



# LE910Cx SGMII and SDIO

## Design Guide

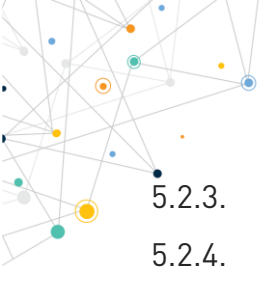
80582NT11874A Rev. 1 – 2021-09-28

## APPLICABILITY TABLE

PRODUCTS	DESCRIPTION
LE910C1-NA	North America – AT&T with global roaming
LE910C1-NS	North America - Sprint variant
LE910C1-AP	APAC variant CAT1 variant
LE910C4-AP	APAC variant CAT4 variant
LE910C4-EU	Europe CAT4 variant
LE910C1-EU	Europe CAT1 variant
LE910C1-EUX	Europe CAT1 variant
LE910C4-NF	North America CAT4 variant
LE910C1-NF	North America CAT1 variant
LE910C1-SA	North America CAT1 variant – AT&T
LE910C1-ST	North America CAT1 variant – T Mobile
LE910C1-SV	North America CAT1 variant – Verizon
LE910C1-LA	Latin America CAT1 variant
LE910C4-LA	Latin America CAT4 variant
LE910C4-CN	China CAT4 variant

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# 1. INTRODUCTION

## 1.1. Scope

This document provides SGMII and SDIO design guidelines for developing a product using the Telit LE910Cx module.

## 1.2. Audience

This document is intended for Telit customers, especially system integrators, about to implement their applications using the Telit LE910Cx module.

## 1.3. Contact Information, Support

For general contact, technical support services, technical questions and report of documentation errors contact Telit Technical Support at:

- [TS-EMEA@telit.com](mailto:TS-EMEA@telit.com)
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- [TS-APAC@telit.com](mailto:TS-APAC@telit.com)
- [TS-SRD@telit.com](mailto:TS-SRD@telit.com)
- [TS-ONEEDGE@telit.com](mailto:TS-ONEEDGE@telit.com)

Alternatively, use:

<https://www.telit.com/contact-us>

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

<https://www.telit.com>

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates the user feedback on our information.

## 1.4. Symbol Conventions



**Danger:** This information **MUST** be followed or catastrophic equipment failure or personal injury may occur.



**Warning:** Alerts the user on important steps about the module integration.



**Note/Tip:** Provides advice and suggestions that may be useful when integrating the module.



**Electro-static Discharge:** Notifies the user to take proper grounding precautions before handling the product.

*Table 1: Symbol Conventions*

All dates are in ISO 8601 format, that is YYYY-MM-DD.

## 1.5. Related Documents

- EDCS-540123 Cisco QSGMII Specification

## 2. SGMII GENERAL GUIDELINES

This chapter provides general guidelines for SGMII interface to improve signal integrity.



**Note:** To connect to the SGMII interface, use the new LE910Cx hardware. For more information, refer chapter 4. LE910CX Old Version Hardware.

### 2.1. Features

LE910Cx module includes an integrated Ethernet MAC with an SGMII interface that includes the following key features:

- IEEE 802.3 compliance
- Full duplex at 1Gbps
- Half/full duplex for 10/100Mbps
- Supports VLAN tagging
- Supports IEEE 1588, Precision Time Protocol (PTP)
- Can be connected to external Ethernet PHY.
- MDC/MDIO supports dual voltage 1.8V or 2.85V operation.

Select an Ethernet PHY that complies with the following specifications:

- IEEE 802.3
- IEEE 1588
- IEEE 802.3az
- IEEE 802.1AS and 802.1Qav

#### 2.1.1. Guidelines

LE910Cx module supports a 10/100/1000 Mbps ethernet through the SGMII interface.

#### 2.1.2. Signal Routing

Type of guidance	Guideline	Requirement
General	Data rate	1.25Gbps
	Impedance	80-120 ohms differential
	Interconnect loss	< 10 dB at 2.5GHz

Type of guidance	Guideline	Requirement
Length matching	Intra pair match	< 0.7mm
Spacing	SGMII to all other signals	> 3 x line width
	Tx lane to Rx lane	> 3 x line width
	Intra pair (p to n)	Space required to hit the differential impedance

Table 2: SGMII Signal Routing

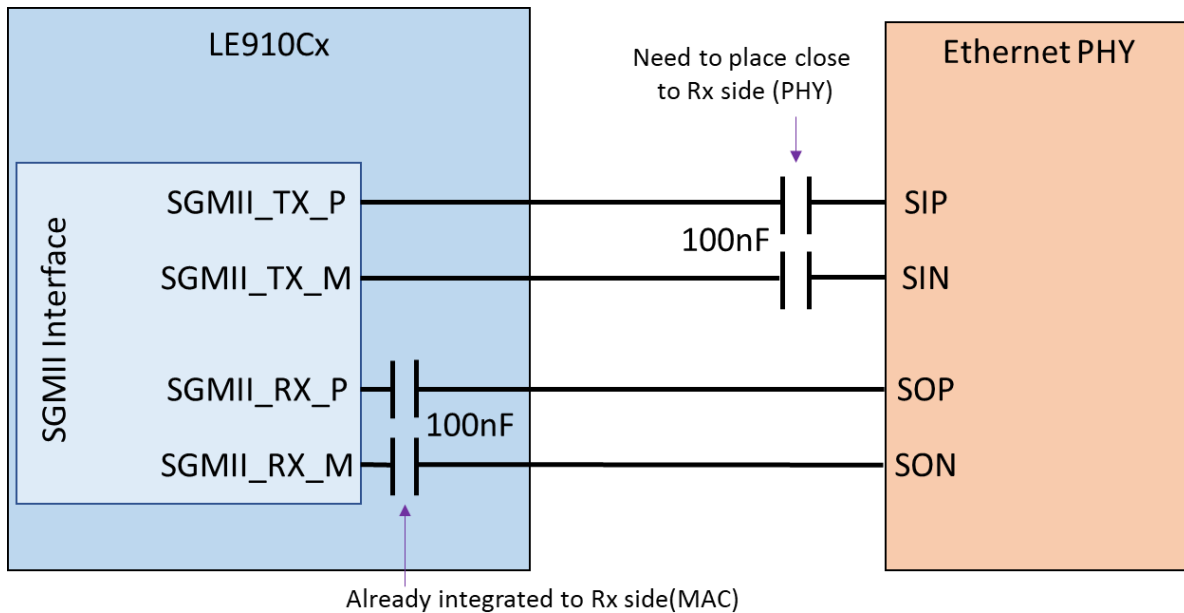


**Note:** Guidelines presented here are made with every effort to be in conformance with EDCS-540123 and are provided to the user as a starting point to achieve the appropriate interface performance. If future revisions of EDCS-540123 cause discrepancies between these guidelines and EDCS-540123, then the specification (EDCS-540123) takes precedence.

For a complete list of specifications, see EDCS-540123.

### 2.1.3. AC Coupling Capacitors

To improve signal integrity and block DC noise, AC coupling capacitors should be placed on the SGMII Rx side.



As shown in the above figure, 100nF capacitors are already integrated close to the Rx side of the Ethernet PHY.



### 3. SDC/SDIO GENERAL GUIDELINES

This chapter provides general guidelines for improving signal integrity at the SDC/SDIO interface.

#### 3.1. Features

The SDC/SDIO interface provides the following features or functions:

- Clock output up to 200 MHz on SDC/SDIO
- SDIO operates at 1.8V.
- 1.8V/2.85V dual-voltage operation on SDC.
- SDIO compatible to WLAN (802.11)
- A microSD card or eMMC device can be connected to the SDC
- A microSD card or eMMC device can be used only for storage, not for booting.

#### 3.2. Guidelines

##### 3.2.1. Signal Routing

Type of guidance	Guideline	Requirement
General	Maximum clock frequency	200MHz
	Maximum data rate	200Mbps
	Single-ended impedance	50 ohms nominal
Length matching	Clock to data/cmd match	< 1mm (7 ps)
Spacing	SDC/SDIO to other signal spacing	2x line width
	SDC/SDIO to other SDC/SDIO	2x line width
Bus loading	Maximum bus capacitance	15 pF
	Maximum trace length	50 mm

Table 3: SDC/SDIO Signal Routing

Other comments and guidelines:

- Protect other sensitive signals/circuits from SDC/SDIO corruption
- Protect SDC/SDIO signals from noisy signals (clocks, SMPS, and so on).

### 3.2.2. Termination Resistor

Termination resistor should be placed on the SDC/SDIO clock line as close to LE910Cx processor as possible.

Termination resistors prevent radiated emissions and bus errors due to reflections.

As illustrated in the above image, a 24-ohm series resistor for termination is already integrated close to the LE910Cx processor.

As a result, customer does not need to add series termination resistor on their board.

## 4. LE910CX OLD VERSION HARDWARE

It is not recommended to use LE910Cx old version hardware if the customer wants to use SGMII or SDC/SDIO interface.



**Warning:** For SGMII and SDC/SDIO signal quality, it is recommended to use the latest hardware.

Telit cannot guarantee that using older hardware will not cause SGMII and SDC/SDIO issues.

### 4.1. Hardware Revision

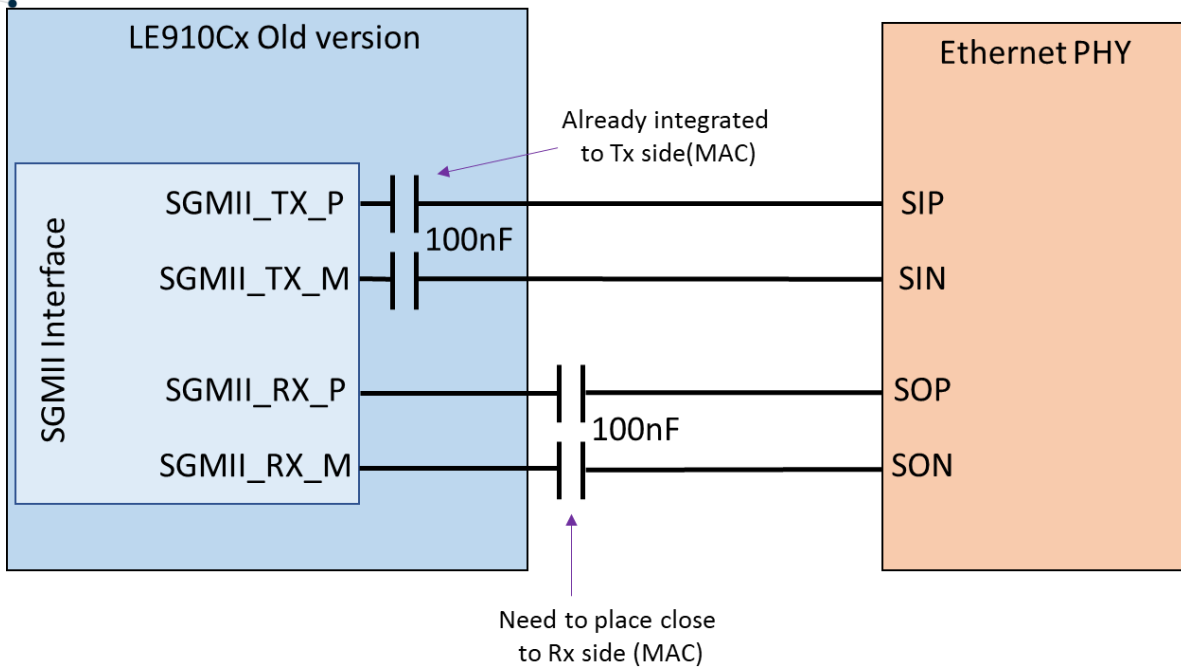
Below table lists the latest hardware revisions for each module.

Module Name	New HW Revision
LE910C1-LA	More than or equal to V1.0
LE910C4-LA	More than or equal to V1.0
LE910C4-CN	More than or equal to V1.0
LE910C1-SV	More than or equal to V1.0
LE910C1-SA	More than or equal to V1.1
LE910C1-ST	More than or equal to V1.1
LE910C1-NF	More than or equal to V1.1
LE910C4-NF	More than or equal to V1.1
LE910C1-EU	More than or equal to V1.1
LE910C4-EU	More than or equal to V1.1
LE910C1-EUX	More than or equal to V1.1
LE910C1-AP	More than or equal to V1.2
LE910C4-AP	More than or equal to V1.2
LE910C1-NA	More than or equal to V1.2
LE910C1-NS	More than or equal to V1.2

Table 4: Hardware Revisions

### 4.1. SGMII (AC Coupling Capacitors)

To improve signal integrity and block DC noise, AC coupling capacitors should be placed on the SGMII Rx side.



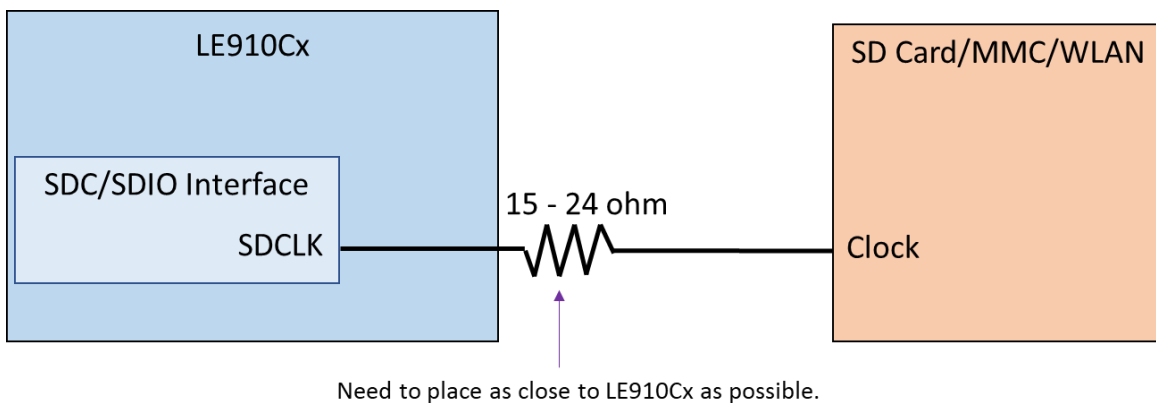
However, in older versions, 100nF capacitors are incorrectly integrated close to Tx side of the MAC, resulting in SGMII quality issues. As a result, it is not recommended to use older hardware versions when using the SGMII interface.

In any case, the customer must install 100nF capacitors close to Rx side of the MAC.

#### 4.2. SDC/SDIO (Termination Resistor)

Termination resistor should be placed on the SDC/SDIO clock line as close to LE910Cx processor as possible.

The termination resistor prevents radiated emissions and bus errors caused by reflections.



However, in older versions, the series termination resistor is not integrated into the LE910Cx module resulting in SDC/SDIO quality issues. As a result, it is not recommended to use older hardware versions when using the SDC/SDIO interface.



In any case, the customer must install a 15 – 24 ohms resistor as close to the LE910Cx as possible.

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### 5.3. Safety Recommendations

Make sure the use of this product is allowed in your country and in the environment required. The use of this product may be dangerous and has to be avoided in areas where:

- it can interfere with other electronic devices, particularly in environments such as hospitals, airports, aircrafts, etc.
- there is a risk of explosion such as gasoline stations, oil refineries, etc. It is the responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conformed to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible for the functioning of the final product. Therefore, the external components of the module, as well as any project or installation issue, have to be handled with care. Any interference may cause the risk of disturbing the GSM network or external devices or having an impact on the security system. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed carefully in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The equipment is intended to be installed in a restricted area location.

The equipment must be supplied by an external specific limited power source in compliance with the standard EN 62368-1:2014.

The European Community provides some Directives for the electronic equipment introduced on the market. All of the relevant information is available on the European Community website:

[https://ec.europa.eu/growth/sectors/electrical-engineering\\_en](https://ec.europa.eu/growth/sectors/electrical-engineering_en)

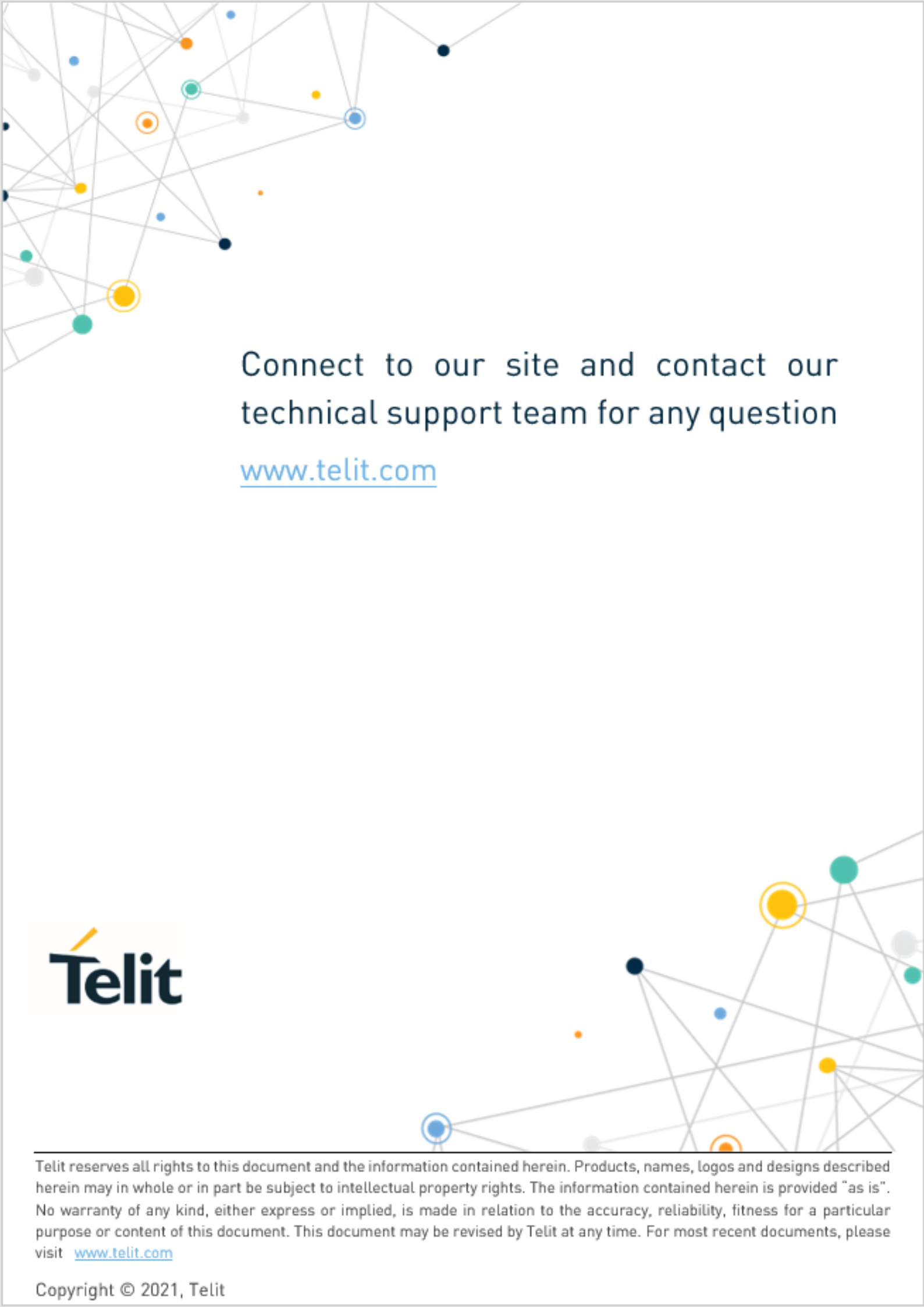
## 6. GLOSSARY

<b>MDC</b>	MDIO Interface Clock
<b>MDIO</b>	Management Data Input Output
<b>PTP</b>	Precision Time Protocol
<b>SDC</b>	Secure Digital (SD) Card
<b>SDIO</b>	Secure Digital Input Output
<b>SGMII</b>	Serial Gigabit Media Independent Interface
<b>SIM</b>	Subscriber Identification Module
<b>SMPS</b>	Switched-Mode Power Supply
<b>VLAN</b>	Virtual Local Area Networks
<b>WLAN</b>	Wireless Local Area Network

## 7. DOCUMENT HISTORY

Revision	Date	Changes
1	2021-09-28	Minor text changes Updated document to new Telit template standards
0	2020-10-05	Initial Release

From Mod.0809 rev.3

A network diagram consisting of various colored nodes (blue, orange, yellow, green, black, grey) connected by thin grey lines, forming a complex web. The nodes are scattered across the page, with a higher density in the top-left and bottom-right corners.

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