FlexFi Indoor Sub-6GHz Radio Unit

Indoor FR1 n78 and n79

User Guide

v1.0

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Revision History

Revision	Date	Change Log
V1.0	2024 Jun	Initial release

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Table of Contents

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1. Product Overview

LITEON Indoor Sub-6GHz RU is a radio access point with low radio frequency and 1 watt transmission power output. It can be deployed indoors, is easy to install, and is a high-performing solution to provide reliable connectivity in busy areas. Most importantly the products are 100% in-house developed and produced in Taiwan for best quality, including the software and hardware. The sub-6GHz bands can deliver good performance connectivity promised by 5G, providing robust connectivity and great user experiences.

5G is right for your business.

As the 5G gathers momentum, reliable data networks are key differentiators in private network performances. Building for the use of Private 5G Networks, LITEON's 5G small cell and O-RAN products with full spectrum will offer an unprecedented integrated end-to-end 5G testing network for testing specifically industrial applications in accordance with updated 5G standardization specifications.

LITEON's Indoor FR1 RU product portfolio covers Sub-6GHz bands with n78 and n79 spectrum to provide diverse options to broaden the coverage of operator networks and solutions for private 5G local networks. Sub-6GHz Radios are ideally suited to deployment in dense-urban locations and large public venues locations such as shopping-malls, concert halls and sports arenas, where there are typically many users.

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A Complete Solution to Fit Any Situation

The main purpose of Indoor Sub-6GHz RU product series is to accelerate the development and deployment of open, disaggregated, and standards-based technology solutions that deliver the high-quality connectivity that the world needs for now and in the decades to come.

[Overview]

LITEON Indoor FR1 RU is an indoor 3GPP compliant; provides 5G Sub-6GHz radio signal transmitting, receiving, and processing functions; supporting n78 and n79 band for 5G indoor radio coverage. The unit provides 4T4R and 1 watt total radiation output power. The radio is equipped with 10G SFP+, 1G RJ45, and a DC supply port. Additionally, the base station supports advanced timing synchronization for GNSS, IEEE-1588v2 (PTP), and Sync-E sources and is designed to operate over a temperature range of -5 to +45°C. Sub-6GHz Radio products support a wide variety of use cases and deployment requirements, enabled by compact form factors and optimized performance characteristics.

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[HIGHLIGHTS]

- 3GPP Release15-compliant for private and public applications.
- Support Max. 100 MHz bandwidth.
- Support cross-country private network spectrum with n78 and n79.
- Excellent in building coverage.
- Supports 4x4 antenna.
- Max. output power 1 watt in total.
- Support 10G SFP+ and 1G RJ45 backhaul interfaces.
- Integrated Indoor Sub-6GHz RU form factor for quick and easy installation.
- Plug-and-play capabilities.
- Supports Standalone (SA) mode.
- Supports CPE attachment.

NOTE: Features can vary by model or by region.

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2. Product Specification

Product Serial	FF-RFI078I4 FF-RFI079I4
Product Type	5G NR: FR1 Sub-6GHz
Band	n78: 3.3 ~ 3.8 GHz n79: 4.4 ~ 5.0 GHz
Duplex Mode	TDD
Bandwidth	Max 100MHz
Antenna Type	Internal
RF Tx Power	1 watt in total. 24 dBm per chain.
MIMO Order	DL: 4 Layers, UL: 4 Layers
Tx/Rx Path	4T4R
Modulation	DL: 256 QAM / UL: 64 QAM
Synchronization	GNSS, IEEE 1588v2, Sync-E
Fronthaul Connectivity	10Gbps SFP+, 1G RJ45
Operation Temperature	-5℃ ~ 45℃
Humidity	5% ~ 95%
Power Supply	54V DC
Power Consumption	65W
Mounting	Wall, Ceiling mount
Dimensions	252 x 252 x 62.7 mm
Weight without accessories	3 kg
Active Users	Support 64 active users
Ingress Protection Rating	IP20

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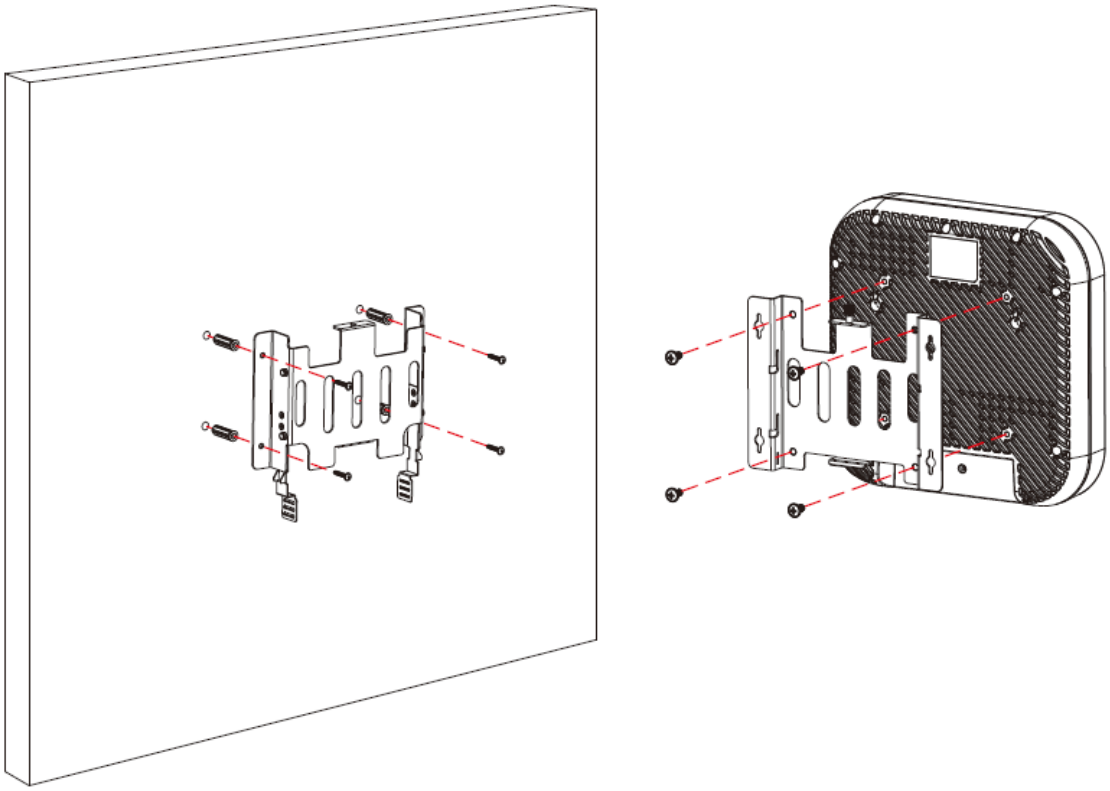
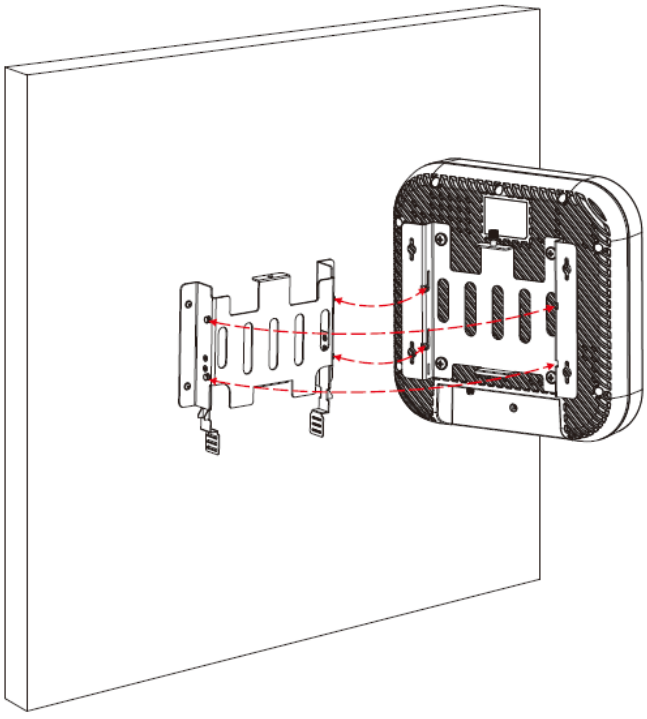
3. Mounting Guide

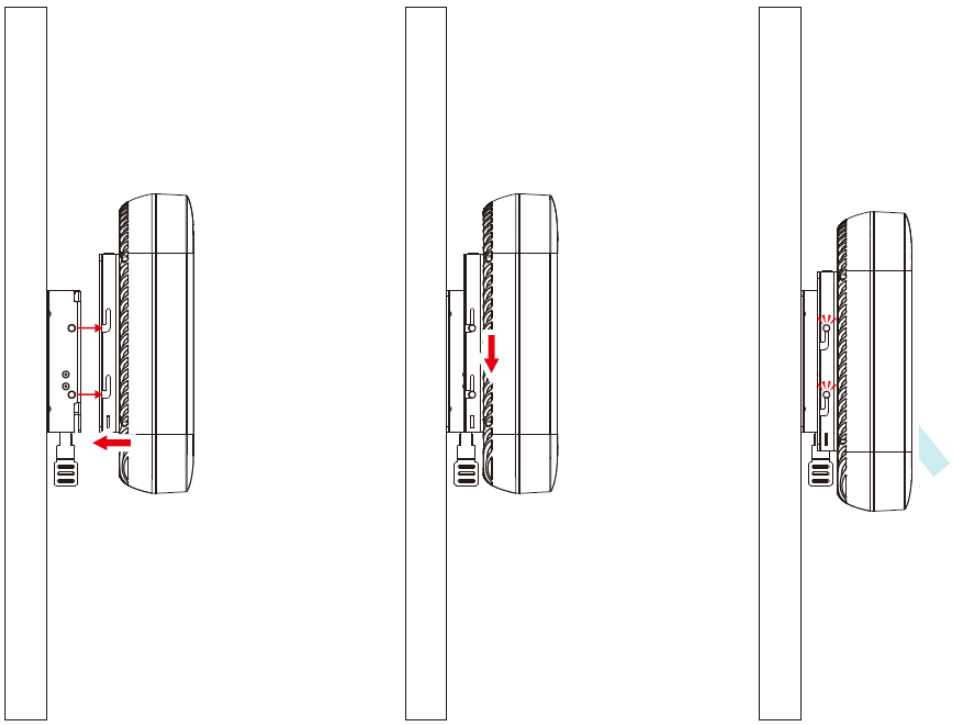
Step 1



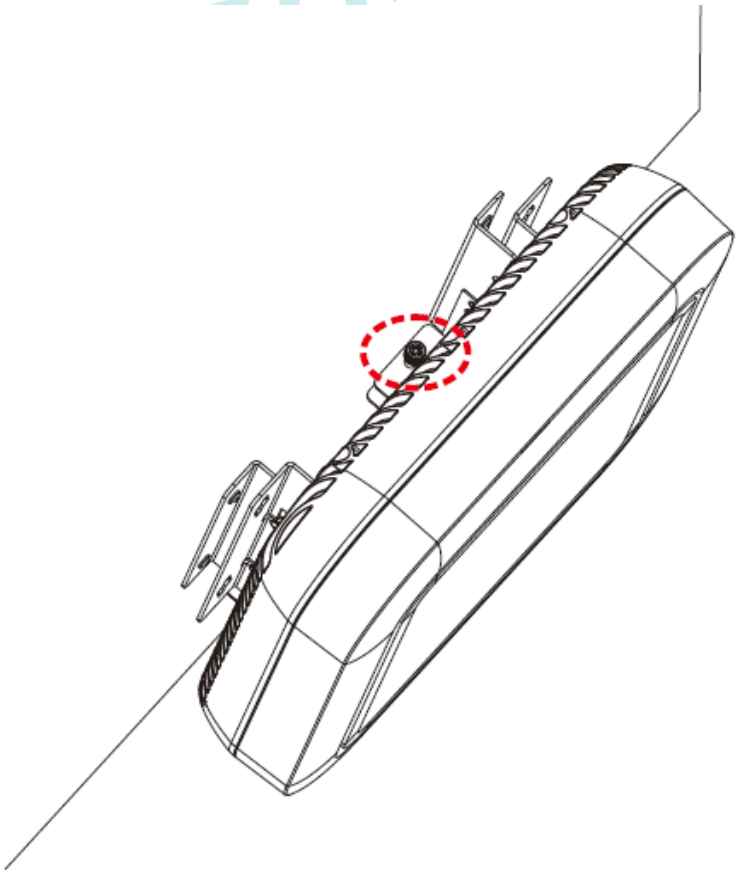
Step 2



Step 3



Step 4



4. Quick Setup

4.1. Check List

FlexFi Radio Units can be configured via KLISH. This chapter clarifies what hardware or software items are required for you to be ready to get into KLISH process.

Hardware

- One laptop
- One FlexFi Radio Unit device
- FlexFi Radio Unit power cable
- One RJ45 cable or console cable
- One fiber cable and two SFP+ modules

Software

- Software installation terminal program (for example: mobaxterm) ready in your laptop. This is to work with the console cable. If you use only RJ45 then you will configure via SSH where this software is not necessary.

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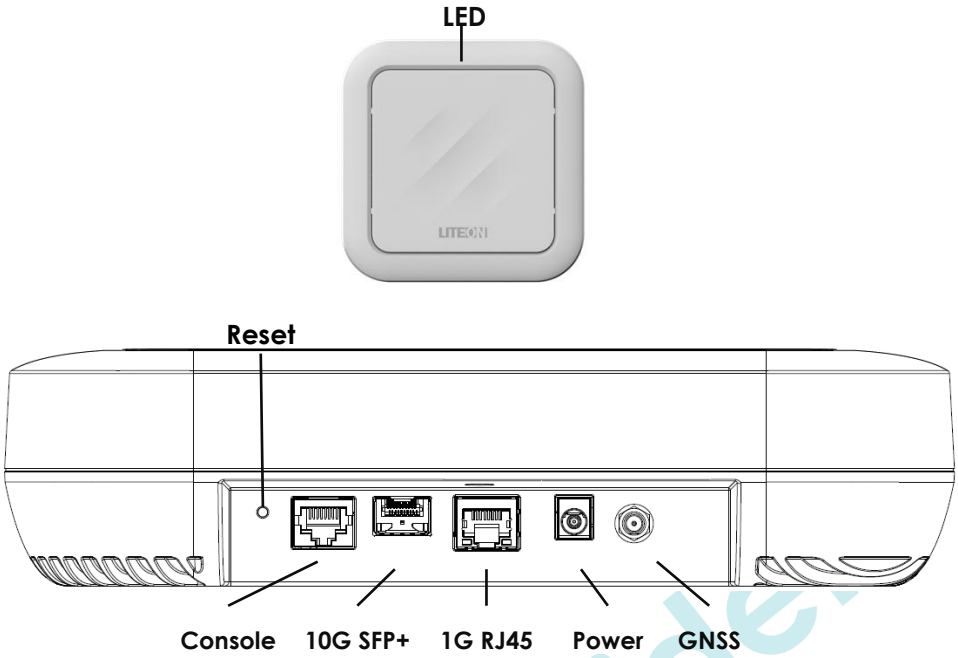
4.2. Getting Started



1. Power up
   Step 1: Plug-in fiber cable and 10G SFP+ module for C/U/S plane
   Step 2: Plug-in 1G RJ45 or console to manage FlexFi 5G ORAN-RU
   Step 3: Plug-in power adaptor (LED turns white when device is powered on)
2. Get online
   Step 1: Connect FlexFi 5G ORAN-RU by console or SSH utility
   Console account/password: root/root
   Step 2: Setup FlexFi 5G ORAN-RU configuration (Refer to 5.1 Software Configuration)
   Step 3: PTP time sync takes about 2~3 minutes (Refer to 4.3.5 Setup FlexFi ORU)
   Step 4: RF initialization takes about 1~2 minutes (LED turns blue when ready)
   Step 5: It takes 1-2 minutes for DU to connect to 5G ORAN-RU (LED turns green when ready)
   Step 6: Conduct UE attachment
3: LED status
   Step 1: LED shows white when device is booting
   Step 2: LED shows blue after device booting is completed
   Step 3: LED shows green after fronthaul connection is completed

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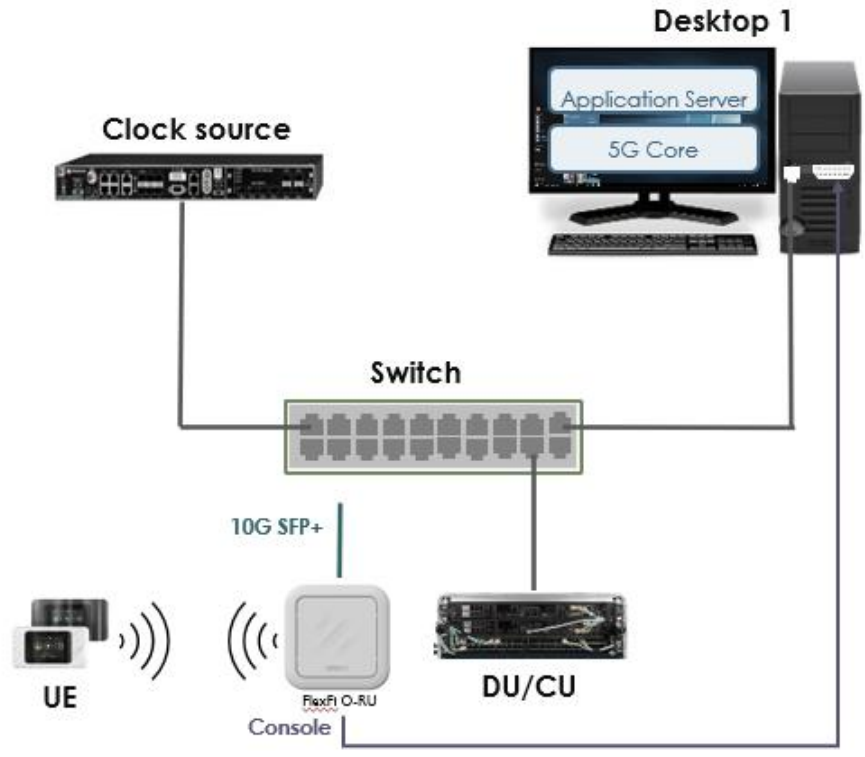
4.3. Testing Environment Setup: E2E System

4.3.1. Check List

Before testing, developers shall setup E2E environment first, including 2 desktops, clock source, switch, DU/CU, FlexFi O-RU, and UE as below:

- Desktop 1
  - Control FlexFi O-RU via console
  - 5GC
  - Application Server (if needed)
- Desktop 2 (if needed)
  - iPerf Server
- Clock source
  - IEEE 1588v2 Server: PTP
  - Sync-E server (optional)
  - GPS generator (optional)
- Switch
  - L2 Function with PTP function
  - with SFP+ interfaces: 10G
- DU/CU
- FlexFi O-RU
- UE



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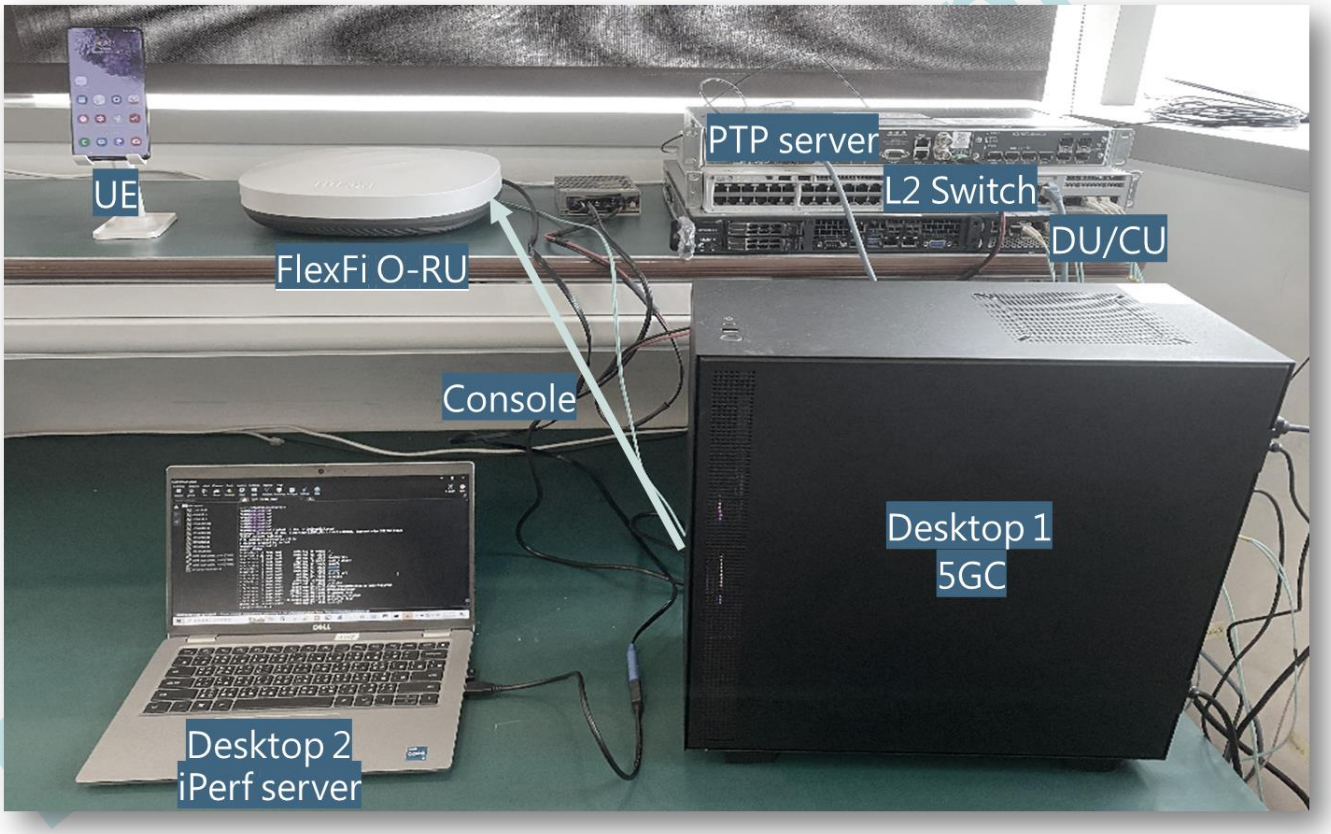
4.3.2. E2E System Schematic View

- Devices List
  - Desktop 1
    - 5G Core
  - Desktop 2
    - Control FlexFi O-RU
    - iPerf Server
  - IEEE 1588v2(PTP) server
  - L2 Switch
  - DU/CU
  - FlexFi O-RU
  - UE



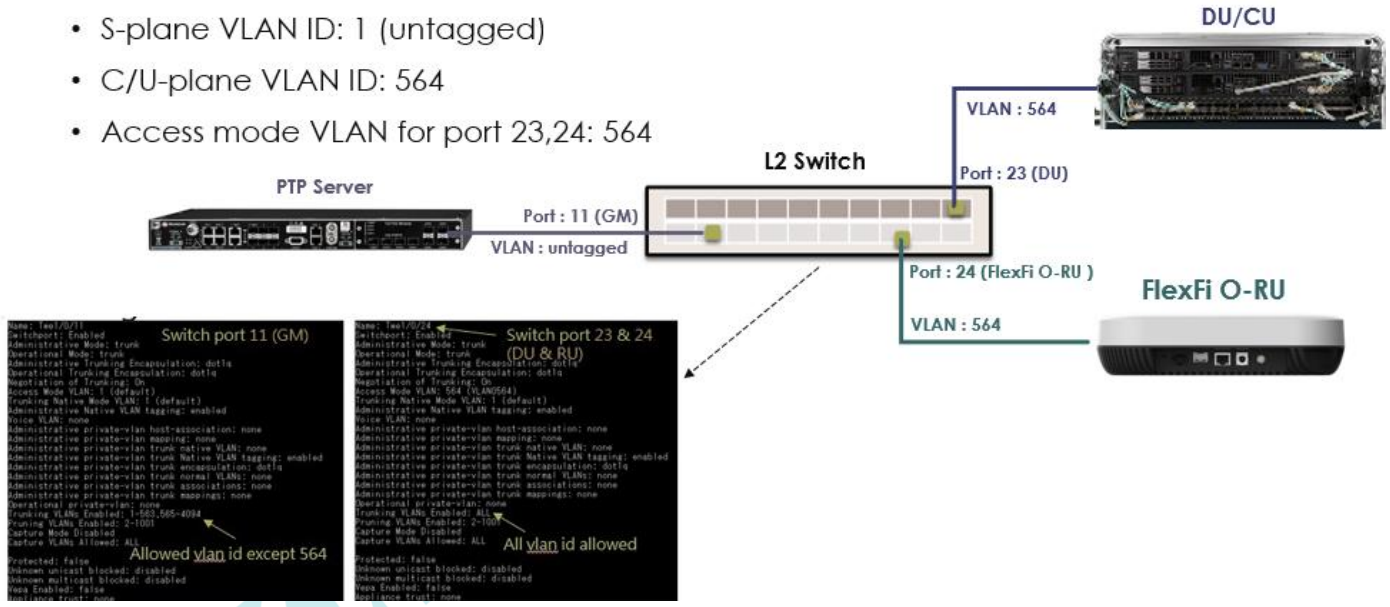
4.3.3. C1 Mode

- L2 Switch VLAN configuration for C1 mode
  - S-plane VLAN ID: 1 (untagged)
  - C/U-plane VLAN ID: 564

4.3.4. C3 Mode

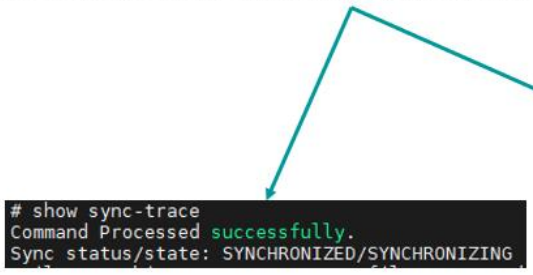
L2 Switch VLAN configuration for C3 mode

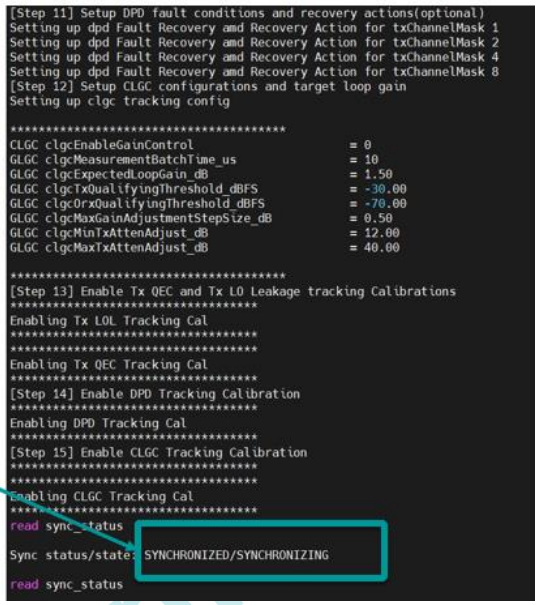
- GM port: 11, DU port:23, FlexFi O-RU port: 24
- S-plane VLAN ID: 1 (untagged)
- C/U-plane VLAN ID: 564
- Access mode VLAN for port 23,24: 564



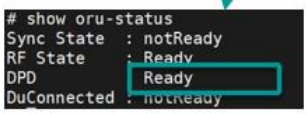
4.3.5. Setup FlexFi ORU

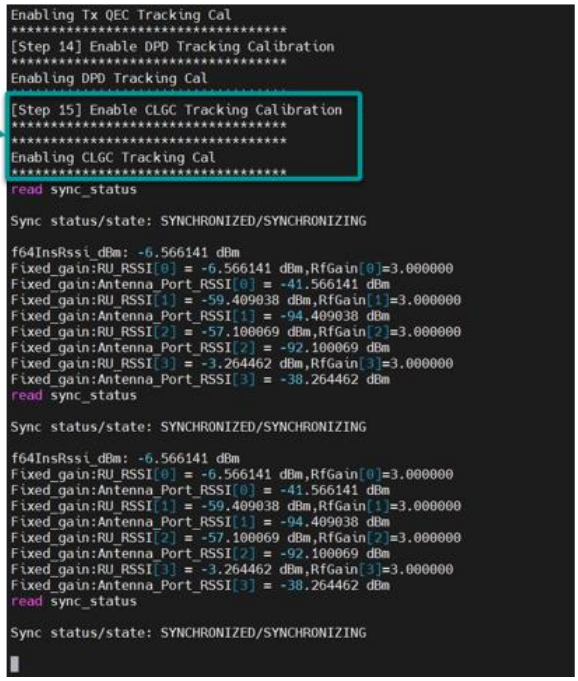
1. Step 1 : Powe on FlexFi O-RU
2. Step 2: Connected FlexFi O-RU to PC by console cord
   - ✓ Console account/password: root/root
3. Step 3 : Set FlexFi O-RU and DU mac address
4. Step 4 : Reboot FlexFi O-RU
5. Step 5 : Wait for time synchronized/synchronizing





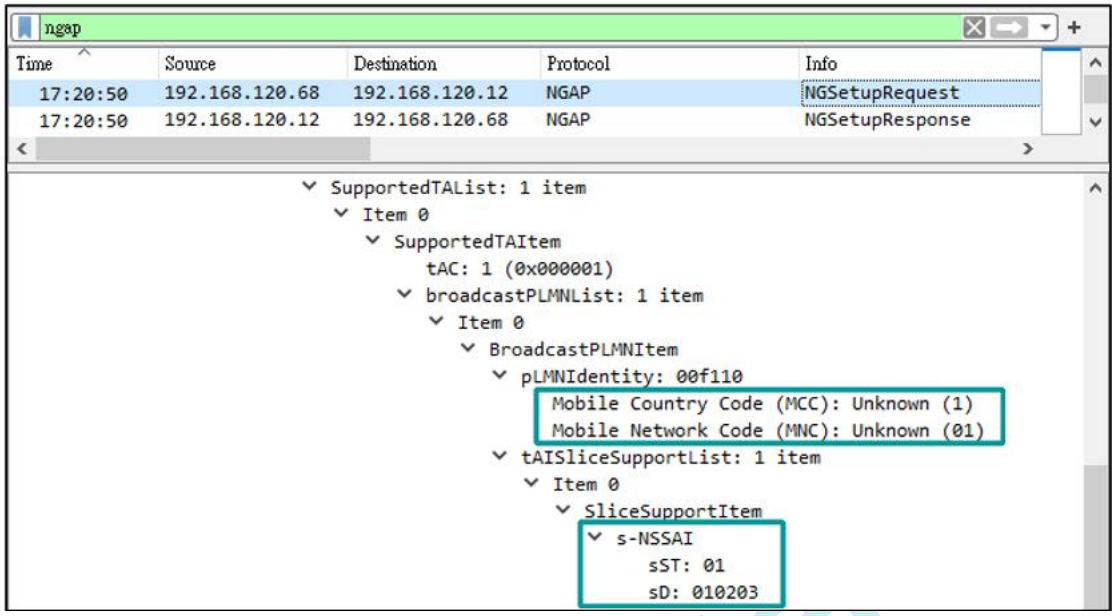
6. Procedure 6: wait for RF initialization
7. Procedure 7: connect to DU
8. Procedure 8: UE attach





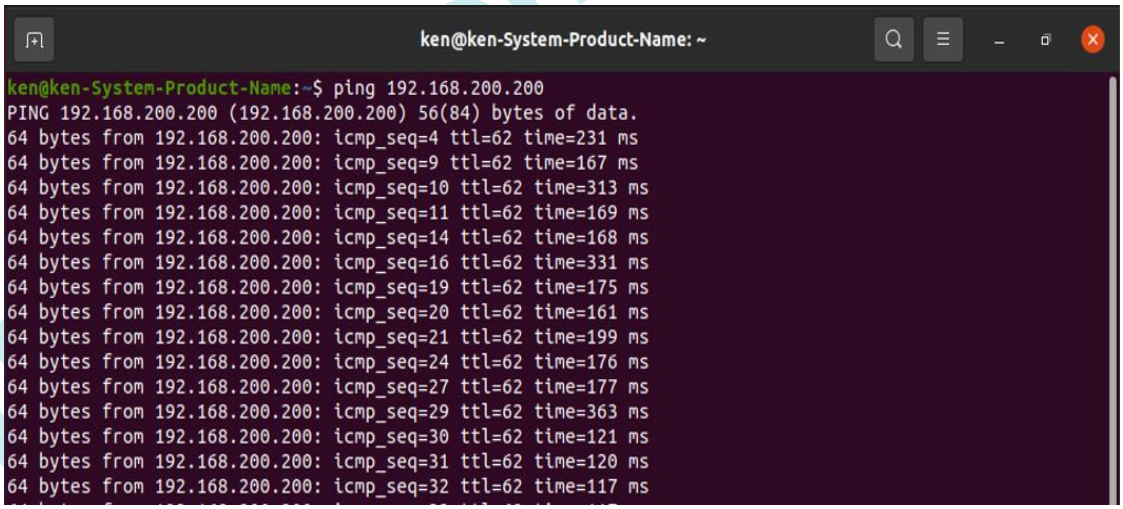
4.3.6. Test Setup Function Test: NGAP Setup

Check NGAP setup status with Wireshark tool.

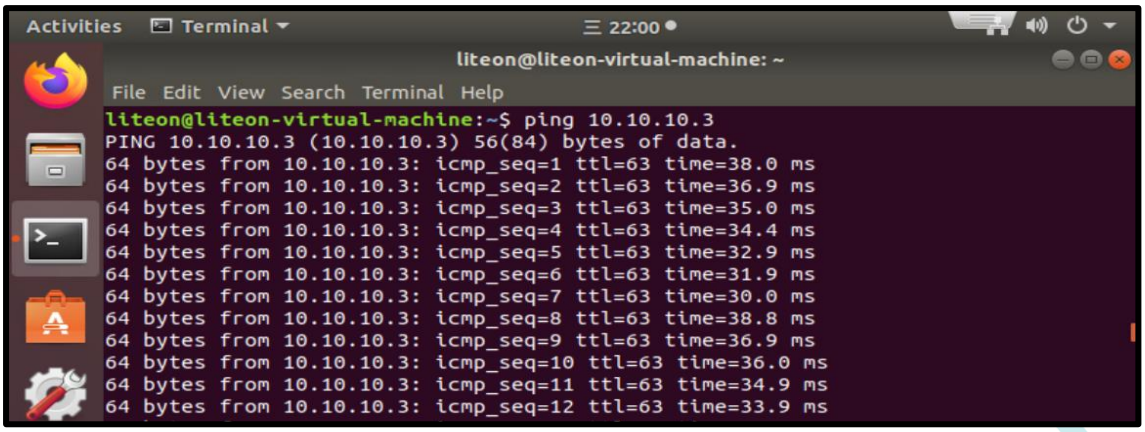


4.3.7. Test Setup Function Test: Ping Test

- Ping (CPE → Application Server)

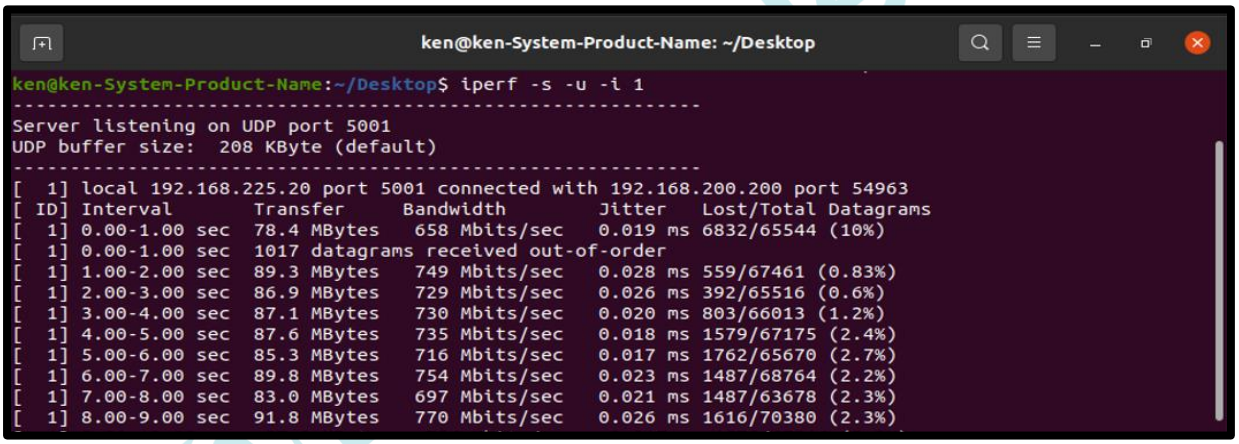


- Ping (Application Server→ CPE)



4.3.8. Test Setup Function Test: iPerf Downlink Throughput Test

- iPerf command
  - Application server: iperf2 -u -c 10.10.10.x -i 1 -b 800m -l 1400 (UE IP:10.10.10.x)
  - UE/CPE: iperf2 -u -s -i 1



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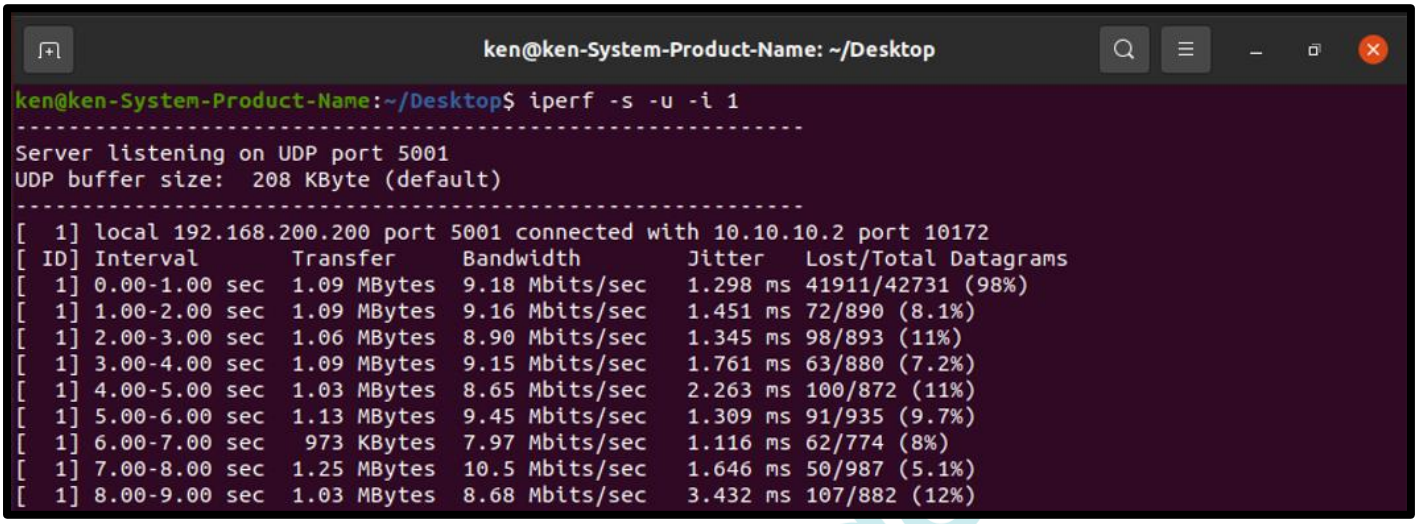
4.3.9. Test Setup Function Test: iPerf Uplink Throughput Test

- iPerf command
  - Application server: iperf2 -u -s -i 1
  - UE/CPE: iperf2 -u -c 192.168.200.200 -i 1 -b 10m -l 1400 (application server IP: 192.168.200.200)



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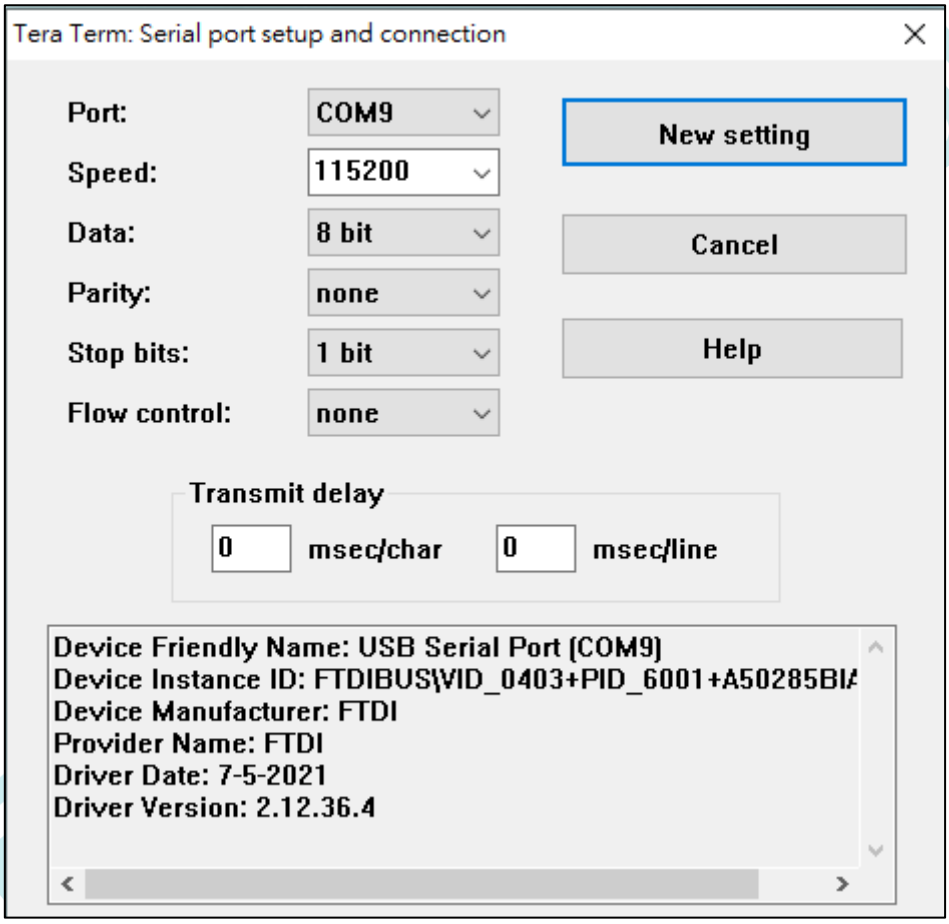
5. Software Guide

5.1. Software Configuration

5.1.1. SW Configuration: Console

- Running FlexFi O-RU, we use the following console configuration for connecting to FlexFi O-RU by console port
- Console account/password: user/user



5.1.2. SW Configuration: ssh

- SSH tools connect to FlexFi O-RU by ethernet port (RJ45)
    - Default ip address: 10.101.131.59 / netmask 255.0.0.0
    - Setting local ip address: Refer to 5.3.3.Check Network Status
- SSH account/password: user/user

5.1.3. SW Configuration: Overview Procedure

- Step 1: Run FlexFi O-RU and connect by console
- Step 2: Log in and Edit configuration
  - Login user/user
  - Before running FlexFi O-RU, we need do configuration modification for end-to-end test
  - Enter `?` can show more information
- Step 3: Enter configure terminal then setting config
- Step 4: Reboot FlexFi O-RU

```
Welcome to Liteon ORU Thu Dec 14 08:45:59 UTC 2023
Please enter help
>
  enable      Turn on privileged commands
  exit        Exit from the CLI
  help        Display an overview of the CLI syntax
  ping        Send ICMP ECHO_REQUEST packets to network hosts.
  traceroute  Print the route packets trace to network host

>
```

5.1.4. SW Configuration: Edit configuration

I.

1. Login user/user
2. Enter `?` can show more information
3. Enter `enable` into enable mode; password: **liteon168**

```
Welcome to Liteon ORU Mon May  8 02:39:47 UTC 2023
Please enter help
>
  enable      Turn on privileged commands
  exit        Exit from the CLI
  help        Display an overview of the CLI syntax
  ping        Send ICMP ECHO_REQUEST packets to network hosts.
  traceroute  Print the route packets trace to network host

> enable
Enter Password:
Auto exit privileged commands in 300 Seconds
#
```

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II.

1. Enter `?` can show more information
2. Enter `configure` into configure mode

```
Auto exit privileged commands in 300 Seconds
#
  arp               Display the kernel's IPv4 network neighbour cache.
  configure         Enter configuration mode
  exit              Turn off privileged commands
  ping              Send ICMP ECHO_REQUEST packets to network hosts.
  reboot            Halt and perform a cold restart
  route             Display the kernel's routing tables.
  show              Show system information
  software_upgrade  Upgrade ORU software, ex: software_upgrade [ftp_server_username] [ftp_server_password] [ftp_server_ip] [oru_upgrade_version]
  tcpdump           Dump eth1 tcp data, ex: tcpdump
  traceroute        Print the route packets trace to network host
  useradd           Add user, ex: useradd testuser1
  userdel           Delete user, ex: userdel testuser1
```

III.

1. Enter `?` can show more information

```
Entering configuration mode...
(config)#
  bandwidth                   Setting band width (Hz)
  c/u-plane-vlan              Setting c/u plane interface vlan (sfp+)
  center-frequency            Setting Center Frequency
  compression-bit             Setting decompress block floating point compression bit
  default-gateway             Set/Show default gateway.
  dpd-mode                    Setting dpd mode
  du-mac-address              Setting DU MAC
  eAXC_id                     Setting the id for four ports, ex: 0 1 2 3 (must input four numbers!)
  env-tx-power                Setting RU TX power
  exit                        Go back to main menu
  gain-rx                     Setting RU RX Gain
  gain-tx                     Setting RU TX attenulation
  get_devmem                  Get device memory, ex: get_devmem [address] [bit]
  jumboframe                  Setting jumbo packet length
  m-plane-rj45-vlan-static-ip Configure rj45 vlan interface static ip address, ex: m-plane-rj45-vlan-static-ip [ip address]
  m-plane-SFP-vlan-static-ip  Configure SFP vlan interface static ip address, ex: m-plane-SFP-vlan-static-ip [ip address]
  m-plane-vlan                Configure vlan interfaces for rj45 and SFP+, ex: m-plane-vlan [vlan]
  mgmt-interace-ip            Set management port IPV4 (1G)
  phasecomp-mode              Setting phase compensation mode
  reset-to-default            Reset config to default. reset-to-default LITEON
  set_devmem                  Setting device memory, ex: set_devmem [address] [bit] [value]
  slot-id                     Setting slot id
  subcarrier-spacing          Setting subcarrier spacing (μ)
  sync-source                 Setting sync source.

(config)#
```

5.1.5. SW Configuration: Parameter List

End-to-End with O-DU parameters	Default Value	Description
bandwidth	100000000 (100M)/default 40000000 (40M)	• Tx/Rx Bandwidth (Hz)
c/u-plane-vlan	564	• eCPRI VLAN ID between DU and RU
center-frequency	CF = 3749700000 (ARFCN: 649980)	

compression-bit	8 (8 bits)/default 9 (9 bits) 0 (16 bits)	• eCPRI compression bits between O-DU and O-RU • Compression Method: Block Floating Point compression
default-gateway	10.101.131.254	• For management interface (eth0)
dpd-mode	true (Enable)/default false (Disable)	• Enable DPD (Must be open)
du-mac-address	001122334466	• DU MAC address in O-DU is used to connect to O-DU
eAXC_id	port 0 id = 0x0000 port 1 id = 0x0001 port 2 id = 0x0002 port 3 id = 0x0003	• Setting PRACH eAxC_ID of each antenna port
env-tx-power	24)/default	• Setting each antenna as 24 dbm • Adjust Tx power
gain-rx	14	• Adjust Rx gain
jumboframe	0x00000000 (jumbo frame disable)/default 0x0000001 (jumbo frame enable)	• Jumbo frame switch
m-plane-rj45-vlan-static-ip	10.101.131.61 (It can be set when m-plane-vlan is not equal to 0)	• Setting IP address of ethernet port VLAN interface
m-plane-SFP-vlan-static-ip	10.101.131.62 (It can be set when m-plane-vlan is not equal to 0)	• Setting IP address of SFP+ port VLAN interface
m-plane-vlan	0 (not use VLAN)/default	• Configuring VLANs for VLAN interfaces on ethernet and SFP+ ports
mgmt-interace-ip	[IP mode] / [IP] / [MASk] / [Gateway] STATIC / 10.101.131.59 / 255.0.0.0 / 10.101.131.254	• For management interface (eth0)
phasecomp-mode	false (Disable)/default true (Enable)	• Enable phase-compensation or not
reset-to-default		• Reset all the configuration to the default value

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set_devmem	eaxc-id: 0, 1, 2, 3)/default Slot-id: 0,2/default	• Command to modify eaxc-id and slot id temporarily
slot-id	0x00000002	• Setting slot ID • 1: slot ID is 0 and 1 • 2: slot ID is 0 and 2
subcarrier-spacing	1	• μ=0;15kHz • μ=1;30kHz
sync-source	sync source = INTER_CLOCK	• PTP/GNSS/SYNCE_PTP/INTER_CLOCK • INTER_CLOCK only for LITEON internal test

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5.1.6. SW Configuration: Parameter List

- Bandwidth

```
(config)# bandwidth 40000000
Old Band Width = 100000000
New Band Width = 40000000
```

- c/u-plane-vlan

```
(config)# c/u-plane-vlan 564
Old vlan = 564
New vlan = 564
```

- center-frequency

```
(config)# center-frequency 3749000000
Old Center Frequency = 3749000000
New Center Frequency = 3749000000
```

- compression-bit

```
(config)# compression-bit 8
Old Compression Bit = 8
New Compression Bit = 8
```

- default-gateway

```
(config)# default-gateway 10.101.131.254
default gateway = 10.101.131.254
(config)#
```

- dpd-mode(true/false)

```
(config)# dpd-mode true
dpd mode : Enable
```

- du-mac-address

```
(config)# du-mac-address 001122334466
Old DU MAC Address = 001122334466
New DU MAC Address = 001122334466
```

- eAXC_id

```
(config)# eAXC_id 0 1 2 3
Old prach eAxC-id port 0, 1, 2, 3 = 0x0000, 0x0001, 0x0002, 0x0003
New prach eAxC-id port 0, 1, 2, 3 = 0x0000, 0x0001, 0x0002, 0x0003
```

- env-tx-power

```
(config)# env-tx-power 24
Old env_tx_target_power=24
New env_tx_target_power=24
```

- gain-rx

```
(config)# gain-rx 14
Old RX attenuation = 14
New RX attenuation = 14
```

- jumboframe (0/1)

```
(config)# jumboframe 1
Old jumboframe = 0x00000000
New jumboframe = 0x00000001
```

- m-plane-rj45-vlan-static-ip

```
(config)# m-plane-rj45-vlan-static-ip 10.101.131.61
Old rj45_vlan_ip = 10.101.131.61
New rj45_vlan_ip = 10.101.131.61
```

- m-plane-SFP-vlan-static-ip

```
(config)# m-plane-SFP-vlan-static-ip 10.101.131.62
Old SFP_vlan_ip = 10.101.131.62
New SFP_vlan_ip = 10.101.131.62
```

- m-plane-vlan

```
(config)# m-plane-vlan 20
Old m-plane vlan = 0
New m-plane vlan =20
Active after reboot
```

- phasecomp-mode(true/false)

```
(config)# phasecomp-mode true
phase compensation mode : Enable
```

- subcarrier-spacing

```
(config)# subcarrier-spacing 1
Old Subcarrier Spacing = 1
New Subcarrier Spacing = 1
```

- slot-id

```
(config)# slot-id 1
Old slotid = 0x00000000
New slotid = 0x00000001
```

- sync-source(S-plane)

```
(config)# sync-source PTP
sync mode : Enable
Active after reboot
(config)# sync-source
sync mode : Enable
sync source = PTP
(config)#
```

PTP only

```
(config)# sync-source GNSS
sync mode : Enable
Active after reboot
(config)# sync-source
sync mode : Enable
sync source = GNSS
(config)#
```

GNSS(GPS)

```
(config)# sync-source SYNCE_PTP
sync mode : Enable
Active after reboot
(config)# sync-source
sync mode : Enable
sync source = SYNCE_PTP
(config)#
```

PTP and SyncE

- mgmt-interace-ip [IP mode] [IP][MASk][Gateway]
  DHCP

```
(config)# mgmt-interace-ip DHCP
(config)# udhcpc: started, v1.31.0
udhcpc: sending discover
udhcpc: sending select for 172.19.205.53
udhcpc: lease of 172.19.205.53 obtained, lease time 90060
/etc/udhcpc.d/50default: Adding DNS 168.95.1.1

(config)# mgmt-interace-ip
eth0      Link encap:Ethernet  HWaddr 00:0a:35:00:22:05
          inet addr:172.19.205.53  Bcast:172.19.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:46977 errors:0 dropped:2554 overruns:0 frame:0
          TX packets:1944 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5146733 (4.9 MiB)  TX bytes:334852 (327.0 KiB)
          Interrupt:29
```

Static IP

```
(config)# mgmt-interace-ip STATIC 10.101.131.50 255.0.0.0 10.101.131.100
(config)# mgmt-interace-ip
eth0      Link encap:Ethernet  HWaddr 00:0a:35:00:22:05
          inet addr:10.101.131.50  Bcast:10.255.255.255  Mask:255.0.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:47620 errors:0 dropped:2580 overruns:0 frame:0
          TX packets:1985 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5207212 (4.9 MiB)  TX bytes:341220 (333.2 KiB)
          Interrupt:29
```

5.1.7. SW Configuration: S-plane

1. Login user/user
2. Enter `?` can show more information
3. Enter `enable` into enable mode; password: liteon168
4. Enter `configure` into configure mode
5. Enter ` sync-source PTP` setting S-plane

☐ S-plane enabled

```
(config)# sync-source PTP
sync mode : Enable
Active after reboot
(config)# sync-source
sync mode : Enable
sync source = PTP
(config)#
```

PTP only

```
(config)# sync-source GNSS
sync mode : Enable
Active after reboot
(config)# sync-source
sync mode : Enable
sync source = GNSS
(config)#
```

PTP and GNSS(GPS)

```
(config)# sync-source SYNCE_PTP
sync mode : Enable
Active after reboot
(config)# sync-source
sync mode : Enable
sync source = SYNCE_PTP
(config)#
```

PTP and SyncE

☐ S-plane disabled

```
(config)# sync-source INTER_CLOCK
sync mode : INTER_CLOCK
Active after reboot
(config)# sync-source
sync mode : INTER_CLOCK
sync source = PTP
(config)#
```

Internal Clock

5.1.8. SW Configuration: Phase Compensation

1. Login user/user
2. Enter `?` can show more information
3. Enter `enable` into enable mode; password: liteon168
4. Enter `configure` into configure mode
5. Enter ` phasecomp-mode true` setting Phase Compensation mode

- Phase compensation enabled

```
(config)# phasecomp-mode true
phase compensation mode : Enable
```

- Phase compensation disabled

```
(config)# phasecomp-mode false
phase compansation mode : Disable
```

5.1.9. SW Configuration: RU MAC checking

1. Login user/user
2. Enter `?` can show more information
3. Enter `enable` into enable mode; password: liteon168
4. Enter `show eth-info` ; Check RU MAC in eth1

- RU MAC checking

```
# show eth-info
eth0      Link encap:Ethernet  HWaddr 00:0a:35:00:22:05
          inet addr:172.19.205.53  Bcast:172.19.255.255  Mask:255.255.0.0
          inet6 addr: fe80::20a:35ff:fe00:2205/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:19469 errors:0 dropped:887 overruns:0 frame:0
          TX packets:2167 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:2128132 (2.0 MiB)  TX bytes:348320 (340.1 KiB)
          Interrupt:29

eth1      Link encap:Ethernet  HWaddr 00:aa:ff:bb:ff:cc
          inet addr:10.101.131.60  Bcast:10.255.255.255  Mask:255.0.0.0
          inet6 addr: fe80::2aa:ffff:febb:ffcc/64 Scope:Link
          UP BROADCAST RUNNING  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:178 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:33816 (33.0 KiB)
```

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5.1.10. Reset to default config

1. Login user/user
2. Enter `enable` into enable mode; password: liteon168
3. Enter `configure` into configure mode
4. Enter `reset-to-default LITTEON` ; then auto-reboot

```
(config)# reset-to-default LITEON
Wait to Reboot
```

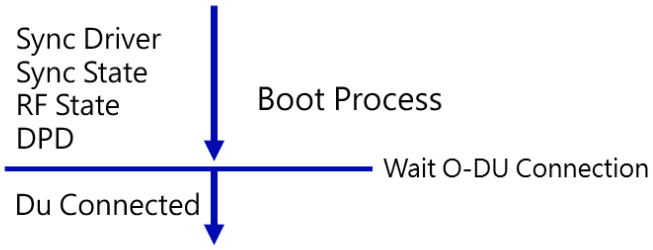
5.2. FlexFi O-RU Monitor

1. Login user/user
2. Enter `?` can show more information
3. Enter `enable`; password: liteon168
4. Enter `show oru-status` show
5. Enter `show ?` show more option

```
> enable
Enter Password:
Auto exit privileged commands in 300 Seconds
# show oru-status
Sync State  : notReady
RF State    : Ready
DPD         : Ready
DuConnected : notReady
# show
  arp             Display the kernel's IPv4 network neighbour cache.
  date            Display date.
  dl-ul-layer     Display Tx/Rx antenna
  eAXC-id         Display PRACH ethernet Aggregation Switch Card(eAXC)
  eth-info        Display network interfaces information.
  fw-info         Display firmware information.
  oru-status      Display O-RU state report.
  ps              Report a snapshot of the current processes.
  route           Display the kernel's routing tables.
  running-config  Display all configuration mode parameters.
  sync-trace      Display time synchronize status
  system          Display system information
  tx-evm          Display system information
  uptime          Display system uptime

# show
```

- show oru-status

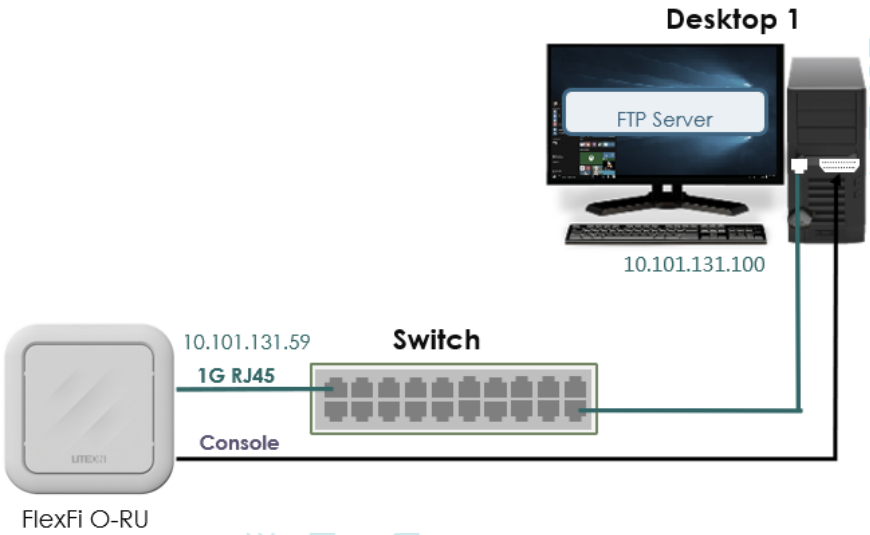


5.3. Software Upgrade

5.3.1. Software Upgrade: Architecture

Check list to setup environment first for software upgrade:

- Desktop 1
  - Control FlexFi O-RU via console
  - FTP server (FlexFi O-RU software)
- FlexFi O-RU
- Switch
  - L2 Function
  - with RJ45 interfaces: 1G



5.3.2. Software Upgrade: Procedures

Step 1: Put the new FlexFi O-RU image files in FTP server

Step 2: Check Network Status

Step 3: Connect to FlexFi O-RU by console

Login: user/user

Step 4: Type commands for software upgrade from FTP server via RJ45 cable

Enter `**?**` can show more information

Enter `**enable**`; password: **liteon168**

Enter `**?**` can show more information

software_upgrade [ftp_server_username] [ftp_server_password] [ftp_server_ip] [n78/n79] [oru_upgrade_version]

PS: n78 or n79 depends on the frequency your Radio Unit operates with. Apply either n78 or n79.

5.3.3. Software Upgrade: Check Network Status

I.

1. Enter `?` can show more information
2. Enter `enable`; password: liteon168
3. Enter `configure`;
4. Set DHCP mode or Static IP address mode
5. mgmt-interace-ip [IP mode] [IP][MASk][Gateway]

DHCP

```
(config)# mgmt-interace-ip DHCP
(config)# udhcpc: started, v1.31.0
udhcpc: sending discover
udhcpc: sending select for 172.19.205.53
udhcpc: lease of 172.19.205.53 obtained, lease time 90060
/etc/udhcpc.d/50default: Adding DNS 168.95.1.1

(config)# mgmt-interace-ip
eth0      Link encap:Ethernet  HWaddr 00:0a:35:00:22:05
          inet addr:172.19.205.53  Bcast:172.19.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:46977 errors:0 dropped:2554 overruns:0 frame:0
          TX packets:1944 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5146733 (4.9 MiB)  TX bytes:334852 (327.0 KiB)
          Interrupt:29
```

Static IP

```
(config)# mgmt-interace-ip STATIC 10.101.131.50 255.0.0.0 10.101.131.100
(config)# mgmt-interace-ip
eth0      Link encap:Ethernet  HWaddr 00:0a:35:00:22:05
          inet addr:10.101.131.50  Bcast:10.255.255.255  Mask:255.0.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:47620 errors:0 dropped:2580 overruns:0 frame:0
          TX packets:1985 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5207212 (4.9 MiB)  TX bytes:341220 (333.2 KiB)
          Interrupt:29
```

II.

1. Enter `ifconfig`
2. Check eth0 (ethernet 1G port)

```
# show eth-info
eth0      Link encap:Ethernet  HWaddr e8:c7:4f:1e:c7:12
          inet addr:10.101.131.59  Bcast:10.255.255.255  Mask:255.0.0.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
          Interrupt:29

eth1      Link encap:Ethernet  HWaddr e8:c7:4f:1e:c7:13
          inet addr:10.101.131.60  Bcast:10.255.255.255  Mask:255.0.0.0
          inet6 addr: fe80::eac7:4fff:fe1e:c713/64 Scope:Link
          UP BROADCAST RUNNING  MTU:1500  Metric:1
          RX packets:100 errors:0 dropped:100 overruns:0 frame:0
          TX packets:14 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:55486 (54.1 KiB)  TX bytes:1076 (1.0 KiB)
```

5.3.4. Software Upgrade: Showcase

1. Format:
   - software_upgrade [ftp_server_username] [ftp_server_password] [ftp_server_ip] [oru_upgrade_version]

2. Example:
   - `software_upgrade kevin kevin 172.19.205.164 01.00.06`

3. Auto reboot after execute `software_upgrade`

```
# software_upgrade kevin kevin 172.19.205.164 01.00.06
--2023-02-24 11:59:02--  ftp://kevin:*password*@172.19.205.164/FF-RFI078I4-01.00.06.tar.gz
           => 'FF-RFI078I4-01.00.06.tar.gz'
Connecting to 172.19.205.164:21... connected.
Logging in as kevin ... Logged in!
==> SYST ... done.    ==> PWD ... done.
==> TYPE I ... done.  ==> CWD not needed.
==> SIZE FF-RFI078I4-01.00.06.tar.gz ... 234133666
==> PASV ... done.    ==> RETR FF-RFI078I4-01.00.06.tar.gz ... done.
Length: 234133666 (223M) (unauthoritative)

FF-RFI078I4-01.00.06.tar.gz                      100%[=============================================================================================================>] 223.29M  1.12MB/s    in 3m 20s

2023-02-24 12:02:21 (1.12 MB/s) - 'FF-RFI078I4-01.00.06.tar.gz' saved [234133666]

Untar image file...
Upgrade image file...
pwd=/home/user/scripts, Image=/home/user/scripts/../images
devpart_boot 1 devpart_root 3
auto update u-boot & part (2,4)
master partition=(2, 4), slave partition=(1, 3)
Installing /home/user/scripts/../images/BOOT.BIN to /media/sd-mmcblk0p1, waiting ...
Program /home/user/scripts/../images/BOOT.BIN into /dev/mmcblk0p1     [Done]
Installing /home/user/scripts/../images/image.ub to /media/sd-mmcblk0p2, waiting ...
Install /home/user/scripts/../images/image.ub in /dev/mmcblk0p2     [Done]
Cleaning data in /media/sd-mmcblk0p4
Installing /home/user/scripts/../images/rootfs_final.tar.gz to /media/sd-mmcblk0p4, waiting ...
Install /home/user/scripts/../images/rootfs_final.tar.gz in /dev/mmcblk0p4     [Done]
Backup config from /usr/local/BackupCfgData to /media/sd-mmcblk0p4/usr/local/OrgImgCfgData of the new image.
```

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5.4. References

Application Server VM link:
https://drive.google.com/file/d/1ZDb0pQvGRI1JQ1P6siiLzbjn3BQm5d2X/view?usp=sharing

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6. Industry Compliance

LITEON 5G Indoor Sub-6GHz RU software follows the 3GPP and O-RAN Alliance standards-based architecture and interfaces, to support interoperability with other vendors.

3GPP Spec. No.	Description
TS 38.104	5G; NR; Base Station (BS) radio transmission and reception
TS 38.141	5G; NR; Base Station (BS) conformance testing (RF)
TS 38.401	5G; NG-RAN; Architecture Description
TS 38.817	5G; NR; Base Station (BS) Radio Frequency (RF)

O-RAN Spec. No.
ORAN-WG4.CUS.0-v07.00
O-RAN.WG4.MP.0-R003-v7.00
O-RAN.WG4.IOT.0-R003-v07.00
O-RAN.WG4.CONF.0-R003-v07.00

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