ Power Injector.
- The Internal interface is a port with P+E power pinout. This port transfers power and Ethernet traffic between PoE+ In and P+E In interfaces.
- The P+E Out interface works as P+E PSE port and can be used to feed another Lite at the same location (chain site).

At a chain site, two Lites can be powered from a single PoE+ PSE power feed. Figure 11 shows the scenario where a PoE+ device is powering two Lites.

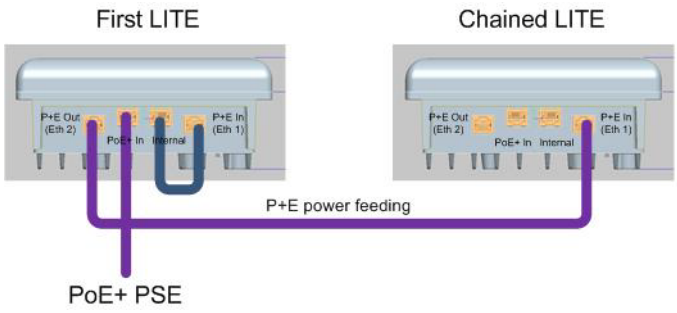


Figure 11 Power Feeding Two Lites Using PoE+ Equipment at A Chain Site

3.11 Synchronization

Sync Ethernet is supported on both Ethernet interfaces.

Lite can also deliver synchronization and timing across the radio when RF interface is selected as timing source.

TDD RF is naturally unfriendly to synchronization and timing delivery, Lite can achieve synchronization quality close to physical timing based on proprietary time stamping mechanism.

3.12 Co-site Synchronization

To better reuse the frequency and reduce the interference of co-site implementation, co-site synchronization is implemented.

When two collocated Lites who use the same frequency or frequency close to each other are not synchronized and one of them is in transmitting status and another one is receiving status, the receiving Lite will receive the remote site signal plus the transmitting Lite's interference signal, which results in packet loss or even link breakdown.

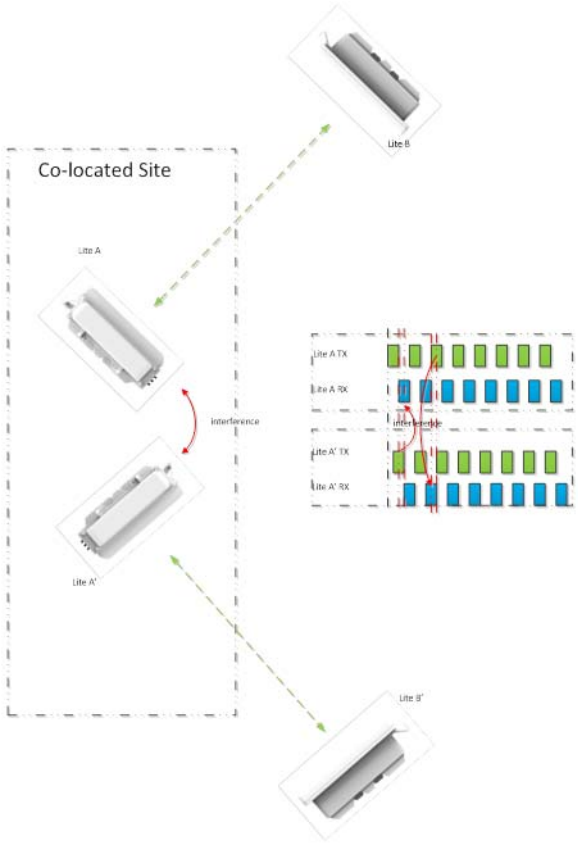


Figure 12 Co-site Synchronization Realization

Co-site synchronization is used to control all links connected to the same node to transmit and receive at the same time, thus transmitting over receiving interference can be avoided. Site synchronization is achieved through in-band protocol on GE interfaces without any need for GPS signal and/or dedicated distribution.

A 1588-like mechanism is employed to synchronize the transmission trigger. One Lite at the hub site is assigned the role of master and the rest co-site Lites are assigned slave. The 1588-like protocol synchronizes the transmitting and receiving time and interval so the Lite in the same site can switch to transmit or to receive at the same time to avoid any site receiving the signal from the collocated Lite.

When the co-site synchronization is enabled, the Tx/Rx cycle will be aligned so the local Tx will not interfere with the collocated Rx.

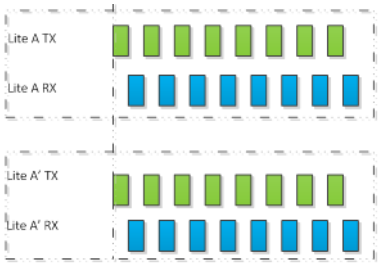


Figure 13 Co-site Synchronization Mechanism

3.13 OFDM Modulation

The PHY block of Lite is a half-duplexed OFDM baseband processor which supports 52 sub-carrier in 20 MHz bandwidth and 114 sub-carrier in 40 MHz bandwidth which allows the system to have high spectral efficiency while have robust performance against narrow-band interference and frequency-selective fading due to multi-path.

Configurable GI allows Lite to work in different scenarios to combat with different delay spread. The short GI configuration allows Lite to work in low delay spread condition to have better throughput while the long GI configuration allows Lite to have better radio performance in worse delay spread condition by sacrificing the throughput.

3.14 Low-density Parity Check (LDPC) Encoding

Lite implies LDPC as the FEC coding method which can correct bit error during transmission. It allows the system to survive in poor SNR scenario. In the same SNR scenario, it may allow the system to work in higher modulation scheme or have a better packet error performance.

Lite supports 1/2, 2/3, 3/4, 5/6 LDPC encoding combined with different modulation schemes, to meet different SNR and throughput requirement.

3.15 LLDP

LLDP is supported to advertise the system key capabilities on the Ethernet LAN and also learn the key capabilities of other systems on the same Ethernet LAN. Information like system name and description, IP management address, etc., can be sent or received as LLDPDU (LLDP data unit) via SNMP MIB for every station to know their neighbors, LLDP frames are sent at a fixed rate on each port of every station and no acknowledgement is expected from the receiver. It is so-called one way connectionless data link layer protocol which runs on MAC layer.

LLDP allows the NMS to build the physical topology of the network under its supervision. The NMS can only get a complete picture of the controlled network when all the NEs support LLDP.

Both Single-IDU mode and Dual-IDU mode support LLDP.

For detailed information about LLDP, refer to IEEE 802.1 ABTM-2005.

3.16 Radio Port Performance Monitoring

Lite provides sophisticated performance monitoring method to allow customer to monitor its working status, e.g.,

- Tx/Rx power statistics do the Tx/Rx monitoring and the attenuation change information collection;
- EVM statistics do the link quality monitoring;
- Link available time adds up the working time of the link;
- Packet error statistics do the packet error calculation in both real time and history, allowing the customer to understand the impact of link quality degradation;
- Interference statistics do the co-channel interference and off-channel interference calculation in both real time and history to help the customer make manual operation when it is needed.

3.17 Adaptive Noise Immunity (ANI)

5 GHz unlicensed band often operates in challenging environment with many different sources of interference, compromising the performance of Lite.

Many system can operate in the same frequency band, such as WLAN devices, wireless cameras and microwave ovens. This may have significant influence on Lite. By activating Adaptive Noise Immunity, Lite ignores sources of interference in the radio field and only focuses on remote Lite with sufficient signal strength. This process is based on measured values of the link with regard to interferences in the radio field. If a defined threshold is exceeded, the reception sensitivity of Lite will be reduced respectively. Therefore, the probability is increased that the system will ignore interferences while searching for a free transmission slot. These adaptive changes of the reception sensitivity are based on the permanent check of the radio field.

4 Mechanical Structure and Interfaces

4.1 Dimensions and Weight

The following table lists the dimensions and weight of the equipment.

Item	Value
Height	218 mm
Width	223 mm
Depth	97.0 mm (with 190x190 mm integrated antenna)
	94.5 mm (with box cover for external antenna)
Weight (without daughter card or cables)	1.80 Kg (with 190x190 mm integrated antenna)
	2.03 Kg (with box cover for external antenna)

Table 4 Dimensions and Weight

4.2 Interfaces

Lite is a compact system with two versions, PoE+/P+E version (Figure 14) and P+E version (Figure 15).

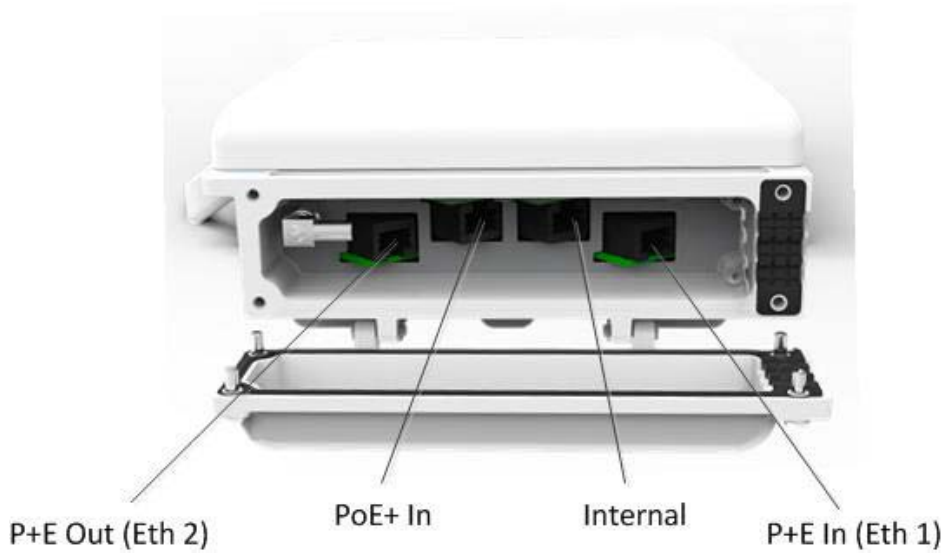


Figure 14 PoE+/P+E Interfaces

Figure 15 P+E Interfaces

The PoE+/P+E version supports both PoE+ and P+E feeding method, but not in the same time. It embeds 4 interfaces, whose functions will be introduced in the following text.

The P+E version supports only P+E feeding method. It embeds 2 interfaces, whose functions will be introduced in the following text.

Lite has two deployments, one is with an integrated antenna, the other is with a box cover (Figure 16) to co-work with an external antenna.

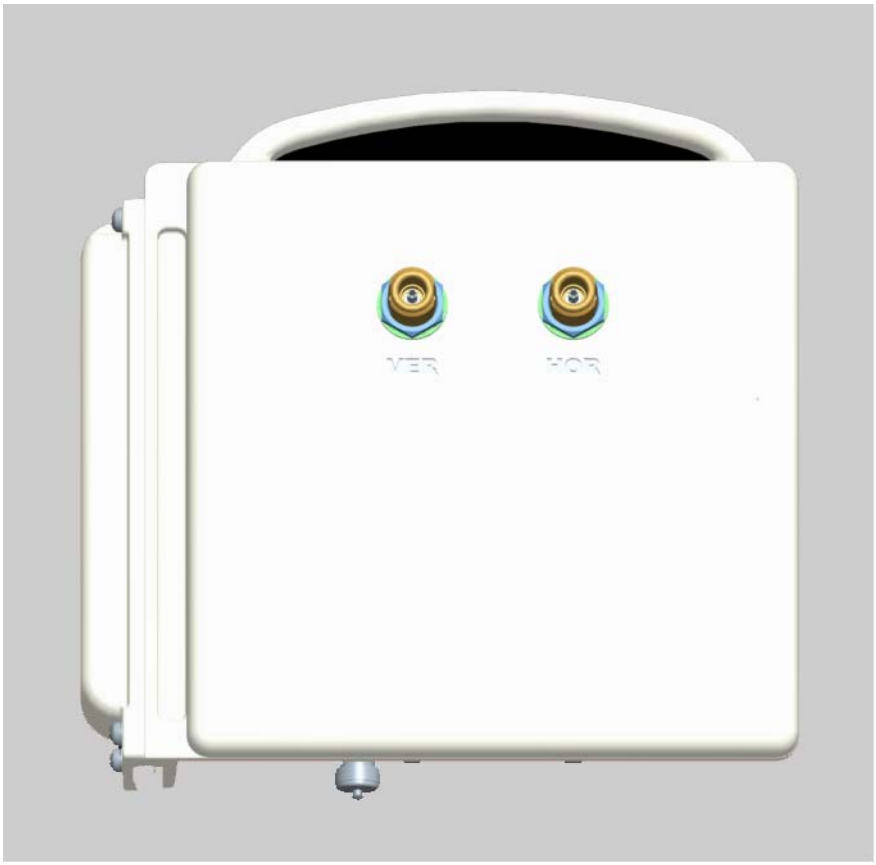


Figure 16 Lite With Box Cover

The main connectors are all enclosed in the weatherproof compartment, having a hinged lid with a weather seal. The grounding point locates on the back.

4.2.1 P+E In (Eth 1) Interface

This is a P+E PD interface which can be connected to an IDU's power sourcing equipment port or a collocated Lite's power sourcing equipment port.

Property	Description
Interface type	100/1000 Base-T
Duplex mode	half and full with auto-negotiation or manual
Rate	100/1000 Mbit/s with auto-negotiation
MDI type	auto sensing MDI/MDIX or manual
Front panel reference	P+E IN (ETH 1)

Table 5 P+E In

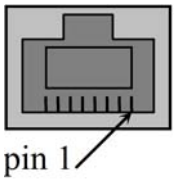
Property	Description
Connector type	Shielded GE RJ45 8 pin gold plated contacts. 
Suggested cable	Shielded twisted pair (STP cat5e), at least 24 AWG wire
Power supply	Works as P+E PD port. Lite can be fed by P+E PSE via this port.

Table 5 P+E In

The pinout definition is shown in the following table.

Pin Number	Pin Function	Power Pinout
1	pair A+	negative
2	pair A-	negative
3	pair B+	negative
4	pair C+	positive
5	pair C-	positive
6	pair B-	negative
7	pair D+	positive
8	pair D-	positive

Table 6 Pinout Definition of P+E In

4.2.2 P+E Out (Eth 2) Interface

This is a P+E PSE interface which can be used to connect with collocated Lite at the chain site. This interface can also be used for troubleshooting and installation in field.

Property	Description
Interface type	100/1000 Base-T
Duplex mode	half and full with auto-negotiation or manual
Rate	100/1000 Mbit/s with auto-negotiation
MDI type	auto sensing MDI/MDIX or manual
Front panel reference	P+E OUT (ETH 2)

Table 7 P+E Out

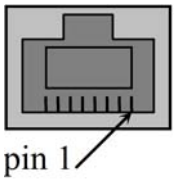
Property	Description
Connector type	Shielded GE RJ45 8 pin gold plated contacts. 
Suggested cable	Shielded twisted pair (STP cat5e), at least 24 AWG wire
Power supply	Works as P+E PSE port. It can feed to the second Lite at a chain site.

Table 7 P+E Out

The pinout definition is shown in the following table.

Pin Number	Pin Function	Power Pinout
1	pair A+	negative
2	pair A-	negative
3	pair B+	negative
4	pair C+	positive
5	pair C-	positive
6	pair B-	negative
7	pair D+	positive
8	pair D-	positive

Table 8 Pinout Definition of P+E Out

4.2.3 PoE+ In Interface (optional)

The optional PoE+ In interface is located with the Internal interface on the PoE+ module, which is only required in the PoE+ application. The PoE+ In interface is a PoE+ PD port that can be connected with an IDU which can work as PoE+ PSE.

Property	Description
Interface type	100/1000 Base-T
Duplex mode	half and full with auto-negotiation or manual
Rate	100/1000 Mbit/s with auto-negotiation
MDI type	auto sensing MDI/MDIX or manual
Front panel reference	PoE+ IN

Table 9 PoE+ In

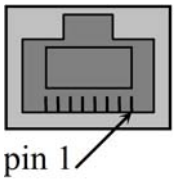
Property	Description
Connector type	Shielded GE RJ45 8 pin gold plated contacts. 
Suggested cable	Shielded twisted pair (STP cat5e), at least 24 AWG wire
Power supply	Works as P+E PD port. Lite can be fed by standard PoE+ PSE via this port.

Table 9 PoE+ In

The pinout definition is shown in the following table.

Pin Number	Pin Function	Power Pinout Alternatives	
		Alternative A	Alternative B
1	pair A+	positive/negative	-
2	pair A-	positive/negative	-
3	pair B+	negative/positive	-
4	pair C+	-	positive
5	pair C-	-	positive
6	pair B-	negative/positive	-
7	pair D+	-	negative
8	pair D-	-	negative

Table 10 Pinout Definition of PoE+ In

4.2.4 Internal Interface (optional)

This optional Internal interface is located with the PoE+ In interface on the PoE+ module, which is only required in the PoE+ application. This interface is used to transfer power and Ethernet traffic between PoE+ and P+E, when Lite is connected with PoE+ PSE via PoE+ In interface.

Property	Description
Interface type	100/1000 Base-T
Duplex mode	half and full with auto-negotiation or manual
Rate	100/1000 Mbit/s with auto-negotiation
Front panel reference	INTERNAL

Table 11 Internal

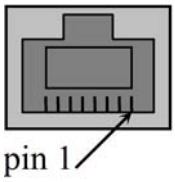
Property	Description
Connector type	Shielded GE RJ45 8 pin gold plated contacts. 
Suggested cable	Shielded twisted pair (STP cat5e), at least 24 AWG wire
Power supply	The P+E power pinout is built into this port. It is an internal port to provide power transfer between P+E and PoE+.

Table 11 Internal

The pinout definition is shown in the following table.

Pin Number	Pin Function	Power Pinout
1	pair A+	negative
2	pair A-	negative
3	pair B+	negative
4	pair C+	positive
5	pair C-	positive
6	pair B-	negative
7	pair D+	positive
8	pair D-	positive

Table 12 Pinout Definition of Internal

4.2.5 RF Interface (optional)

The RF interfaces consist of two N-type antenna connectors located on a box cover. These interfaces are used when Lite is assembled with external antenna.

4.2.6 RSSI/EVM Interface

RSSI interface enables the measurement of the received RF signal level by means of a standard voltmeter through a female BNC 50 ohm, an IP66 waterproof connector.

Parameter	Value
Output voltage range and received power range	BCN output = A.BCD; A.B show EVM, and CD show RSSI; For example: BNC = 1.479V means RSSI = -79dBm, EVM = -14dB; BCN = 2.245V means RSSI = -45dBm, EVM = -22dB.
Accuracy	±1 dB for EVM indication; RSSI indication is mainly used to demonstrate the trend.

Table 13 RSSI/EVM parameters

5 Product Structure

Figure 17 shows the top-level block diagram. Lite includes 6 function modules, including

- Frame processing module (switching, QoS, radio frame processing);
- Control function (TPC/ACM/DCS/DFS/Retransmission) processing module;
- Power supply module;
- IEEE 1588v2 processing module;
- Baseband and RF module;
- Antenna.

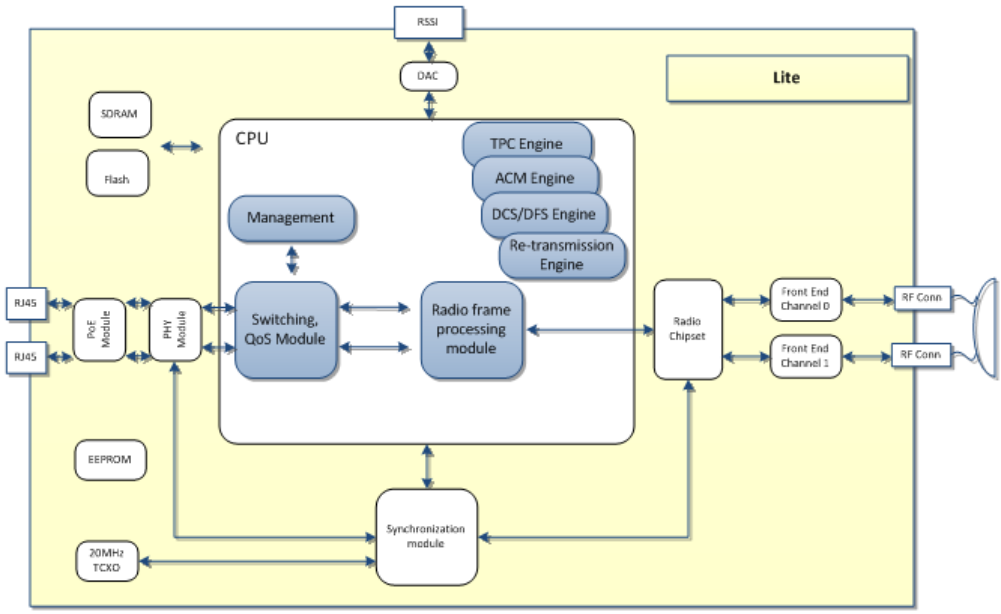


Figure 17 Function modules of Lite

5.1 Packet Processing Module

The packet processing module provides the following functions:

- Packet switching;
- QoS mapping and scheduling;
- Frame fragmentation and aggregation;
- MAC frame encapsulation.

The packet switching unit switches traffic between an Ethernet port and a radio port, and also performs VLAN manipulation.

The switch can be done based on port or on MAC learning. Lite supports up to 48 VLANs switch.

The QoS mapping and scheduling unit maps the QoS class for different traffic and implements strict priority or WRR/DWRR scheduling to provide different SLA for different traffic classes.

The frame fragmentation and aggregation unit support aggregates different packets into the same MAC frame to better utilize the radio bandwidth and fragments packets that

exceed the radio frame limit, to allow long packets to be processed in low modulation schemes, or low radio bandwidth.

The MAC frame encapsulation unit encapsulates packets into the radio frame.

5.2 Power Supply Module

The power supply module supports power over Ethernet. It generates tertiary voltage sources which are stabilized, monitored and distributed to the other sections.

5.3 IEEE 1588v2 Module

The 1588 module processes 1588 packets, controls 1588 time stamping and runs the proprietary 1588-like synchronization process.

5.4 Baseband and RF Module

The baseband and RF module encapsulates the MAC frames into radio frames, modulates and demodulates, encrypts, processes TPC and DFS functions.

5.5 Antenna

The antenna is connected to the RF module. Lite support both integrated antenna and external antenna which will provide flexibility for customer for installation and other purposes.

6 Management

Lite can be managed locally or remotely. Both in-band and out-band management are realized through 3 types of management IP addresses. Lite can be managed by a Web-based GUI (i.e., Link Viewer) or NetViewer. It can also be managed by other standard third party management systems which support SNMP.

6.1 Web-based GUI (Link Viewer) Management

Through an embedded Link Viewer program in Lite, the user can access Lite system through network to monitor, administer and configure it. More specifically, with this user-friendly program, the user can perform the following tasks:

- System general parameter management;
- Radio parameter management;
- Service management;
- DCN management;
- Software management;
- Licensing management;
- Performance management;
- Maintenance.

6.2 Accessing

Lite supports the following 3 kinds of management IP addresses to guarantee the operators accessibility in any conditions.

- Public IP to support the management through management VLAN.
  The IP address, management VLAN and priority of the management IP are configurable.
- Local management IP to support local access to Lite, collocated Lite and remote Lite.
  It supports direct connection between Lite and the management computer. The local management IP is configurable.
- Private IP to support Lite access when both public IP and local management IP are lost.
  This IP address only supports the access to local Lite and limited access to radio link through the private in-band management channel.

6.3 SNMP Agent

Lite has an inbuilt simple network management protocol (SNMP) agent that provides management functions for the whole radio terminal. Fault, performance and configuration management functions can be performed using SNMP actions. The version supported is SNMP v2c.

6.4 SNTP, SFTP and SSH

The simple network time protocol (SNTP) functionality is used to update the real time clock of the node by connecting to an NTP server, which must be accessible through the IP-based DCN. The SNTP can be enabled or disabled in NetViewer.

Secured file transfer protocol (SFTP) is supported for the purpose of software download and large file size downloads, e.g., performance monitoring data.

SSH is supported for remote command interface control.

6.5 Software Upgrade

Lite software can be upgraded from previous release so that new features will be supported without hardware change. The upgrade can be performed both locally or remotely by Link Viewer.

6.6 License

The user who wants to use certain features has to purchase the corresponding licenses. A license can be purchased together with the hardware and the application software when the system is initially purchased, or it can be later purchased and installed onto an already operating system. If the license is ordered together with the equipment, it is installed during commissioning.

Lite is delivered to the customer with the basic software release and the basic license pre-installed, so essential functions are enabled. There are additional features that may be required, for instance, when the network scales up, or network security is required. If additional features need to be activated, the customer can acquire an upgrading license.

The basic license configuration is 50 Mbps UL + DL capacity.

Lite provides the following upgrading licenses:

- Basic (50 Mbps) to 100 Mbps upgrade license;
- Basic (50 Mbps) to full-capacity (230 Mbps) upgrade license;
- 100 Mbps to full-capacity (230 Mbps) upgrade license;
- License for co-site synchronization;
- License for Ethernet OAM (in future release);
- License for 1588v2 TC clock synchronization (in future release);
- License for security (SNMPv3, SSH and SFTP) (in future release);
- License for Radio Ring (in future release).

The following country code licenses are used to meet different regulations in different countries. One of them has to be purchased for use in different countries and areas.

- FCC (required in USA);
- ETSI (required in European countries);
- TELEC (required in Japan);
- ANATEL (required in Brazil);
- ICASA (required in South Africa);
- IC (required in Canada);
- RALI (required in Australia);
- ROW (required in rest of the world).

One country code license can only be activated once and is not allowed to be changed to another one.

In-field license upgrade is also supported, which can be performed by customer service staff or by the user. The upgrade can be performed both locally and remotely using DWI

proprietary EMSs, e.g., Link Viewer. The upgrade may also be performed by other non-DWI proprietary EMSs by the customer themselves.

When the unit is not managed remotely, make sure that the license has been retrieved for the equipment before going to the site. There are no emergency license available.

7 Technical Specification

7.1 Regulation Compliance

The following tables provide the regulation compliance information.

Regulation	Frequency Band (MHz)		Channel Bandwidth		Regulatory Compliance
	Start	End	20 MHz	40 MHz	
FCC/IC	5250	5350	Yes	Yes	FCC 47CFR, Part 15, Subpart E and IC RSS-210
	5470	5725	Yes	Yes	
	5725	5850	Yes	Yes	FCC 47CFR, Part 15, Subpart C and IC RSS-210
ETSI	5470	5725	Yes	Yes	ETSI EN 301 893
	5725	5875	Yes	NA	ETSI EN 302 502
TELEC	5180	5240	Yes	Yes	TELEC Item 19-3 of Article 2 Paragraph 1
	5500	5700	Yes	Yes	TELEC Item 19-3-2 of Article 2 Paragraph 1
ANATEL	5470	5725	Yes	Yes	ANATEL RESOLUTION No.506, From July 1, 2008 Section X
	5725	5850	Yes	Yes	ANATEL RESOLUTION No.506, From July 1, 2008 Section IX
ICASA	5725	5875	Yes	NA	South Africa ICASA Vol.547 31 March 2011
ROW	5250	5875	Yes	Yes	No regulation limitation

Table 14 5 GHz

Regulation	Frequency Band (MHz)		Channel Bandwidth		Regulatory Compliance
	Start	End	20 MHz	40 MHz	
IC	3475	3650	Yes	Yes	IC RSS-192
FCC/IC	3650	3700	Yes	NA	FCC Part 90, Subpart Z and IC RSS-197
ETSI	3400	3800	Yes	Yes	ECC RECOMMENDATION (04)05 CEPT/ERC/RECOMMENDATION 12-08 E Article 21.5 ITU-T Radio Regulations
RALI	3425	3492.5	Yes	Yes	RALI: FX 19
	3542.5	3575	Yes	Yes	RALI: FX 14
ROW	3400	3800	Yes	Yes	No regulation limitation

Table 15 3 GHz

Regulation	Frequency Band (MHz)		Channel Bandwidth		Regulatory Compliance
	Start	End	20 MHz	40 MHz	
ETSI	2570	2620	Yes	Yes	EC Decision 2008/477/EC ECC Report 131

Table 16 2 GHz

7.2 Radio Performance

The following tables provide the transmit power and receive sensitivity of the hardware, the real transmit power is limited by local regulation.

Modulation Format	Max Transmit Power (dBm)	Max Transmit Power (dBm)	Receiving Sensitivity (dBm)	Receiving Sensitivity (dBm)
	20 MHz	40 MHz	20 MHz	40 MHz
BPSK 1/2	17	17	-83	-81
QPSK 1/2	17	17	-82	-78
QPSK 3/4	17	17	-77	-77
16QAM 1/2	17	17	-76	-74
16QAM 3/4	17	17	-75	-73
64QAM 2/3	17	17	-69	-66
64QAM 3/4	17	17	-69	-66
64QAM 5/6	17	17	-66	-65

Table 17 5 GHz Radio Performance

Modulation Format	Max Transmit Power (dBm)	Max Transmit Power (dBm)	Receiving Sensitivity (dBm)	Receiving Sensitivity (dBm)
	20 MHz	40 MHz	20 MHz	40 MHz
BPSK 1/2	22	22	-83	-82
QPSK 1/2	22	22	-82	-81
QPSK 3/4	22	22	-77	-80
16QAM 1/2	22	22	-76	-75
16QAM 3/4	22	21	-75	-73
64QAM 2/3	21	20	-69	-68
64QAM 3/4	20	19	-69	-66
64QAM 5/6	19	18	-66	-65

Table 18 3 GHz Radio Performance

Modulation Format	Max Transmit Power (dBm)	Max Transmit Power (dBm)	Receiving Sensitivity (dBm)	Receiving Sensitivity (dBm)
	20 MHz	40 MHz	20 MHz	40 MHz
BPSK 1/2	26	26	-83	-81
QPSK 1/2	26	26	-82	-78
QPSK 3/4	26	26	-77	-77
16QAM 1/2	26	26	-76	-74
16QAM 3/4	25	25	-75	-73
64QAM 2/3	23	23	-69	-66
64QAM 3/4	22	22	-69	-66
64QAM 5/6	21	21	-66	-65

Table 19 2 GHz Radio Performance

7.3 Ethernet Throughput

The following table shows the Ethernet Throughput of Lite.

MCS	Modulation & Coding Rate
8	BPSK 1/2
9	QPSK 1/2
10	QPSK 3/4
11	16 QAM 1/2
12	16 QAM 3/4
13	64 QAM 2/3
14	64 QAM 3/4
15	64 QAM 5/6

Table 20 MCS table

40 MHz/ GI:400 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	12.60	21.00	42.75	61.81	92.80	116.73	116.66	116.53
128	9.90	18.00	36.00	53.75	78.40	114.43	128.14	143.37
256	9.90	16.50	33.00	48.91	72.00	105.80	117.94	131.36
512	9.00	15.75	31.50	46.23	68.80	101.20	112.84	125.01
1024	9.00	15.00	30.75	44.61	66.40	97.18	108.38	120.77
1280	9.00	15.00	30.75	44.61	67.20	97.75	108.38	121.48
1518	6.19	15.00	30.75	44.61	67.20	92.58	107.10	121.48

Table 21 Ethernet L1 Throughput of 50/50 Tx/Rx Ratio (40 MHz/GI:400 ns)

40 MHz/ GI:800 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	9.80	21.00	41.33	57.00	87.75	114.29	116.15	116.03
128	8.40	18.00	34.80	48.00	73.50	102.50	114.43	128.14
256	7.00	16.50	31.90	45.00	67.50	93.79	105.80	117.94
512	7.00	15.75	30.45	43.00	65.25	89.69	101.20	112.84
1024	7.00	15.00	29.73	41.00	62.25	87.12	97.18	108.38

Table 22 Ethernet L1 throughput of 50/50 Tx/Rx ratio (40 MHz/ GI:800 ns)

40 MHz/ GI:800 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
1280	7.00	15.00	29.73	41.00	63.00	87.13	97.75	109.01
1518	7.00	15.00	29.73	41.00	63.00	87.13	98.33	109.01

Table 22 Ethernet L1 throughput of 50/50 Tx/Rx ratio (40 MHz/ GI:800 ns)

20 MHz/ GI:400 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	2.80	9.80	14.00	18.20	42.75	55.58	58.94	69.60
128	2.00	8.40	12.00	15.60	36.00	46.80	50.23	59.40
256	2.00	7.00	11.00	14.30	33.00	43.88	46.64	54.00
512	2.00	7.00	10.00	13.65	31.50	41.93	44.08	51.60
1024	2.00	7.00	9.38	13.00	30.75	39.98	42.54	49.80
1280	2.00	7.00	10.00	13.00	30.75	39.98	42.54	49.80
1518	2.00	7.00	10.00	13.00	30.75	39.98	42.54	49.80

Table 23 Ethernet L1 throughput of 50/50 Tx/Rx ratio (20 MHz/ GI:400 ns)

20 MHz/ GI:800 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	2.80	4.38	14.00	21.00	36.40	48.45	60.38	66.13
128	2.00	6.13	12.00	18.00	31.20	40.80	50.93	56.93
256	2.00	7.00	11.00	14.06	28.60	37.40	47.78	52.33
512	2.00	4.38	9.38	15.75	27.30	35.70	45.15	49.45
1024	2.00	7.00	9.38	15.00	26.65	34.85	43.58	47.73
1280	2.00	6.13	10.00	15.00	26.65	34.85	43.58	47.73
1518	2.00	7.00	10.00	15.00	26.65	34.85	43.58	47.73

Table 24 Ethernet L1 throughput of 50/50 Tx/Rx ratio (20 MHz/ GI:800 ns)

40 MHz/ GI:400 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	9.60	16.00	32.57	47.10	70.70	88.93	88.89	88.79
128	8.56	15.57	31.14	46.49	67.81	98.96	110.82	123.99
256	9.18	15.30	30.61	45.37	66.78	98.13	109.39	121.84
512	8.66	15.16	30.32	44.49	66.21	97.40	108.60	120.31
1024	8.83	14.71	30.16	43.76	65.13	95.31	106.30	118.46
1280	8.86	14.77	30.28	43.93	66.17	96.25	106.71	119.61
1518	6.11	14.80	30.35	44.03	66.33	91.37	105.71	119.90

Table 25 Ethernet L2 throughput of 50/50 Tx/Rx ratio (40 MHz/ GI:400 ns)

40 MHz/ GI:800 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	7.47	16.00	31.49	43.43	66.86	87.08	88.50	88.40
128	7.26	15.57	30.10	41.51	63.57	88.65	98.96	110.82
256	6.49	15.30	29.59	41.74	62.61	86.99	98.13	109.39
512	6.74	15.16	29.31	41.38	62.80	86.32	97.40	108.60
1024	6.87	14.71	29.16	40.21	61.06	85.46	95.31	106.30
1280	6.89	14.77	29.27	40.37	62.03	85.78	96.25	107.34
1518	6.91	14.80	29.34	40.47	62.18	85.99	97.05	107.60

Table 26 Ethernet L2 throughput of 50/50 Tx/Rx ratio (40 MHz/ GI:800 ns)

20 MHz/ GI:400 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	2.13	7.47	10.67	13.87	32.57	42.34	44.90	53.03
128	1.73	7.26	10.38	13.49	31.14	40.48	43.44	51.37
256	1.86	6.49	10.20	13.26	30.61	40.70	43.26	50.09
512	1.92	6.74	9.62	13.14	30.32	40.35	42.42	49.66
1024	1.96	6.87	9.20	12.75	30.16	39.21	41.72	48.85

Table 27 Ethernet L2 throughput of 50/50 Tx/Rx ratio (20 MHz/ GI:400 ns)

20 MHz/ GI:400 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
1280	1.97	6.89	9.85	12.80	30.28	39.36	41.88	49.03
1518	1.97	6.91	9.87	12.83	30.35	39.46	41.98	49.15

Table 27 Ethernet L2 throughput of 50/50 Tx/Rx ratio (20 MHz/ GI:400 ns)

20 MHz/ GI:800 ns	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	2.13	3.33	10.67	16.00	27.73	36.91	46.00	50.38
128	1.73	5.30	10.38	15.57	26.98	35.29	44.04	49.23
256	1.86	6.49	10.20	13.04	26.53	34.69	44.31	48.53
512	1.92	4.21	9.02	15.16	26.27	34.36	43.45	47.59
1024	1.96	6.87	9.20	14.71	26.14	34.18	42.74	46.81
1280	1.97	6.03	9.85	14.77	26.24	34.31	42.90	46.99
1518	1.97	6.91	9.87	14.80	26.30	34.40	43.01	47.10

Table 28 Ethernet L2 throughput of 50/50 Tx/Rx ratio (20 MHz/ GI:800 ns)

40 MHz/ GI:400 ns/ Tx Ratio: 70	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	14.74	60.29	85.97	94.81	127.28	177.60	188.35	189.72
128	12.65	60.04	85.08	93.16	125.98	170.72	181.61	199.68
256	11.79	59.02	85.62	90.20	123.93	167.42	177.94	193.37
512	11.76	57.74	84.38	89.87	123.16	165.65	173.28	189.41
1024	11.45	59.04	83.16	90.05	123.16	165.65	173.28	188.65
1280	11.41	59.29	83.51	90.62	123.93	166.07	176.01	190.58
1518	11.38	59.29	83.69	91.32	123.67	167.42	175.83	193.63

Table 29 Ethernet L1 Tx throughput of 70/30 Tx/Rx ratio (40 MHz/ GI:400 ns)

40 MHz/ GI:400 ns/ Tx Ratio: 30	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	5.72	49.56	59.99	55.32	70.40	89.30	88.95	95.85
128	5.33	46.07	59.85	54.07	70.28	88.36	87.21	93.36
256	5.14	45.65	58.60	54.30	69.10	85.99	85.09	91.82
512	4.96	47.26	56.95	54.43	69.10	85.99	84.39	90.47
1024	4.86	46.84	58.55	53.82	69.10	85.99	85.09	91.05
1280	4.84	46.84	58.55	53.82	69.10	84.55	85.47	91.82
1518	4.83	46.84	58.55	53.82	69.10	84.55	86.19	91.63

Table 30 Ethernet L1 Rx throughput of 70/30 Tx/Rx ratio (40 MHz/ GI:400 ns)

40 MHz/ GI:800 ns/ Tx Ratio: 70	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	12.78	66.20	83.09	88.44	125.49	158.60	169.90	188.35
128	11.07	65.60	82.09	87.65	120.21	152.70	163.90	181.61
256	10.32	64.49	81.23	85.34	119.28	149.54	160.58	177.94
512	10.30	62.99	81.41	85.28	117.33	147.56	159.02	173.28
1024	10.01	64.47	80.73	85.28	116.36	147.79	158.36	173.37
1280	9.97	64.74	80.57	85.28	117.33	148.78	160.11	175.92
1518	9.95	64.74	80.90	85.17	118.31	149.76	160.58	176.53

Table 31 Ethernet L1 Tx throughput of 70/30 Tx/Rx ratio (40 MHz/ GI:800 ns)

40 MHz/ GI:800 ns/ Tx Ratio: 30	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	4.91	56.30	57.97	52.39	68.12	80.07	82.40	88.95
128	4.82	50.02	57.86	51.20	68.05	79.22	81.46	87.21
256	4.50	50.95	56.63	51.44	66.91	78.38	79.19	85.09
512	3.96	56.87	55.29	51.44	66.91	78.38	79.19	84.39
1024	4.25	52.28	56.59	47.44	69.17	77.08	79.57	85.09
1280	4.24	52.28	56.59	49.22	67.99	78.38	77.86	85.47
1518	4.22	52.28	56.59	47.44	69.17	77.08	78.24	86.19

Table 32 Ethernet L1 Rx throughput of 70/30 Tx/Rx ratio (40 MHz/ GI:800 ns)

20 MHz/ GI:400 ns/ Tx Ratio: 70	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	3.40	84.95	43.39	43.55	93.97	85.37	82.99	97.50
128	3.21	78.42	42.98	44.10	90.92	84.88	82.02	94.81
256	3.00	78.42	42.42	44.44	90.92	82.14	80.03	93.28
512	2.80	83.59	42.89	43.55	89.40	82.58	80.03	92.51
1024	2.74	82.83	42.97	43.66	89.40	81.20	80.39	92.51
1280	2.73	82.83	38.96	46.29	90.92	82.14	80.03	93.28
1518	2.82	80.47	42.97	43.66	90.92	82.14	80.03	94.06

Table 33 Ethernet L1 Tx throughput of 70/30 Tx/Rx ratio (20 MHz/ GI:400 ns)

20 MHz/ GI:400 ns/ Tx Ratio: 30	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	1.46	71.13	36.18	32.55	67.45	50.96	46.31	53.03
128	1.28	79.31	32.75	32.78	67.45	49.24	45.48	52.03
256	1.20	79.31	35.18	33.29	64.06	49.24	45.48	52.03
512	1.15	79.31	34.83	33.54	61.84	50.18	45.48	52.03
1024	1.13	79.31	22.32	48.01	64.06	47.55	46.23	52.03
1280	1.13	79.31	34.83	33.54	64.06	49.24	45.48	52.03
1518	1.12	79.31	34.83	33.54	64.06	49.24	45.48	52.03

Table 34 Ethernet L1 Rx throughput of 70/30 Tx/Rx ratio (20 MHz/ GI:400 ns)

20 MHz/ GI:800 ns/ Tx Ratio: 70	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	3.40	84.95	43.39	51.98	73.30	77.17	89.29	92.72
128	3.21	78.42	42.98	50.88	73.28	76.36	87.59	90.33
256	3.00	78.42	42.42	51.27	72.07	75.54	85.15	88.12
512	2.80	83.59	42.89	50.24	72.07	75.54	85.15	87.38
1024	2.74	82.83	42.97	50.37	72.07	74.27	85.57	88.12
1280	2.82	80.47	42.97	50.37	72.07	75.54	85.15	88.85
1518	2.82	80.47	42.97	50.37	72.07	75.54	85.87	88.66

Table 35 Ethernet L1 Tx throughput of 70/30 Tx/Rx ratio (20 MHz/ GI:800 ns)

20 MHz/ GI:800 ns/ Tx Ratio: 30	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	1.46	71.13	36.18	37.56	52.71	48.03	50.62	50.29
128	1.28	79.31	32.75	37.82	52.71	46.42	49.75	49.34
256	1.20	79.31	35.18	35.78	50.91	47.35	49.75	49.34
512	1.15	72.46	37.56	38.69	50.18	46.42	49.75	49.34
1024	1.13	77.97	35.33	38.69	50.18	46.42	49.75	49.34
1280	1.13	79.31	34.83	38.69	50.18	46.42	49.75	49.34
1518	1.12	77.97	35.33	38.69	50.18	46.42	49.75	49.34

Table 36 Ethernet L1 Rx throughput of 70/30 Tx/Rx ratio (20 MHz/ GI:800 ns)

40 MHz/ GI:400 ns/ Tx Ratio: 70	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	11.23	21.68	44.72	65.51	97.51	147.37	165.84	169.30
128	10.94	21.23	43.81	63.96	95.97	141.28	159.09	177.38
256	10.94	20.87	43.72	61.89	93.66	137.96	155.41	171.32
512	11.32	20.87	43.09	61.38	92.89	136.30	151.11	167.27
1024	11.23	21.23	42.82	61.38	92.89	136.30	151.11	166.60
1280	11.23	21.32	43.09	61.89	93.66	136.85	153.57	168.62
1518	11.23	21.32	43.18	62.41	93.66	137.96	153.57	171.32

Table 37 Ethernet L2 Tx throughput of 70/30 Tx/Rx ratio (40 MHz/ GI:400 ns)

40 MHz/ GI:400 ns/ Tx Ratio: 30	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	4.36	8.87	18.43	26.53	40.14	59.60	66.60	73.71
128	4.61	8.63	18.04	25.64	39.48	58.65	65.03	71.40
256	4.77	8.79	17.89	25.64	38.82	56.75	62.92	69.67
512	4.77	9.10	17.81	25.64	38.82	56.75	62.40	68.51
1024	4.77	9.02	18.20	25.64	38.82	56.75	62.92	69.09
1280	4.77	9.02	18.20	25.64	38.82	55.80	62.92	69.67
1518	4.77	9.02	18.20	25.64	38.82	55.80	63.45	69.67

Table 38 Ethernet L2 Rx throughput of 70/30 Tx/Rx ratio (40 MHz/ GI:400 ns)

40 MHz/ GI:800 ns/ Tx Ratio: 70	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	9.74	21.68	43.22	60.46	94.30	130.85	147.37	165.84
128	9.57	21.23	42.27	59.50	89.97	124.93	141.28	159.09
256	9.57	20.87	41.48	57.58	88.53	121.98	137.96	155.41
512	9.91	20.87	41.57	57.58	87.08	120.00	136.30	151.11
1024	9.82	21.23	41.57	57.58	86.36	120.00	135.74	151.11
1280	9.82	21.32	41.57	57.58	87.08	120.99	137.40	153.57
1518	9.82	21.32	41.74	57.58	87.81	121.98	137.96	154.18

Table 39 Ethernet L2 Tx throughput of 70/30 Tx/Rx ratio (40 MHz/ GI:800 ns)

40 MHz/ GI:800 ns/ Tx Ratio: 30	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	9.74	21.68	43.22	60.46	94.30	130.85	147.37	165.84
128	9.57	21.23	42.27	59.50	89.97	124.93	141.28	159.09
256	9.57	20.87	41.48	57.58	88.53	121.98	137.96	155.41
512	9.91	20.87	41.57	57.58	87.08	120.00	136.30	151.11
1024	9.82	21.23	41.57	57.58	86.36	120.00	135.74	151.11
1280	9.82	21.32	41.57	57.58	87.08	120.99	137.40	153.57
1518	9.82	21.32	41.74	57.58	87.81	121.98	137.96	154.18

Table 40 Ethernet L2 Rx throughput of 70/30 Tx/Rx ratio (40 MHz/ GI:800 ns)

20 MHz/ GI:400 ns/ Tx Ratio: 70	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	2.59	9.74	14.21	18.09	44.63	58.95	61.97	73.71
128	2.78	9.57	13.91	18.09	43.18	58.01	60.99	71.40
256	2.78	9.57	13.73	18.09	43.18	56.14	59.01	69.67
512	2.69	9.91	14.21	18.09	42.46	56.14	59.01	69.09
1024	2.69	9.82	14.15	18.09	42.46	55.20	59.01	69.09
1280	2.69	9.82	12.83	18.09	43.18	56.14	59.01	69.67
1518	2.78	9.82	14.15	18.09	43.18	56.14	59.01	70.25

Table 41 Ethernet L2 Tx throughput of 70/30 Tx/Rx ratio (20 MHz/ GI:400 ns)

20 MHz/ GI:400 ns/ Tx Ratio: 30	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	1.11	3.74	5.70	7.22	17.89	24.06	25.29	29.61
128	1.11	4.17	5.65	7.22	17.89	23.25	24.45	28.62
256	1.11	4.17	6.07	7.75	17.89	23.25	24.45	28.62
512	1.11	4.17	6.01	7.75	17.27	23.25	24.45	28.62
1024	1.11	4.17	3.85	7.75	17.89	22.45	24.45	28.62
1280	1.11	4.17	6.01	7.75	17.89	23.25	24.45	28.62
1518	1.11	4.17	6.01	7.75	17.89	23.25	24.45	28.62

Table 42 Ethernet L2 Rx throughput of 70/30 Tx/Rx ratio (20 MHz/ GI:400 ns)

20 MHz/ GI:800 ns/ Tx Ratio: 70	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	2.59	9.74	14.21	21.59	38.05	50.58	63.99	70.64
128	2.78	9.57	13.91	20.87	37.42	49.76	62.48	68.43
256	2.78	9.57	13.73	20.87	36.80	48.94	60.45	66.21
512	2.69	9.91	14.21	20.87	36.80	48.94	60.45	65.66
1024	2.69	9.82	14.15	20.87	36.80	48.12	60.45	66.21
1280	2.78	9.82	14.15	20.87	36.80	48.94	60.45	66.76
1518	2.78	9.82	14.15	20.87	36.80	48.94	60.96	66.76

Table 43 Ethernet L2 Tx throughput of 70/30 Tx/Rx ratio (20 MHz/ GI:800 ns)

20 MHz/ GI:800 ns/ Tx Ratio: 30	Throughput (Mbps)							
Frame Size	**BPSK 1/2**	**QPSK 1/2**	**QPSK 3/4**	**16QAM 1/2**	**16QAM 3/4**	**64QAM 2/3**	**64QAM 3/4**	**64QAM 5/6**
64	1.11	3.74	5.70	8.33	15.50	20.97	25.91	28.38
128	1.11	4.17	5.65	8.33	15.50	20.27	25.04	27.43
256	1.11	4.17	6.07	8.33	14.97	20.27	25.04	27.43
512	1.11	3.81	6.01	8.94	15.50	20.27	25.04	27.43
1024	1.11	4.10	6.01	8.94	15.50	20.27	25.04	27.43
1280	1.11	4.17	6.01	8.94	15.50	20.27	25.04	27.43
1518	1.11	4.10	6.01	8.94	15.50	20.27	25.04	27.43

Table 44 Ethernet L2 Rx throughput of 70/30 Tx/Rx ratio (20 MHz/ GI:800 ns)

7.4 Latency

The following tables show the latency of Lite.

40 MHz/ GI:400 ns	Latency (ms)							
MCS	**BPSK Coding 1/2**	**QPSK Coding 1/2**	**QPSK Coding 3/4**	**16 QAM Coding 1/2**	**16 QAM Coding 3/4**	**64 QAM Coding 2/3**	**64 QAM Coding 3/4**	**64 QAM Coding 5/6**
64	4.02	4.97	1.72	1.59	1.76	1.80	1.79	1.92
128	3.47	3.78	1.55	1.71	1.65	1.67	1.82	1.83
256	3.22	3.65	1.57	1.67	1.74	1.75	1.73	1.84
512	3.42	3.55	1.62	1.67	1.75	1.75	1.69	1.84
1024	3.84	3.74	1.75	1.63	1.65	1.67	1.70	1.84
1280	3.60	3.89	1.86	1.86	1.69	1.69	1.67	1.84
1518	3.69	3.81	1.89	1.84	1.69	1.77	1.71	1.84

Table 45 Latency - 50/50 Tx/Rx Ratio 40 MHz/GI:400 ns

40 MHz/ GI:800 ns	Latency (ms)							
MCS	**BPSK Coding 1/2**	**QPSK Coding 1/2**	**QPSK Coding 3/4**	**16 QAM Coding 1/2**	**16 QAM Coding 3/4**	**64 QAM Coding 2/3**	**64 QAM Coding 3/4**	**64 QAM Coding 5/6**
64	8.19	9.59	1.76	1.62	1.77	1.85	1.80	1.80
128	3.60	3.60	1.57	1.65	1.66	1.67	1.70	1.86
256	3.63	3.40	1.58	1.58	1.78	1.68	1.79	1.77
512	3.60	3.46	1.67	1.60	1.72	1.69	1.79	1.74
1024	3.53	3.68	1.79	1.56	1.65	1.71	1.71	1.75
1280	3.66	3.79	1.88	1.90	1.74	1.74	1.71	1.72
1518	4.15	3.77	1.95	1.82	1.73	1.79	1.81	1.75

Table 46 Latency - 50/50 Tx/Rx Ratio 40 MHz/GI:800 ns

20 MHz/ GI:400 ns	Latency (ms)							
MCS	**BPSK Coding 1/2**	**QPSK Coding 1/2**	**QPSK Coding 3/4**	**16 QAM Coding 1/2**	**16 QAM Coding 3/4**	**64 QAM Coding 2/3**	**64 QAM Coding 3/4**	**64 QAM Coding 5/6**
64	4.92	4.28	4.90	5.19	1.75	1.63	1.63	1.69
128	4.51	3.59	3.89	3.95	1.58	1.66	1.65	1.78
256	3.91	3.62	3.56	3.74	1.61	1.63	1.68	1.82
512	3.64	3.58	3.59	3.82	1.66	1.63	1.65	1.76
1024	4.62	3.54	3.88	3.89	1.77	1.65	1.66	1.62
1280	5.51	3.66	3.79	3.99	1.91	1.85	1.88	1.76
1518	5.68	4.34	4.00	4.03	1.91	1.84	1.91	1.91

Table 47 Latency - 50/50 Tx/Rx Ratio 20 MHz/GI:400 ns

20 MHz/ GI:800 ns	Latency (ms)							
MCS	**BPSK Coding 1/2**	**QPSK Coding 1/2**	**QPSK Coding 3/4**	**16 QAM Coding 1/2**	**16 QAM Coding 3/4**	**64 QAM Coding 2/3**	**64 QAM Coding 3/4**	**64 QAM Coding 5/6**
64	4.69	4.13	4.52	4.63	1.75	1.64	1.68	1.66
128	4.55	3.64	3.71	3.65	1.58	1.64	1.70	1.81
256	3.95	3.35	3.37	3.44	1.60	1.61	1.71	1.78

Table 48 Latency - 50/50 Tx/Rx Ratio 20 MHz/GI:800 ns

20 MHz/ GI:800 ns	Latency (ms)							
MCS	BPSK Coding 1/2	QPSK Coding 1/2	QPSK Coding 3/4	16 QAM Coding 1/2	16 QAM Coding 3/4	64 QAM Coding 2/3	64 QAM Coding 3/4	64 QAM Coding 5/6
512	3.60	3.63	3.64	3.34	1.71	1.68	1.68	1.77
1024	4.69	3.60	3.83	3.58	1.86	1.79	1.70	1.72
1280	5.56	3.89	3.98	3.65	1.91	1.94	1.90	1.90
1518	5.75	4.27	3.92	4.99	1.99	1.79	1.89	1.92

Table 48 Latency - 50/50 Tx/Rx Ratio 20 MHz/GI:800 ns

40 MHz/ GI:400 ns	Latency (ms)							
MCS	BPSK Coding 1/2	QPSK Coding 1/2	QPSK Coding 3/4	16 QAM Coding 1/2	16 QAM Coding 3/4	64 QAM Coding 2/3	64 QAM Coding 3/4	64 QAM Coding 5/6
64	3.12	1.94	2.02	1.94	2.08	2.10	2.23	2.30
128	3.28	1.99	2.04	2.10	1.98	2.11	2.22	2.18
256	3.32	1.93	2.06	2.15	2.10	2.22	2.16	2.17
512	3.51	1.94	2.08	2.23	2.15	2.25	2.19	2.21
1024	3.80	2.34	2.08	2.09	2.11	2.21	2.18	2.23
1280	3.68	2.36	2.31	2.19	2.15	2.25	2.18	2.20
1518	3.85	2.31	2.31	2.18	2.21	2.28	2.18	2.21

Table 49 Latency - 70/30 Tx/Rx Ratio 40 MHz/GI:400 ns

40 MHz/ GI:800 ns	Latency (ms)							
MCS	BPSK Coding 1/2	QPSK Coding 1/2	QPSK Coding 3/4	16 QAM Coding 1/2	16 QAM Coding 3/4	64 QAM Coding 2/3	64 QAM Coding 3/4	64 QAM Coding 5/6
64	3.09	1.96	1.98	2.15	2.08	2.14	2.08	2.23
128	3.29	2.03	2.00	2.17	2.19	2.18	2.10	2.22
256	3.41	1.90	2.06	2.22	2.06	2.17	2.21	2.16
512	3.54	1.90	2.10	2.25	2.15	2.21	2.24	2.19
1024	3.66	2.26	2.10	2.11	2.12	2.17	2.18	2.18
1280	3.80	2.35	2.34	2.29	2.15	2.16	2.23	2.18
1518	3.99	2.33	2.29	2.31	2.22	2.23	2.25	2.18

Table 50 Latency - 70/30 Tx/Rx Ratio 40 MHz/GI:800 ns

20 MHz/ GI:400 ns	Latency (ms)							
MCS	**BPSK Coding 1/2**	**QPSK Coding 1/2**	**QPSK Coding 3/4**	**16 QAM Coding 1/2**	**16 QAM Coding 3/4**	**64 QAM Coding 2/3**	**64 QAM Coding 3/4**	**64 QAM Coding 5/6**
64	3.25	3.10	3.11	1.94	2.11	2.15	2.13	1.99
128	3.35	3.28	3.36	1.97	2.11	2.08	2.08	2.16
256	3.54	3.40	3.42	1.97	2.15	2.19	2.14	2.18
512	4.09	3.54	3.55	2.07	2.17	2.21	2.17	2.17
1024	3.88	3.68	3.63	2.36	2.15	2.09	2.09	2.18
1280	4.06	3.72	3.86	2.34	2.37	2.17	2.15	2.18
1518	4.26	4.05	3.68	2.31	2.37	2.32	2.16	2.20

Table 51 Latency - 70/30 Tx/Rx Ratio 20 MHz/GI:400 ns

20 MHz/ GI:800 ns	Latency (ms)							
MCS	**BPSK Coding 1/2**	**QPSK Coding 1/2**	**QPSK Coding 3/4**	**16 QAM Coding 1/2**	**16 QAM Coding 3/4**	**64 QAM Coding 2/3**	**64 QAM Coding 3/4**	**64 QAM Coding 5/6**
64	3.26	3.11	3.12	1.98	2.02	2.15	2.05	1.98
128	3.37	3.32	3.39	2.06	2.09	2.04	2.11	2.13
256	3.55	3.43	3.40	1.94	2.04	2.22	2.19	2.18
512	4.13	3.57	3.52	1.94	2.05	2.18	2.20	2.26
1024	3.95	3.67	3.65	2.30	2.11	2.06	2.11	2.13
1280	4.14	3.81	3.83	2.38	2.39	2.23	2.22	2.19
1518	4.27	4.14	3.70	2.34	2.24	2.37	2.20	2.20

Table 52 Latency - 70/30 Tx/Rx Ratio 20 MHz/GI:800 ns

40 MHz/ GI:400 ns	Latency (ms)							
MCS	**BPSK Coding 1/2**	**QPSK Coding 1/2**	**QPSK Coding 3/4**	**16 QAM Coding 1/2**	**16 QAM Coding 3/4**	**64 QAM Coding 2/3**	**64 QAM Coding 3/4**	**64 QAM Coding 5/6**
64	3.23	3.09	3.16	2.26	2.29	2.42	2.26	2.29
128	3.43	3.16	3.21	2.17	2.24	2.39	2.36	2.40
256	3.60	3.25	3.30	2.27	2.17	2.41	2.37	2.38

Table 53 Latency - 30/70 Tx/Rx Ratio 40 MHz/GI:400 ns

40 MHz/ GI:400 ns	Latency (ms)							
MCS	BPSK Coding 1/2	QPSK Coding 1/2	QPSK Coding 3/4	16 QAM Coding 1/2	16 QAM Coding 3/4	64 QAM Coding 2/3	64 QAM Coding 3/4	64 QAM Coding 5/6
512	3.75	3.43	3.39	2.34	2.19	2.41	2.34	2.35
1024	4.24	3.62	3.49	2.45	2.17	2.23	2.29	2.37
1280	4.31	3.76	3.60	2.54	2.44	2.37	2.34	2.32
1518	4.39	4.21	3.68	2.57	2.40	2.42	2.33	2.36

Table 53 Latency - 30/70 Tx/Rx Ratio 40 MHz/GI:400 ns

40 MHz/ GI:800 ns	Latency (ms)							
MCS	BPSK Coding 1/2	QPSK Coding 1/2	QPSK Coding 3/4	16 QAM Coding 1/2	16 QAM Coding 3/4	64 QAM Coding 2/3	64 QAM Coding 3/4	64 QAM Coding 5/6
64	3.43	3.11	3.15	2.27	2.27	2.41	2.42	2.25
128	3.42	3.16	3.22	2.23	2.25	2.28	2.38	2.35
256	3.53	3.25	3.32	2.26	2.17	2.40	2.41	2.37
512	3.96	3.43	3.40	2.35	2.29	2.37	2.40	2.33
1024	4.27	3.64	3.48	2.47	2.31	2.22	2.23	2.29
1280	4.36	3.84	3.67	2.58	2.48	2.36	2.37	2.34
1518	4.59	4.21	3.63	2.59	2.38	2.49	2.41	2.33

Table 54 Latency - 30/70 Tx/Rx Ratio 40 MHz/GI:800 ns

20 MHz/ GI:400 ns	Latency (ms)							
MCS	BPSK Coding 1/2	QPSK Coding 1/2	QPSK Coding 3/4	16 QAM Coding 1/2	16 QAM Coding 3/4	64 QAM Coding 2/3	64 QAM Coding 3/4	64 QAM Coding 5/6
64	3.91	3.33	3.28	3.10	3.15	2.27	2.25	2.25
128	4.03	3.41	3.28	3.13	3.25	2.21	2.21	2.22
256	4.62	3.53	3.45	3.25	3.35	2.25	2.24	2.26
512	4.73	3.77	3.76	3.36	3.41	2.26	2.32	2.30
1024	7.16	4.25	4.32	4.18	3.69	2.57	2.52	2.52
1280	8.25	4.34	4.32	4.18	3.69	2.57	2.52	2.52
1518	9.38	4.41	4.28	4.25	3.71	2.55	2.56	2.53

Table 55 Latency - 30/70 Tx/Rx Ratio 20 MHz/GI:400 ns

20 MHz/ GI:800 ns	Latency (ms)							
MCS	**BPSK Coding 1/2**	**QPSK Coding 1/2**	**QPSK Coding 3/4**	**16 QAM Coding 1/2**	**16 QAM Coding 3/4**	**64 QAM Coding 2/3**	**64 QAM Coding 3/4**	**64 QAM Coding 5/6**
64	3.94	3.36	3.30	3.12	3.17	2.27	2.30	2.28
128	4.03	3.45	3.30	3.20	3.26	2.31	2.24	2.19
256	4.65	3.57	3.50	3.29	3.30	2.25	2.29	2.26
512	4.79	3.98	3.81	3.49	3.40	2.25	2.36	2.34
1024	7.21	4.32	4.31	3.67	3.54	2.54	2.48	2.45
1280	8.29	4.41	4.23	3.87	3.67	2.57	2.59	2.50
1518	9.37	4.63	4.30	4.26	3.64	2.55	2.59	2.61

Table 56 Latency - 30/70 Tx/Rx Ratio 20 MHz/GI:800 ns

8 Standards

Lite is in compliance with the following standards.

Recommendation	Recommendation Name
IEEE 802.3-2005	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications
IEEE 802.1Q	Virtual LANs
IEEE 802.1ad	Provider bridge (QinQ)
IEEE 802.1D-2004	Media access control (MAC) bridge
IEEE 802.11-2012	Wireless LAN medium access control (MAC) and physical layer (PHY) specifications
IEEE 802.11n-2009	Wireless LAN medium access control (MAC) and physical layer (PHY) specifications
IEEE P802.3at/D1.0	Enhanced data terminal equipment (DTE) power via media dependent interface (MDI) enhancements

Table 57 IEEE Standards

Recommendation	Recommendation Name
EN 60215	Safety Requirements for radio transmitting equipment
EN 60950-1	Information technology equipment - Safety - Part 1: General requirements
EN 60950-22	Information Technology Equipment - Safety - Part 22: Equipment to be Installed Outdoors
EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4 : Testing and measurement techniques - Section 2: Electrostatic discharge requirements
EN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated electromagnetic field requirements
EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test. Basic EMC Publication
EN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity test
EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 6: Testing and measurement techniques - Section 6: Immunity to conducted disturbances, induced by radio frequency fields

Table 58 CEPT standards

Recommendation	Recommendation Name
EN 55022	Limits and methods of measurement of radio interference characteristics of information technology equipment

Table 58 CEPT standards

Recommendation	Recommendation Name
EN 300 019-1-1	Environmental conditions and environmental tests for telecommunications equipments. Parts 1-1: Classification of environmental conditions: Storage
EN 300 019-1-2	Environmental conditions and environmental tests for telecommunications equipments. Parts 1-2: Classification of environmental conditions: Transportation
EN 300 019-1-4 (2003-04)	Environmental conditions and environmental tests for telecommunications equipments. Parts 1-4: Classification of environmental conditions: Stationary use at non-weather protected locations
EN 300 019-2-1	Environmental conditions and environmental tests for telecommunications equipment; Part 2-1: Specification of environmental tests; Storage
EN 300 019-2-2	Environmental conditions and environmental tests for telecommunications equipment; Part 2-2: Specification of environmental tests; Transportation
EN 300 019-2-4	– Environmental conditions and environmental tests for telecommunications equipment; Part 2-4: Specification of environmental tests; Stationary use at non-weather protected locations
EN 301 489-1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Electro-Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
EN 301 489-17	Electromagnetic compatibility and Radio spectrum Matters (ERM); Electro-Magnetic Compatibility (EMC) standard for radio equipment and services;
EN 300 132-2 (2007-10)	Power supply interface at the input to telecommunications equipment; Part 2: operated by direct current (DC)
EN 301 893 V1.7.1 (2012-06)	Broadband Radio Access Networks (BRAN); 5 GHz high performance RLAN; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive
EN 302 502 V1.2.1 (2008-07)	Broadband Radio Access Networks (BRAN); 5, 8 GHz fixed broadband data transmitting systems; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive

Table 59 ETSI Standards

Recommendation	Recommendation Name
G.8261/Y.1361	Timing and synchronization aspects in packet networks
G.8262/Y.1362	Timing characteristics of synchronous Ethernet equipment slave clock (EEC)
G.8264/Y.1364	Distribution of timing information through packet networks
G.826	End-to-end error performance parameters and objectives for international, constant bit-rate digital paths and connections
G.828	Error performance parameters and objectives for international, constant bit-rate synchronous digital paths
K.48	EMC requirements for telecommunication equipment – Product family Recommendation
Y.1731	OAM functions and mechanisms for Ethernet based networks

Table 60 ITUT Standards

Recommendation	Recommendation Name
EN 61000-4-11	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests
EN 61000-4-29	Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests

Table 61 IEC Standards

Recommendation	Recommendation Name
GR-63-CORE	Network equipment-building system (NEBS) requirement: Physical protection
GR-478-CORE	Network maintenance: Alarm and control for network elements
GR-1089-CORE	Electromagnetic compatibility and electrical safety: Generic criteria for network telecommunications equipment

Table 62 NEBS Standards

Recommendation	Recommendation Name
CFR47 Part 15 Subpart B Class B	Unintentional radiators (Digital Emissions)
CFR47 Part 15 Subpart C	Intentional radiators

Table 63 FCC Standards

Recommendation	Recommendation Name
CFR47 Part 15 Subpart E	Unlicensed national information infrastructure devices
CFR47 Part 90 Subpart Y	Private land mobile radio services
CFR47 Part 27	Miscellaneous wireless communications services
CFR47 Part 90 Subpart Z	Wireless Broadband Services in the 3650-3700 MHz Band.

Table 63 FCC Standards

Recommendation	Recommendation Name
ICES-003	Information technology equipment (ITE) - Limits and methods of measurement

Table 64 ICES Standards

Recommendation	Recommendation Name
UL 50E	Enclosures for electrical equipment, environmental consider-ations

Table 65 UL Standards

Recommendation	Recommendation Name
ECC recommendation (06)04	Use of the band 5 725-5 875 for broadband fixed wireless access (BFWA)
ECC/DEC/(04)08	ECC decision of 09 July 2004 on the harmonized use of the 5 GHz frequency bands for the implementation of wireless access systems including radio local area networks (WAS/RLANs)

Table 66 ECC Standards

Recommendation	Recommendation Name
IC RSS-210	License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
IC RSS-192	Fixed Wireless Access Equipment Operating in the Band 3450-3650 MHz
SRSP-303.4	Technical Requirements for Fixed Wireless Access Systems Operating in the Band 3475-3650 MHz

Table 67 IC Standards

Recommendation	Recommendation Name
IC RSS-197	Wireless Broadband Access Equipment Operating in the Band 3650-3700 MHz
SRSP-303.65	Technical Requirements for Wireless Broadband Services (WBS) in the Band 3650-3700 MHz

Table 67 IC Standards