Corning 5G Sub-6 N77 Radio Node Installation and Operating Guide

☰ Property

Project name	Local 5G NR System
Version	v1.9
Date	2022/12/2

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⚠ **Federal Communication Commission Interference Statement**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

§ 15.105 (a) For class A digital device or peripheral

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Version History

Version	Date	Description of revision
v1.0	2022/7/12	Initial version of Corning 5G Sub-6 N77 Radio Node Installation and Operating Guide
v1.1	2022/8/25	Fix mistake
v1.2	2022/10/27	Modify model no.
v1.3	2022/11/07	Modify wrong model name
v1.4	2022/11/07	Add FCC Interference Statement
v1.5	2022/11/10	Update FCC caution for class A digital device
v1.6	2022/11/22	Add more information. Remove usb console related content.
v1.7	2022/12/1	Add back section 5&6.
v1.8	2022/12/1	Remove CLI information.
v1.9	2022/12/2	Modify product name for uniformity.

Relevant documents

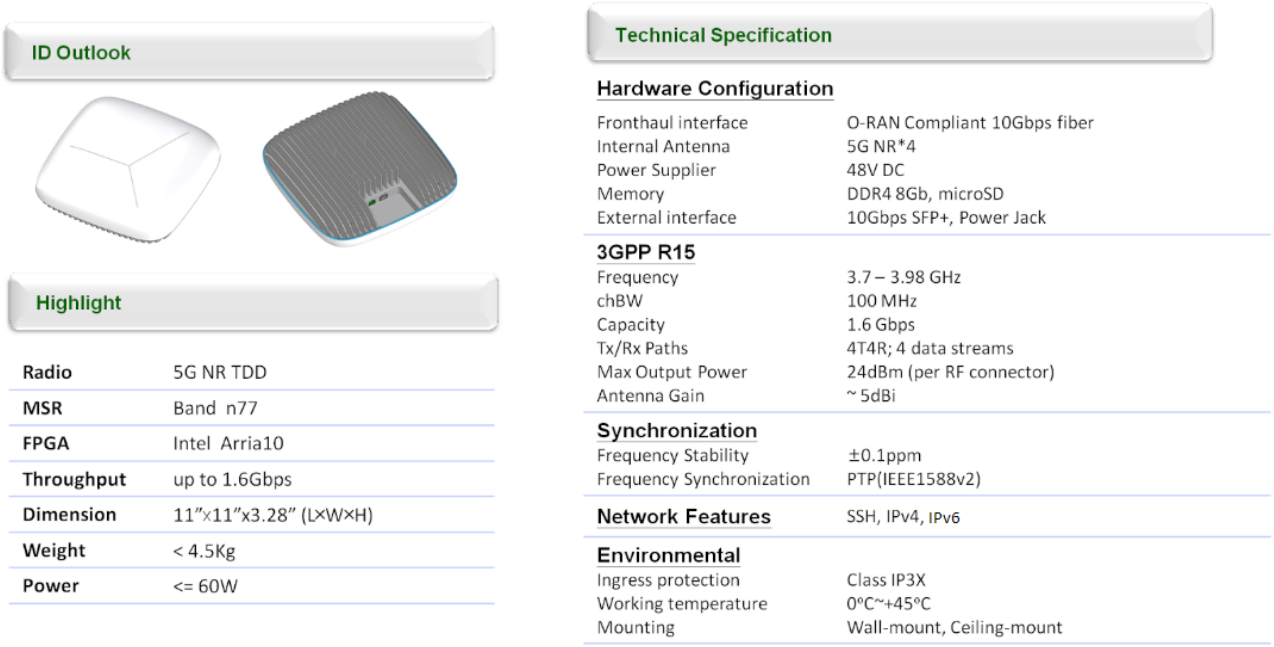
DOC-ID	Brief
[RC0-415]	Corning 5G Sub-6 N77 Radio Node Firmware Upgrade Guide
[RC0-407]	Corning 5G Sub-6 N77 Radio Node Sample App Operation Guide
[RC0-406]	Corning 5G Sub-6 N77 Radio Node Mounting Bracket Installation Guide
[RC0-412]	How to export log of Corning 5G Sub-6 N77 Radio Node

Table of Contents

1. List of Packages

- Applicable to below product:
  - Corning 5G Sub-6 N77 Radio Node
  - Corning 5G Sub-6 N77 External Antenna Radio Node
- Model Name:
  - SCRN-610-77 (Internal Antenna)
  - SCRN-610-77-EQ (External Antenna)
- Antenna x 4 (For external antenna type O-RU)
- Accessories: Following items are not included in the default package. These are optional and ordered separately.
  - 10Gb SFP+ GBIC
  - -48VDC Adapter Power cord
  - Mounting Kit

1.1 Overview of Corning 5G Sub-6 N77 Radio Node



ID Outlook

Highlight

Radio	5G NR TDD
MSR	Band n77
FPGA	Intel Arria10
Throughput	up to 1.6Gbps
Dimension	11"x11"x3.28" (L×W×H)
Weight	< 4.5Kg
Power	<= 60W

Technical Specification

Hardware Configuration

Fronthaul interface	O-RAN Compliant 10Gbps fiber
Internal Antenna	5G NR*4
Power Supplier	48V DC
Memory	DDR4 8Gb, microSD
External interface	10Gbps SFP+, Power Jack

3GPP R15

Frequency	3.7 – 3.98 GHz
chBW	100 MHz
Capacity	1.6 Gbps
Tx/Rx Paths	4T4R; 4 data streams
Max Output Power	24dBm (per RF connector)
Antenna Gain	~ 5dBi

Synchronization

Frequency Stability	±0.1ppm
Frequency Synchronization	PTP(IEEE1588v2)

Network Features SSH, IPv4, IPv6

Environmental

Ingress protection	Class IP3X
Working temperature	0°C~+45°C
Mounting	Wall-mount, Ceiling-mount

Figure 1-1 Corning 5G Sub-6 N77 Radio Node Specification

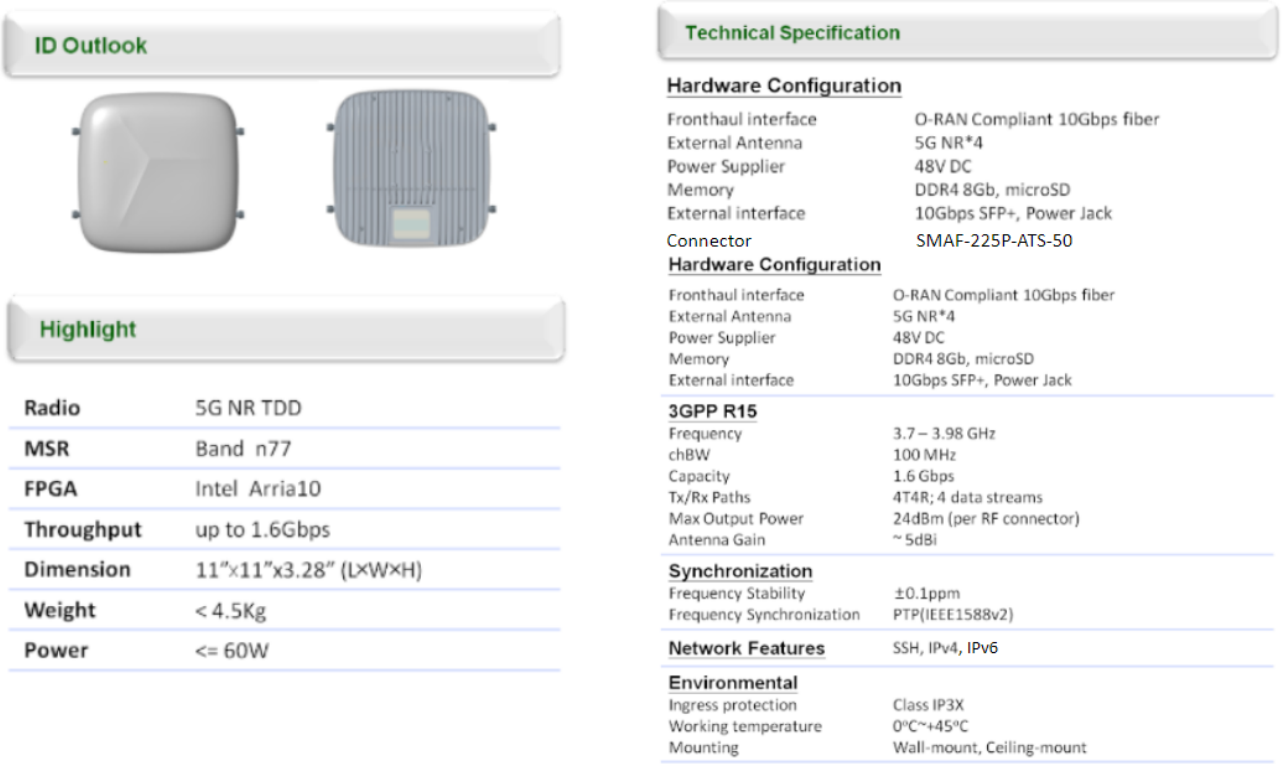


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Figure 1-2 Corning 5G Sub-6 N77 External Antenna Radio Node Specification

1.2 Outlook

1.2.1 Indoor Corning 5G Sub-6 N77 Radio Node

Figure 2 Corning 5G Sub-6 N77 Radio Node Interfaces

ORU Status LED

- A single tri-color LED. Limited to R, G and B only
- Shines through the ORU enclosure when lit. Not at all visible when not lit.

State	Pattern	Description
Boot Sequence		
State 0	Std. Flashing Blue	Booting
State 1	Std. Flashing Green	DHCP
State 2	Std. Flashing Red	M-plane connection
Running States		
State 3	Slow Flashing Green	Unconfigured (not provisioned)
State 4	Solid Green	Running, no fault and PTP in-sync
State 5	Std. Flashing Green	PTP sync'ing
State 6	Solid Red	PTP In-sync but have faults/alarms
Additional Functions in Running States		
Locate	Std. Flashing Blue	For locating ORU (an M-plane message will be sent)
	Off	Ability to turn off/on LED through M-plane message

Std. Flashing: 0.5s on/ 0.5s off
Slow Flashing: 0.5s on/ 1.5s off

FXN: Please suggest any additional states to capture during boot sequence

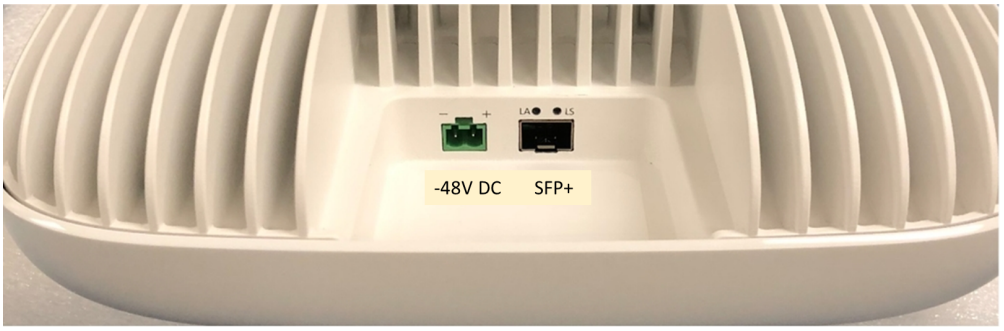
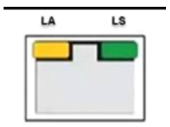


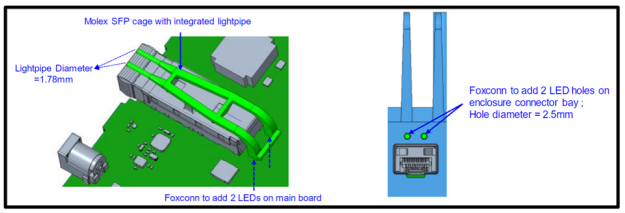
Figure 3 Corning 5G Sub-6 N77 Radio Node Interfaces

SFP Status LED

- 2 small LEDs near the SFP cage inside the connector bay.
- Reuse the existing Corning style & behavior for these:
  - LS (green) on right and
  - LA (orange) on the left
  - Same labeling as in mmRN Gen2



STAUS	Description
LS LED - Green	
Off	No Link (disconnected)
Solid	10 Gbps link has been established
LA LED - Orange	
Off	No link (disconnected)
Solid	Error (HW is in reset state) ~~LS LED assumed off~~
Blinking	Network activity has been detected



- One 10Gbps SFP+ (support of C/U-Plane)

1.2.2 Mounting Kit

Please refer to " [RC0-406] Corning 5G Sub-6 N77 Radio Node Mounting Bracket Installation Guide_v1.0 " for the mounting bracket, wall-mount, ceiling-mount and rack-mount installation.

1.3 Software Version

To show the current software version of Corning 5G Sub-6 N77 Radio Node. Please refer to the " **[RP0-415] Corning 5G Sub-6 N77 Radio Node Firmware Upgrade Guide** " Execute command "**cat /home/root/test/version.txt**", it may looks like below:

```
root@arria10:~/test# cat version.txt
branch: 320-modify_mechanism_of_xran_init
version: 9489b337149df1db4c52c143c1bc86546a82ebba
tag: v2.2.4q.524
```

In this example, the software version tag was **v2.2.4q.524**.

2. Regulation and Certification

2.1 Environmental and safety requirement

Environmental and safety requirements for Corning 5G Sub-6 N77 Radio Node hardware installation.

⚠️ **Warning: Electric Shock.**

Please notice that the RF ports should be connected to a 50 Ω load (for example, feeder with an antenna) before powering on the Corning 5G Sub-6 N77 Radio Node.

⚠️ **Warning: Hot parts.**

To avoid the risk of hot parts, please use the Corning 5G Sub-6 N77 Radio Node with caution, and wait at least 30 minutes before handling the Corning 5G Sub-6 N77 Radio Node after powering off.

💡 **Only trained and qualified personnel are recommended to install, operate, maintain or handle the Corning 5G Sub-6 N77 Radio Node, and please carefully read the safety information applicable to this product.**

💡 **Only install Corning 5G Sub-6 N77 Radio Node in a restricted access location, and meet the minimum requirements of RF exposure compliance distance.**

3. Cabling and Assembly Instruction

Below the figure shows the SA L5G system.

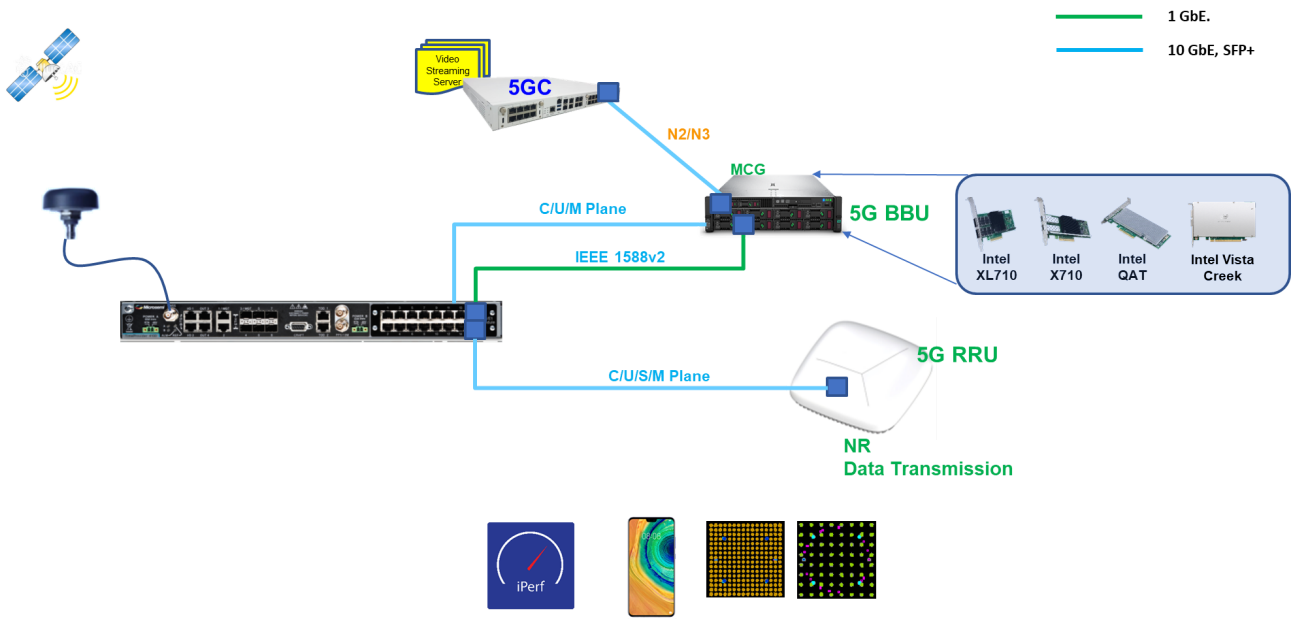


Figure 8 SA L5G System Architecture

3.1 Corning 5G Sub-6 N77 Radio Node cabling instruction

3.1.1 For O-RAN C/U/S/M-plane connection

10Gb SFP+ fiber cabling

- Intel 10Gb Short Range Optics (model: E10GSFPSR, 850 nm wavelength) + multi-mode fiber

or

- Intel 10Gb Long Range Optics (model: E10GSFPLR, 1310 nm wavelength) + single-mode fiber.

3.1.2 Antenna port number

4. Operating Instruction

4.1 Firmware upgrade

Please refer to " **[RP0-415] Corning 5G Sub-6 N77 Radio Node Firmware Upgrade Guide** " for the firmware upgrade procedure.

4.2 How to use the sample app to verify Corning 5G Sub-6 N77 Radio Node working properly?

Please refer to "**[RP0-407] Corning 5G Sub-6 N77 Radio Node Sample App Operation Guide**" for using sample-app to verify the FH connection (C/U-plane), S-plane and RF TX power.

4.3 How to export log of Corning 5G Sub-6 N77 Radio Node

Please refer to " **[RC0-412] How to export log of Corning 5G Sub-6 N77 Radio Node**" for the operating instruction.

5. FAQ

5.1 How to check if the O-RU is booted up?

non-oam mode: O-RU default IP is 192.167.27.49. We can ping this ip to check if O-RU is booted up.

oam mode: O-RU works as DHCP client as default.We can check DHCP server if receiving DHCP request from O-RU.

5.2 Can I add a Switch between O-RU and GM?

- Yes. But, please make sure Switch supports IEEE 1588 PTPv2

5.3 Can I add a Switch to connect O-RU and O-DU?

Yes. Please make sure the switch supports the following items:

- The L2 switch should support VLAN with tag.
- Those ports (connected to BBU and RU) should be in trunk mode.
- Both VLAN 1 and VLAN 2 should be in those trunk ports.
- Keep VLAN tag in those ports (DO NOT set untag).
- Enable jumbo frames. Set frame size more than 9000 Bytes.

5.4 How to configure IP permanently?

O-RU works as DHCP client as default. You must prepare a DHCP server.

5.5 Which FlexRAN version complies?

- FlexRAN version 21.03 and later version.

5.6 Which PRACH format does RU support?

- RU only supports short PRACH format B4.

5.7 How to calculate Tx power?

- With HW SKU S4, which is a calibrated unit, Tx power is fixed to 24 dBm based on Max(I,Q) r.m.s **512** sending from DU to RU.
- Peak antenna gain is 5.22 dBi (External antenna).

5.8 Is RU PTP profile compliant with ITU-T G.8273.2? (T-TSC) – please confirm?

- Yes, RU is compliant with ITU-T G.8273.2 T-TSC

5.9 What is the T-TSC clock class for RU? Is it class B or class C?

- Class B

5.10 What is the max |TE| for the RU?

- 80 ns

6. Troubleshooting

6.1 Why the DU is not receiving any data from the RU?

Please check the following items:

1. Check that PTP is synced plus the GM's quality. You may need to check the GM's status with satellites, O-RU's log and O-DU's log.
2. Check that the 10GbE interface in the DU server is linked up.
3. Check that the 10GbE interface in the DU server is running at 10 Gb speed
4. Check the connectivity, make sure that the SFP+ module is fully seated into the cage of the connector in the DU server.
5. Check the O-RU's log for xRAN packet:
    a. If the log does not contain "xRan: log……", it means that the O-RU is not receiving any C-Plane packet from the O-DU.
    b. Sometimes, it is caused by a PTP sync issue.

```
xRAN: log=0 toU(2) sec=39 tick=6745 smp_cnt=139614e4 pkt_en=139614e4 c_arr=0501bd0e 1pps=313b14e0 t2f_en=00000000 jesd_en=00000000
diff: sec=39 tick=6745 c_arr_vs_1pps=683593us t2f_vs_1pps=-6721643us jesd_vs_1pps=-6721643us
Cmsg1_p0: 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
c_kpi: total=2 early=0 on=1 late=1 dropTci=0 dropPort=0 dropSect=0
40R: idx=0 tick=6745 total=0 uni=51421 64b=0 65to128=41199 uni>1158=0 multi=45049 fcs_err=0 cplane=000014fb


xRAN: log=1 toN(15) sec=39 tick=6743 smp_cnt=139614e4 pkt_en=139614e4 c_arr=00000000 1pps=313b14e0 rst=00000000
diff: sec=39 tick=6743 c_arr_vs_1pps=0us 1pps_vs_ul_rst=-6721643us
c_kpi: total=0 early=0 on=0 late=0 dropTci=0 dropPort=0 dropSect=0
40R: idx=1 tick=6743 total=0 uni=51419 64b=0 65to128=41197 uni>1158=0 multi=45047 fcs_err=0 cplane=000014fb
```

6. Run an Intel sample app to make sure that the O-RU is working properly.