

IRM-1101 Expansion Module

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IRM-1100 Expansion Module Overview

The IR1101 Router has an Expansion Module that adds key capabilities such as dual LTE Pluggables, mSATA SSD FRU, SFP, and Digital GPIO connections.

The Expansion Module comes in two types:

- IRM-1100-SPMI
- IRM-1100-SP

Warning It is important to note that just like the Base IR1101, Online Insertion and Removal (OIR) is not supported on The Expansion Module. If the 4G module (or mSATA) is inserted or pulled out while the device is powered up, it may damage the module.

The following figure shows the front panel of the IRM-1100-SPMI and highlights some of its capabilities:

Figure 1: IRM-1100-SPMI Expansion Module Details



Item	Description
1	4 GPIO + 1 Return (Digital I/O) **Note** Functionality is available on Cisco IOS-XE release 16.12.1 and above.
2	SFP Connector
3	Pluggable Module
4	mSATA SSD Slot
5	Digital I/O LEDs

The supported hardware interfaces and their naming conventions are in the following table:

Hardware Interface	Naming Convention
Gigabit Ethernet SFP port on Expansion Module	gigabitethernet 0/0/5
Cellular Interface on Expansion Module	cellular 0/3/0 and 0/3/1
GPIO on Expansion Module	alarm contact 1-4

mSATA Overview

IOx/Guest-OS legacy systems on which end users can host applications, typically came with a disk storage of 4GB to store user data. Functionality has been added allowing for a Cisco supported Pluggable mSATA SSD PID to add 50 GB of available storage. Support for a 100 GB mSATA SSD has the following limitations:

- There is no support for the **show inventory** command.
- Supports 55GB (IOx allocation for applications and packages alike), 32B (IOS allocation for storage can be viewed using the **dir msata** command).



Warning Online Insertion and Removal (OIR) is not supported. If the mSATA SSD is inserted or pulled out while the device is powered up, it may damage the module.



Note As with any IoT platform, for IOx, use the Fog Director, Local Manager, or app-hosting CLI's to install applications and access the new mSATA disk storage provided.

50 GB mSATA Partitioning

IOS-XE divides the mSATA SSD into 2 partitions. One for IOS-XE and the other for IOx. The percentage of usage is:

- IOS: 33.33 %
- IOx: 66.66 %

Using these percentages, the space allocation breaks down as follows:

50GB mSATA:

- IOS: 16.51 GB
- IOx: 31.43 GB

Using the mSATA SSD

Functionality-wise, there are no configuration and troubleshooting differences to the end-user in IOS or IOx, with or without mSATA. The system simply recognizes the additional storage. There are some CLI commands that will show information that pertains to the mSATA storage. Examples are show inventory, and show platform msata.

```
Router#show inventory
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
INFO: Please use "show license UDI" to get serial number for licensing.
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
Router#show platform hardware msata lifetime
SSD Lifetime Remaining: 99% -> 99% of the net disk read/write lifetime is remaining

Router#show platform hardware msata status
SSD is present

Router#show platform hardware msata
SSD Lifetime remaining(%): 99
```

Display the mSATA Partitioning:

Display mSATA partition 1 in IOS-XE:

```
Router#dir msata:
Directory of msata:/
11 drwx 16384 Jun 4 2019 17:59:45 +00:00 lost+found
33820622848 bytes total (32052379648 bytes free)
```

Copy contents to and from mSATA partition:

```
Router#copy bootflash: msata:
Source filename []? ir1101-uefi-rommon.SSA
Destination filename [ir1101-uefi-rommon.SSA]?
Copy in progress...CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
2097152 bytes copied in 0.164 secs (12787512 bytes/sec)
```

Display disk space allocated by mSATA to IOx:

```
Router#show app-hosting resource
CPU:
Quota: 1000(Units)
Available: 1000(Units)
Memory:
Quota: 862(MB)
Available: 862(MB)
Storage space:
Total: 58313(MB)
Available: 58313(MB)
```

Displaying the Wear Leveling Data for the mSATA SSD

IOx Local Manager/ Fog Director can now display the wear leveling data for the mSATA SSD on the IR1101.

In the IOx Local Manager, it is observed by selecting **System > Storage**.

From the IOS command line, you can monitor the lifetime using the **show platform hardware msata** command.

```
Router#show platform hardware msata lifetime
SSD Lifetime remaining(%): 98
```

After a router reload, it will take a few minutes (approximately 5) before this data will be populated again.

When the SSD lifetime reduces to 15% and 5% of the lifetime limit, errors start getting reported in syslog.

For example:

```
*Jan 30 19:03:00.257: %IOX-4-IOX_SSD_LIFETIME_WARN: SSD Lifetime remaining in module:15
*Jan 30 19:02:30.157: %IOX-2-IOX_SSD_LIFETIME_CRITICAL: SSD Lifetime remaining in module:5
```

MIB support for mSATA Wear Ratio and Usage

mSATA functionality was added to the router to add extra storage for IOx apps. The following table shows the router with the OID:

Table 1: mSATA OIDs

SKU	OID
IR1100-SSD-100G	1.3.6.1.4.1.9.12.3.1.9.96.176

As part of this enhancement, SNMP support has been added for the following mSATA parameters on the router:

- lifetime remaining (wear leveling)
- memory usage for the mSATA SSD

The **show platform hardware msata** command gives information about this MIB.

Related documentation:

https://www.cisco.com/c/en/us/support/cloud-systems-management/iox/tsd-products-support-series-home.html

https://developer.cisco.com/docs/iox/

Example: Actual OID and output of SNMP get/walk on OID

<OID> = STRING: "Lifetime Remaining: 99%, Usage: 30%"

Feature Details

The following conditions must be met before performing SNMP requests on the Router:

- An active mSATA module must be configured in the router.
- The Integrator must have incorporated the supported pluggable mSATA into their design.
- Verify this using the **show platform hardware msata** CLI.

Feature Assumptions

- After a router reload it will take approximately 5 minutes before mSATA data will be populated again. Only SNMP get is allowed on the OID and is marked as read-only. Setting its value will not be allowed.
- Configurations to enable SNMP on the router are necessary for fetching MIB value.

Yang model for mSATA

YANG is a popular data modeling language to represent data sent over network management protocols such as NETCONF and RESTCONF. The Cisco-IOS-XE-device-hardware-oper YANG model has been modified to show mSATA information. mSATA has two CLIs to display associated data.

These two CLIs are:

show platform hardware msata status

- The CLI gives information on whether the SSD is present or not.
- If the SSD is present, a message "SSD is present" is displayed.
- If the SSD is not present, a message "SSD is not present" is displayed.

show platform hardware msata lifetime

- If SSD is present an output representing the SSD lifetime in % is displayed: "SSD lifetime remaining (%): 99"
- If SSD is not present, a message "SSD is not present" is displayed.

A typical YANG response for mSATA in device-inventory is as shown below:

```
 <device-inventory>
          <hw-type>hw-type-ssd</hw-type>
          <hw-dev-index>5</hw-dev-index>
          <version>V00</version>
          <part-number>IR-SSD-MSATA-100G</part-number>
          <serial-number>FOC21520XFV</serial-number>
          <hw-description>mSATA Module</hw-description>
          <dev-name>Expansion module 2 - mSATA Module</dev-name>
          <field-replaceable>true</field-replaceable>
          <hw-class>hw-class-virtual</hw-class>
          <lifetime>99</lifetime>
</device-inventory>
```

Cisco IOS-XE Yang Data Models are found here:

https://github.com/YangModels/yang/tree/master/vendor/cisco/xe

Each release has a directory, and the 17.5.1 release is found under 1751.

Support for mSATA and IO Support for IRM-1100-SPMI in CM Side

With previous software releases, the mSATA and Digital I/O on the IRM-1100-SPMI were only supported on the Expansion Module side of the IR1101. With 17.8.1, support is available on the Compute Module (CM) side with the following restrictions:

IRM-1100-SPMI installed on both sides:

- This combination is not supported.
- Only the mSATA and Digital I/O from the EM side will work.
- The Digital I/O from the CM side will NOT work.

IRM-1100-SPMI installed on the CM side:

- The mSATA and Digital I/O will work.
- The Digital I/O instances will be numbered 1-4.

Digital IO

The IR1101 has two different Expansion Modules, the IRM-1100-SP and IRM-1100-SPMI. The IRM-1100-SPMI comes with a Digital I/O connector which has 4 GPIO connections plus 1 Return connection. Both Dry and Wet contacts up to 60Volts.

- Dry contact is isolated from a voltage source (or “No Volt”), with an embedded relay function (NPN transistor), usually used to indicate an event. For example: open/close, alarm.
- Wet contact is a contact with external power (+3.3V to +60V, max 150mA of current allowed at high voltage) applied, usually used to energize something. For example: solenoid, light.

Digital IO is similar to the ALARM IN and ALARM OUT supported on the IR800 series routers. The differences are that on the IR800 series, ALARM IN is a dedicated input, the ALARM OUT is a dedicated output. With Digital IO, it can be input or output. ALARM OUT includes a relay to provide the Normally Open (NO) or Normally Close (NC) terminals. Digital IO does not include a relay.

There are no traps for alarms on the GPIO.

More information on the Digital IO hardware capabilities can be found in the Cisco Catalyst IR1101 Rugged Series Router Hardware Installation Guide .

Configuration Commands

You can set the alarm severity to critical, major, minor, or none. The severity is included in the alarm message when the alarm is triggered.

To configure and show alarms on the IR1101, use the Command Line Interface (CLI).

Command	Purpose
configure terminal	Enters global configuration mode.
alarm contact *contact-number***enable**	Enables the alarm contact number. o The contact-number value is from 0 to 4. <0-4> Alarm contact number (0: Alarm port, 1-4: Digital I/O). Alarm contact 0 is located in the base unit (pins 3 and 4) and always in Output Mode. Additional configurations for Alarm 0 include *severity* , *threshold* and *trigger* . Alarm contact 1-4 (pins 1-4) are located in the IRM-1100 Expansion Module and can be in Input or Output Mode. Pin 5 is for ground. Additional configurations for Alarms 1-4 include *application* , *output* , *severity* , *threshold* and *trigger* .

Command	Purpose
alarm contact {*contact-number* {**application** {dry | wet} | **description** | **enable** | {**output** {1 for High | 0 for Low} | **severity** {critical | major | minor | none} | **threshold** {1600-2700} | **trigger** {closed | open}}	• Enter a *contact number* (0-4) that you are configuring. • The **description** string is up to 80 alphanumeric characters in length and is included in any generated system messages. • For **application**, select dry (default) or wet. Only applicable for Digital I/O ports 1-4. • **enable** is for enabling the alarm port. A no alarm contact contact-number x will disable the alarm port. • The **output** is either 1 for High or 0 for Low. Only application for Digital I/O ports 1-4. • For **severity**, enter *critical* , *major* , *minor* or *none* . If you do not configure a severity, the default is minor. • For **threshold**, select a value between 1600-2700. The default value is 1600 mv. • For **trigger**, enter *open* or *closed* . If you do not configure a trigger, the alarm is triggered when the circuit is closed.
end	Returns to privileged EXEC mode.
show alarm	Shows the configured alarm contacts.
copy running-config startup-config	(Optional) Saves your entries in the configuration file.

Verify alarm contacts using the CLI:

```
Router(config)#alarm contact ?
<0-4> Alarm contact number (0: Alarm port, 1-4: Digital I/O)
```

Configuration Examples

Configure an alarm.

```
ir1101#conf term
Enter configuration commands, one per line.   End with CNTL/Z.
ir1101(config)#alarm contact 1 description

Your Descriptive Text Here
ir1101(config)#alarm contact 1 severity critical

ir1101(config)#alarm contact 1 trigger closed

ir1101#
```

To show the alarm status:

```
ir1101#show alarm
```

```
Alarm contact 0:
Enabled: Yes
Status: Not Asserted
Application: Dry
Description: test
Severity: Critical
Trigger: Open
Threshold: 2000
```

Example of an alarm being generated:

```
ir1101# !
*Nov 27 14:54:52.573: %IR1101_ALARM_CONTACT-0-EXTERNAL_ALARM_CONTACT_ASSERT: External alarm
 asserted, Severity: Critical
```

To show the alarm status during an event:

```
ir1101#show alarm
ALARM CONTACT
Enabled: Yes
Status: Asserted
Application: Dry
Description: test
Severity: Critical
Trigger: Open
Threshold: 2000
Digital I/O 1:
Enabled: No
Status: Not Asserted
Application: Dry
Description: External digital I/O port 1
Severity: Minor
Trigger: Closed
Threshold: 1600
Digital I/O 2:
Enabled: No
Status: Not Asserted
Application: Dry
Description: External digital I/O port 2
Severity: Minor
Trigger: Closed
Threshold: 1600
Digital I/O 3:
Enabled: No
Status: Not Asserted
Application: Dry
Description: External digital I/O port 3
Severity: Minor
Trigger: Closed
Threshold: 1600
Digital I/O 4:
Enabled: Yes
Status: Not Asserted
Description: External digital I/O port 4
Mode: Output
Router#
```

Example of an alarm being cleared:

```
ir1101# !
```

```
*Nov 27 14:55:02.573: %IR1101_ALARM_CONTACT-0-EXTERNAL_ALARM_CONTACT_CLEAR: External alarm
 cleared
ir1101#
```

New Cellular Pluggable Modules

Release 16.12.1 supports new pluggable modules/modems. The IR1101 with an Expansion Module supports DUAL LTE (Active/Active), DUAL SIM and DUAL Radio.

- Dual LTE (active/active or active/backup) is supported on the IR1101 equipped with an expansion module and two LTE pluggable interfaces. One on the base unit, the other on the expansion module.
- With DUAL SIM, the two SIMs operate in active/backup mode on the single LTE pluggable module. With DUAL Radio the two LTE pluggable modules operate in active/active mode with each of the two SIMs assigned to a specific cellular radio on the DUAL Radio.

See the following table for details on the new SKUs.

SKU ID	Modem Used	Description	Technology Supported
P-LTE-VZ	WP7601-G	U.S. (Verizon) Single Micro SIM	LTE CAT4: B4, B13
P-LTE-US	WP7603-G	North America (AT&T) Dual Micro SIM	LTE CAT4:B2,B4,B5,B12HSPA+,UMTS: B2,B4,B5
P-LTE-GB	WP7607-G	Europe Dual Micro SIM	LTE CAT4: B3, B5, B8, B20, B28 HSPA+: B1, B5, B8 EDGE: 900/1800
P-LTEA-LA	EM7430	APAC	**LTE Bands**: B1, B3, B5, B7, B8, B18, B19, B21, B28, B38, B39, B40, B41. **Non-LTE Bands**: B87 - WCDMA (Europe, Japan, and China) 2100 band B91 - WCDMA US 850 band B92 - WCDMA Japan 800 band B114 - WCDMA Europe and Japan 900 band B115 - WCDMA Japan 1700 band B125 - WCDMA Japan 850 band

SKU ID	Modem Used	Description	Technology Supported
P-LTEA-EA	EM7455	USA, Canada, Europe, Latin America	**LTE bands**: Bands B2, B4, B5, B13 **Non-LTE bands**: B87 - WCDMA (Europe, Japan, and China) 2100 band B88 - WCDMA US PCS 1900 band B89 - WCDMA (Europe and China) DCS 1800 band B90 - WCDMA US 1700 band B91 - WCDMA US 850 band B114 - WCDMA Europe and Japan 900 band

IRM-1100 Expansion Module on the Compute Side

The IR1101 has two attachment points for expansion modules. The top side of the router is referred to as the Expansion side. The bottom side of the router is referred to as the Compute side.

Prior to IOS XE release 17.7.1, support was only on the Expansion side.

Starting with the 17.7.1 release, additional modules can be connected on the Compute side.

Features and Limitations

The following apply to the IRM-1100 with release 17.7.1:

- Switchports will not work if anything is connected on the Compute side
- MSATA and GPIO Pins for IRM-1100-SPMI are not supported when it is connected to the Compute side (bottom) for 17.7.1
- The IR1101 can only support a maximum of two LTE interfaces. Connecting an IRM-1100 on both sides is not supported. If connected in this configuration, only the Expansion side will be active.
- LTE interfaces when connected on Compute side, are enumerated cellular 0/4/0 and cellular 0/4/1
- CAT18 LTE module is not supported on the Compute side.
- Only the LTE interface functions when the IRM-1100-SP or IRM-1100-SPMI is connected on the Compute side.

SFP Support

The SFP interface on the Expansion Module operates differently than on the Base unit. The SFP interface on the IR1101 base module is part of the combo port (SFP/RJ45) for GigabitEthernet0/0/0. It may be configured as Layer-3 (default) or Layer-2 interface.

The SFP interface on the Expansion Module is only an SFP interface. It is named GigabitEthernet0/0/5, and is a Layer-2 interface. For Layer-3 feature set, it must be assigned to a VLAN interface.

Note For IRM-1100-4S8IO and IRM-1100-SPMI/IRM-1100-SP, copper SFPs support only 1G speed and full duplex operation. 10/100M speed and half duplex operating modes are not supported.

Details about the SFP Interface can be displayed using the **show interfaces transceiver detail** CLI, for example:

```
Router#show interfaces transceiver detail
IDPROM for transceiver Gigabitethernet0/0/0:
  Description                               = SFP or SFP+ optics (type 3)
  Transceiver Type:                         = GE T (26)
  Product Identifier (PID)                  = ABCU-5710RZ-CS4
  Vendor Revision                           =
  Serial Number (SN)                        = AGM151124J4
  Vendor Name                               = CISCO-AVAGO
  Vendor OUI (IEEE company ID)              = 00.17.6A (5994)
  CLEI code                                 =
  Cisco part number                         =
  Device State                              = Enabled.
  Date code (yy/mm/dd)                      = 11/03/21
  Connector type                            = Unknown.
  Encoding                                  = 8B10B (1)
  Nominal bitrate                           = GE (1300 Mbits/s)
  Minimum bit rate as % of nominal bit rate = not specified
  Maximum bit rate as % of nominal bit rate = not specified

Socket Verification

  SFP IDPROM Page 0xA0:
        000:        03 04 00 08 00 00 00 00 00 00
        010:        00 01 0D 00 00 00 00 00 64 00
        020:        43 49 53 43 4F 2D 41 56 41 47
        030:        4F 20 20 20 20 20 01 00 17 6A
        040:        41 42 43 55 2D 35 37 31 30 52
        050:        5A 2D 43 53 34 20 20 20 20 20
        060:        41 0C C1 15 00 10 00 00 41 47
        070:        4D 31 35 31 31 32 34 4A 34 20
        080:        20 20 20 20 31 31 30 33 32 31
        090:        20 20 00 00 00 99 00 00 06 17
        100:        C5 44 22 B7 DE 02 63 0F 59 73
        110:        64 EC A5 37 19 00 00 00 00 00
        120:        00 00 00 00 0F 2C 6D 22 FF FF
        130:        FF FF FF FF FF FF FF FF FF FF
        140:        FF FF FF FF FF FF FF FF FF FF
        150:        FF FF FF FF FF FF FF FF FF FF
        160:        FF FF FF FF FF FF FF FF FF FF
        170:        FF FF FF FF FF FF FF FF FF FF
        180:        FF FF FF FF FF FF FF FF FF FF
        190:        FF FF FF FF FF FF FF FF FF FF
        200:        FF FF FF FF FF FF FF FF FF FF
        210:        FF FF FF FF FF FF FF FF FF FF
        220:        FF FF FF FF

  SFP IDPROM Page 0xA2:
        000:        00 00 00 00 00 00 00 00 00 00
        010:        00 00 00 00 00 00 00 00 00 00
        020:        00 00 00 00 00 00 00 00 00 00
        030:        00 00 00 00 00 00 00 00 00 00
        040:        00 00 00 00 00 00 00 00 00 00
        050:        00 00 00 00 00 00 00 00 00 00
        060:        00 00 00 00 00 00 00 00 00 00
```

```
        070:        00 00 00 00 00 00 00 00 00 00
        080:        00 00 00 00 00 00 00 00 00 00
        090:        00 00 00 00 00 00 00 00 00 00
        100:        00 00 00 00 00 00 00 00 00 00
        110:        00 00 00 00 00 00 00 00 00 00
        120:        00 00 00 00 00 00 00 00 00 00
        130:        00 00 00 00 00 00 00 00 00 00
        140:        00 00 00 00 00 00 00 00 00 00
        150:        00 00 00 00 00 00 00 00 00 00
        160:        00 00 00 00 00 00 00 00 00 00
        170:        00 00 00 00 00 00 00 00 00 00
        180:        00 00 00 00 00 00 00 00 00 00
        190:        00 00 00 00 00 00 00 00 00 00
        200:        00 00 00 00 00 00 00 00 00 00
        210:        00 00 00 00 00 00 00 00 00 00
        220:        00 00 00 00 00 00 00 00 00 00
        230:        00 00 00 00 00 00 00 00 00 00
        240:        00 00 00 00 00 00 00 00 00 00
        250:        00 00 00 00 00 00
  Link reach for 9u fiber (km)                    = SX(550/270m) (0)
                                                    1xFC-MM(500/300m) (0)
                                                    2xFC-MM(300/150m) (0)
                                                    ESCON-MM(2km) (0)
  Link reach for 9u fiber (m)                     = SX(550/270m) (0)
                                                    1xFC-MM(500/300m) (0)
                                                    2xFC-MM(300/150m) (0)
                                                    ESCON-MM(2km) (0)
  Link reach for 50u fiber (m)                    = SR(2km) (0)
                                                    IR-1(15km) (0)
                                                    IR-2(40km) (0)
                                                    LR-1(40km) (0)
                                                    LR-2(80km) (0)
                                                    LR-3(80km) (0)
                                                    DX(40KM) (0)
                                                    HX(40km) (0)
                                                    ZX(80km) (0)
                                                    VX(100km) (0)
                                                    1xFC, 2xFC-SM(10km) (0)
                                                    ESCON-SM(20km) (0)
  Link reach for 62.5u fiber (m)                  = SR(2km) (0)
                                                    IR-1(15km) (0)
                                                    IR-2(40km) (0)
                                                    LR-1(40km) (0)
                                                    LR-2(80km) (0)
                                                    LR-3(80km) (0)
                                                    DX(40KM) (0)
                                                    HX(40km) (0)
                                                    ZX(80km) (0)
                                                    VX(100km) (0)
                                                    1xFC, 2xFC-SM(10km) (0)
                                                    ESCON-SM(20km) (0)
  Nominal laser wavelength                  = 16652 nm.
  DWDM wavelength fraction                  = 16652.193 nm.
  Supported options                          = Tx disable
```

Assigning L3 SVI with IP address to Extended Module GE 0/0/5 SFP interface:

```
IR1101#config t
IR1101(config)#interface g0/0/5
IR1101(config-if)#switchport access vlan 2
IR1101(config-if)#no shut
IR1101(config-if)#interface vlan2
IR1101(config-if)#ip address 192.168.1.2 255.255.255.0
IR1101(config-if)#no shut
```

You can find all of the supported SFP Interfaces in the Cisco Catalyst IR1101 Rugged Series Router Hardware Installation Guide

Support 1G SFPs

Release 17.7.1 will add support for these SFPs:

- GLC-T-RGD
- CWDM-SFP-1470=
- CWDM-SFP-1610=
- CWDM-SFP-1530=
- DWDM-SFP-3033=
- DWDM-SFP-3112=
- GLC-BX-D-I=
- GLC-BX-U-I=
- GLC-TE