

4. RU MANAGEMENT

CREATING A VLAN SUB-INTERFACE

A dot1q VLAN sub-interface is a virtual interface that is associated with a VLAN ID on a routed physical interface. The base interface is a physical interface. All IEEE802.1q tagged packets are sent and received on the VLAN sub-interface.

ORAN C/U PLANE

To create the eCPRI transport VLAN sub-interface, follow the steps, beginning in privileged EXEC mode.

VLAN sub-interface - ORAN C & U planes

Step	Command	Purpose
1	config ru# config	Entering global configuration mode
2	interface <ifname> Example: ru(config)# interface eth1 ru(conf-if eth1)#	Entering interface configuration mode for primary fronthaul interface Note: OOB MGMT cannot be a fronthaul interface.
3	sub-interface <sub-ifname> encapsulation vlan <vid> Example: ru(conf- if eth1)# sub-interface eth1.500 encapsulation vlan 500	Setting the creating sub-interface name and VLAN ID. Note: sub-interface name must be unique in the system. Suggested format is base.vlan but not restricted to this format.
4	no shutdown Example: ru(conf-if eth1)# no shutdown ru(conf-if eth1)#	Enables the VLAN sub-interface, changing its state to administration up.
5	exit Example: ru(conf-if eth1)# exit ru(config)#	Exits interface configuration mode and returns to global configuration mode.
6	radio ru(config)# radio 1 ru(conf-rf 1)#	Entering radio configuration mode. Note: Available radio channel ID are 1 to 4.
7	transport interface <ifname> Example: ru(conf-rf 1)# transport interface eth1.500 ru(conf-rf 1)#	Setting the eCPRI transport interface. Note: transport interface is a shared configuration among radio channels. You just need to specify one channel, and the other three channels will be applied with this configuration.

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CREATING A VLAN SUB-INTERFACE

ORAN M PLANE

To create the VLAN sub-interface for O-RAN management plane, follow these steps, beginning in privileged EXEC mode.

VLAN sub-interface - M plane

Step	Command	Purpose
1	config ru# config	Entering global configuration mode
2	interface <ifname> Example: ru(config)# interface eth1 ru(config-if eth1)#	Entering interface configuration mode for M plane interface Note: All Ethernet interfaces can be configured as a M plane interface
3	sub-interface <sub- ifname> encapsulation vlan <vid> Example: ru(config-if eth1)# sub- interface eth1.mplane encapsulation vlan 1000	Setting the creating sub-interface name and VLAN ID. Note: sub-interface name must be unique in the system. Suggested format is base.vlan but not restricted to this format.
4	no shutdown Example: ru(config-if eth1)# no shutdown ru(config-if eth1)#	Enables the VLAN sub-interface, changing its state to administration up.
5	exit Example: ru(config-if eth1)# exit ru(config)#	Exits interface configuration mode and returns to global configuration mode.
6	interface <sub- ifname> Example: ru(config)# interface eth1.mplane	Entering sub-interface configuration mode.
7	ip address <ip/prefix-len> Example: ru(config-if eth1.mplane)# ip address 192.168.5.1/24 ru(config-if eth1.mplane)#	Setting the IP address and prefix length for the M plane interface.
8	exit Example: ru(config-if eth1. mplane)# exit ru(config)#	Exits sub-interface configuration mode and returns to global configuration mode.

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VLAN SUB-INTERFACE

DELETING

The VLAN ID is determined when a sub-interface is created. If you want to change the VLAN ID for C/U plane, you need to create a new VLAN sub-interface, assign the radio transport interface to the new sub-interface, then delete the old sub-interface. To delete the VLAN sub-interface, follow the steps, beginning in privileged EXEC mode.

VLAN sub-interface - Deleting

Step	Command	Purpose
1	config Example: ru# config	Entering global configuration mode
2	interface <ifname> Example: ru(config)# interface eth1 ru(config-if eth1)#	Entering interface configuration mode for the deleting sub-interface's base interface. Note: Ensure the C/U/M plane is not using this sub- interface before deleting it.
3	no sub-interface <sub-ifname> Example: ru(config-if eth1)# no sub-interface eth1.500	Deleting the sub-interface.

4. RU MANAGEMENT

CHANGING CENTER FREQUENCY

Step	Command	Purpose
1	config Example: ru# config	Entering global configuration mode
2	radio <channel> Example: ru(config)# radio 1 ru(conf-rf 1)#	Entering radio configuration mode. Valid channel numbers are 1 to 4.
3	center-freq <frequency> Example: ru(conf-rf 1)# center-freq 349998	Setting the center frequency in kHz. The center frequency must be at a 5G NR ARFCN frequency. Otherwise, the system will reject the input and suggest a closest frequency.[1]
4	exit Example: ru(conf-rf 1)# exit ru(config)#	Exits radio configuration mode and returns to global configuration mode.
5	exit Example: ru(config)# exit ru#	Exits global configuration mode and returns to privileged EXEC mode.
6	copy running- config startup- config Example: ru# copy running- config startup- config	Save the running config to startup config.
7	reboot Example: ru# reboot	Reboot the system. Make the new center frequency effect.[2]

[1]: In the current design, center frequency is a shared parameter among all radio channels. When you change one channel, the other channels' center frequencies change as well.

[2]: The new center frequency will take effect at the next boot. However, the phase compensation for each symbol will be recalculated by the new center frequency and will take effect immediately. As a result, when you change the center frequency, it is recommended that you reboot the system after the setting is confirmed.

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SYMBOL PHASE COMPENSATION

PHASE COMPENSATION

Enabling

Step	Command	Purpose
1	config Example: ru# config	Entering global configuration mode
2	radio <channel> Example: ru(config)# radio 1 OK ru(conf-rf 1)#	Entering radio configuration mode. Valid channel number is from 1 to 4.
3	phase-compensation Example: ru(conf-rf 1)# phase-compensation	Enabling symbol phase compensation.
4	exit Example: ru(conf-rf 1)# exit OK ru(config)#	Exits radio configuration mode and returns to global configuration mode.
5	exit Example: ru(config)# exit OK ru#	Exits global configuration mode and returns to privileged EXEC mode.
6	show phase- compensation Example: ru# show phase-compensation	Ensure the symbol phase compensation is activated correctly.[1]
7	copy running-config startup-config Example: ru# copy running-config startup-config	Save the running config to startup config.

You should see the symbol phase-compensation is running and all phase compensation offsets are non-zero. If the offsets are all zero, reconfigure center frequency to force the system to apply the phase compensation based on the center frequency. See section 2.8 Changing Center Frequency for detailed steps.

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SYMBOL PHASE COMPENSATION (CONT.)

RADIO TRANSMIT POWER LEVEL

Changing

Step	Command	Purpose
1	config Example: ru# config	Entering global configuration mode
2	radio <channel> Example: ru(config)# radio 1 ru(conf-rf 1)#	Entering radio configuration mode. Valid channel number is from 1 to 4.
3	transmit- power Example: ru(conf-rf 1)# transmit- power	Setting the transmit power for the specific radio channel. The input unit is dBm and the step in 1 dBm. Valid range is from 10dBm to 24dBm. Default setting is 22dBm.
4	exit Example: ru(conf-rf 1)# exit	Exits radio configuration mode and returns to global configuration mode.
5	exit Example: ru(config)# exit	Exits global configuration mode and returns to privileged EXEC mode.
6	copy running- config startup- config Example: ru# copy running- config startup- config	Saves the running config to startup config.

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FIRMWARE UPGRADE

Step 1 - Establish the above topology and follow the port connection in the diagram.

Step 2 - The IN port on the PoE adapter is the RU's management port. Default IP address is 192.168.1.1/24. Please configure your management laptop within the same subnet 192.168.1.*/24. (e.g. 192.168.1.201/24).

Step 3 - Start the SSH connection to RU.

Step 4 - Type in the credentials here

SSH Authentication

Logging in to 192.168.1.1

Authentication required.

User name:

Passphrase:

☒ Remember password in memory

☐ Forward agent

Authentication methods

☒ Use plain password to log in

☐ Use RSA/DSA/ECDSA/ED25519 key to log in

Private key file:

☐ Use rhosts to log in (SSH1)

Local user name:

Host private key file:

☐ Use keyboard-interactive to log in

☐ Use Pageant to log in

You will then see the RU's welcome message.

```
=====
WNC O-RU Command Line System
=====
arria10>
```

Step 5 - Type in command “show inventory” to display RU's firmware slot. In this table, you can see the firmware version and the current running slot. Find an empty slot for the new firmware.

```
arria10# show inventory
```

Name	Status	Active	Running	Access	Version
=====					
slot_1	VALID	true	true	READ_ONLY	0.7.1
slot_2	EMPTY	false	false	READ_WRITE	-----
slot_3	EMPTY	false	false	READ_WRITE	-----
slot_4	EMPTY	false	false	READ_WRITE	-----
OK					

5. SYSTEM AND FIRMWARE

FIRMWARE UPGRADE (CONT.)

Step 6 - Before the firmware upgrade, make sure the SFTP service is running on your management PC.

Step 7 - Generate the RSA key pair and install the SFTP server's certification on the RU.

```
arria10# crypto key generate rsa
Generating public/private rsa key pair.
/home/root/.ssh/id_rsa already exists.
Overwrite (y/n)? Your identification has been saved in
/home/root/.ssh/id_rsa
Your public key has been saved in /home/root/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:LIglidylreDRkiF45RCtbZgghkmtRzibeijz2DQadt0A root@arria10
The key's randomart image is:
+---[RSA 3072]-----+
| o==o . .          |
| |=..=.O *         |
| |=.EX B .         |
| o.X.+ + +         |
| .o *. .o S        |
| o o o ..          |
| |= o .            |
| . + o             |
|   . .             |
+---[SHA256]-----+
OK
```

This command is to install the RSA key for user wnc:

```
arria10# crypto key install 192.168.2.200 user wnc
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed:
"/home/root/.ssh/id_rsa.pub"
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s),
to filter out any that are already installed
expr: warning: '^ERROR: ': using '^' as the first character
of a basic regular expression is not portable; it is ignored
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you
are prompted now it is to install the new keys
wnc@192.168.2.200's password:

Number of key(s) added: 1

Now try logging into the machine, with:  "ssh 'wnc@192.168.2.200'"
and check to make sure that only the key(s) you wanted were added.

OK
```

5. SYSTEM AND FIRMWARE

FIRMWARE UPGRADE (CONT.)

Step 8 - Download firmware to slot 4

```
arria10# sftp wnc 192.168.2.200 fw-v1-0-0b-rc3.zip firmware slot 4
[download]...start
mqrpc_event_subscribe: wnc/rpc/sw_mgmt/event/+ subscribed
download complete
result ok
[download]...done
[install]...slot 4 start
mqrpc_event_subscribe: wnc/rpc/sw_mgmt/event/+ subscribed
install complete
result ok
[install]...slot 4 done
OK
```

Step 9 - The RU is currently running on slot 2. Make sure the new firmware is downloaded to slot 4.

```
arria10# show inventory
Name      Status   Active   Running   Access           Version
=====
slot_1    VALID    false    false     READ_ONLY        0.7.1
slot_2    VALID    true     true      READ_WRITE       1.0.0b-rc3
slot_3    EMPTY    false    false     READ_WRITE       -----
slot_4    VALID    false    false     READ_WRITE       1.0.0b-rc3
OK
```

Step 10 - Run command “boot firmware slot 4” to activate firmware slot 4. After activating, the RU will reboot.

```
arria10# boot firmware slot 4
[activate]...slot 4 start
mqrpc_event_subscribe: wnc/rpc/sw_mgmt/event/+ subscribed
activate complete
result ok
[activate]...slot 4 done
[reboot]...slot 4 start
[ OK ] Removed slice system-modprobe.slice.
[ OK ] Stopped target Multi-User System.
[ OK ] Stopped target Login Prompts.
[ OK ] Stopped target Host and Network Name Lookups.
[ OK ] Stopped target Remote File Systems.
[ OK ] Stopped target System Time Synchronized.
[ OK ] Stopped target System Time Set.
[ OK ] Stopped target Timers.
[ OK ] Stopped Daily Cleanup of Temporary Directories.
      Stopping Avahi mDNS/DNS-SD Stack...
      Stopping Kernel Logging Service...
      Stopping Sy[24069.633758] device eth1.ecpri left promiscuous
mode
```

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6. SYSTEM MAINTENANCE

This chapter provides command instructions for the RU's system maintenance, including how to perform factory reset, how to save RU's running configuration from console session, and how to reboot the device.

FACTORY RESET

Type in command “erase config” to perform a factory reset on the RU.

```
arria10# erase config
This command will restore to factory default setting and reboot the
system.
Continue? (Y/N) [N]
```

Type “y” and the system will restore to its default configuration and reboot.

SAVE RU'S RUNNING CONFIGURATION

Type in command “copy running-config startup-config” to save the RU's current configuration.

```
arria10# copy running-config startup-config
OK
```

REBOOT DEVICE

Type in command “reboot” to reboot the RU.

```
arria10# reboot
This command will reboot the system and disconnect your session.
Continue? (Y/N) [N]
```

7. TROUBLESHOOTING

When you have problems operating the RU, please collect the related information so we can know how to help. This section introduces several commonly used commands from the console that would help you troubleshoot.

SHOW VERSION

Type in command “show version” to display u-boot loader version, the current firmware version, and the FPGA version.

```
arria10# show version
U-boot      : U-Boot 2014.10_WNC_1.0.0
Firmware    : 0.7.1
FPGA        : 0x0701429B
OK
```

SHOW PLATFORM

Type in command “show platform” to display the RU’s hardware information.

```
arria10# show platform
R1220-078L
SGE
OK
```

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7. TROUBLESHOOTING

SHOW RUNNING CONFIGURATION

Type in command “show running configuration” to check for the configuration currently running on the RU.

```
arrial0# show running-config
!
hostname arrial0
!
aaa
!
 enable crypt enjz9NkNiFXAs
!
interface eth0
 ip address 192.168.25.1/24
 exit
!
interface eth1.ecpri
 exit
!
interface eth1.mplane
 ip address 192.168.100.1/24
 exit
!
interface eth1
 ip address 192.168.2.1/24
 sub-interface eth1.mplane encapsulation vlan 100
 sub-interface eth1.ecpri encapsulation vlan 564
 exit
!
radio 1
 no shutdown
 center-freq 3499980
 transmit-power 24
 no lna shutdown
 lna low-gain
 eaxc-id downlink 0x0000
 eaxc-id uplink 0x0000
 eaxc-id prach 0x0004
 transport interface eth1.ecpri
 transport peer-mac 00:00:00:00:00:00
 no phase-compensation
 bandwidth 100
 sub-carrier 30
 exit
!
radio 2
 no shutdown
 center-freq 3499980
 transmit-power 24
 no lna shutdown
 lna low-gain
 eaxc-id downlink 0x0001
 eaxc-id uplink 0x0001
 eaxc-id prach 0x0005
 transport interface eth1.ecpri
 transport peer-mac 00:00:00:00:00:00
 no phase-compensation
 bandwidth 100
 sub-carrier 30
 exit
!
```

```
radio 3
 no shutdown
 center-freq 3499980
 transmit-power 24
 no lna shutdown
 lna low-gain
 eaxc-id downlink 0x0002
 eaxc-id uplink 0x0002
 eaxc-id prach 0x0006
 transport interface eth1.ecpri
 transport peer-mac 00:00:00:00:00:00
 no phase-compensation
 bandwidth 100
 sub-carrier 30
 exit
!
radio 4
 no shutdown
 center-freq 3499980
 transmit-power 24
 no lna shutdown
 lna low-gain
 eaxc-id downlink 0x0003
 eaxc-id uplink 0x0003
 eaxc-id prach 0x0007
 transport interface eth1.ecpri
 transport peer-mac 00:00:00:00:00:00
 no phase-compensation
 bandwidth 100
 sub-carrier 30
 exit
!
mgmt
 no shutdown
 master netconf-client-1 hostname
 192.168.100.200:4334
 no alarm history rotate duration
 exit
!
ptp
 no shutdown
 clock accept-list 6,7
 clock domain 24
 clock profile g.8275.1
 interface eth1
 master ip 192.168.2.100
 message frequency announce 8
 message frequency delay-req 16
 message frequency sync 16
 transport ethernet forwardable
 exit
!
OK
```

7. TROUBLESHOOTING

SHOW INTERFACE STATUS

Type in command “show interface brief” to display interface status and the information of each interface. As indicated in the image below, we can see the MAC address, VLAN ID, IP address and the interface status.

```
arria10# show interface brief
Interface      Hardware      VLAN      IP address      Status
=====
lo             00:00:00:00:00:00      127.0.0.1/8      unknown
eth0           00:0b:6b:00:00:00      down
sit0           0.0.0.0             down
eth1           00:0b:6b:00:00:01      192.168.2.1/24    up
eth1.ecpri     00:0b:6b:00:00:01      564              169.254.196.222/16 up
eth1.mplane    00:0b:6b:00:00:01      100              192.168.100.1/24  up
OK
```

SHOW PTP CLOCK

Type in command “show ptp clock” to display the PTP clock information. S-Plane state is also shown here.

```
arria10# show ptp clock
PTP Clock Information:
  PTP Device Type      : slave clock
  Clock Identify       : 000b6b.ffffe.000001
  Profile              : g.8275.1
  Clock Domain         : 24
  Number of PTP ports  : 1
  Priority1            : 128
  Priority2            : 128
  Clock Quality        :
    Class              : 255
    Accuracy           : 0xfe
    Offset (log variance) : 0xffff
  Offset From Master(ns) : 0.0
  Mean Path Delay(ns)   : 0.0
  Steps Removed        : 0
  S-plane State        : freerun
OK
```

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SHOW PTP CLOCK (CONT.)

```
arrial0# show ptp clock
PTP Clock Information:
  PTP Device Type           : slave clock
  Clock Identify            : 000b6b.ffff.000001
  Profile                   : g.8275.1
  Clock Domain              : 24
  Number of PTP ports       : 1
  Priority1                  : 128
  Priority2                  : 128
  Clock Quality             :
    Class                   : 255
    Accuracy                 : 0xfe
    Offset (log variance)   : 0xffff
  Offset From Master(ns)    : -83.0
  Mean Path Delay(ns)       : 85.0
  Steps Removed             : 1
  S-plane State             : locked
OK
```

SHOW ENVIRONMENT

Type in command “show environment” to display the RU’s hardware status, including temperature for PA, FPGA, RF-Transceiver and the 10G Ethernet PHY.

```
arrial0# show environment
Temperature:
PA-2:          +29.0 C (high = +125.0 C, hyst = +120.0 C)
                (crit = +150.0 C, hyst = +145.0 C)
FPGA:          +47.5 C (high = +150.0 C, hyst = +145.0 C)
                (crit = +150.0 C, hyst = +145.0 C)
PA-1:          +31.1 C (high = +150.0 C, hyst = +145.0 C)
                (crit = +150.0 C, hyst = +145.0 C)
RF-Transceiver: +37.4 C (high = +150.0 C, hyst = +145.0 C)
                (crit = +150.0 C, hyst = +145.0 C)
10G-Ethernet:  +34.1 C (high = +100.0 C, hyst = +95.0 C)
                (crit = +125.0 C, hyst = +120.0 C)
OK
```

7. TROUBLESHOOTING

SHOW RADIO TRANSPORT

Type in command “show radio transport” to display the information of RU frontend interface.

```
arria10# show radio transport
eCPRI transport status:
VLAN                : 564
local MAC address    : 00:0B:6B:00:00:01
peer MAC address     : 00:00:00:00:00:00
OK
```

SHOW RADIO COUNTERS

Type in command “show radio counters” to display eCPRI messages counters for all RF channels.

```
arria10# show radio counters
CH Downlink Control   Downlink Data   Uplink Control   Uplink Data
=====
1                     0               0               0
2                     0               0               0
3                     0               0               0
4                     0               0               0
OK
```

Type in command “show radio 1 performance” for the performance counters of RF channel 1.

```
arria10# show radio 1 performance
Channel 1 performance counters:
=====
|                               User Plane |                               Control Plane
=====
downlink early |                               0 |                               0
downlink ontime |                               0 |                               0
downlink late  |                               0 |                               0
downlink total |                               0 |                               0
-----
uplink early   |                               n/a |                               0
uplink ontime  |                               n/a |                               0
uplink late    |                               n/a |                               0
uplink total   |                               0  |                               0
OK
```

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SHOW RADIO DELAY PROFILE

Type in command “show radio delay-profile” to display T2a and Ta3 min / max value.

```
arria10# show radio delay-profile
T2a downlink user plane minimum      :          77usec
T2a downlink user plane maximum      :          464usec
T2a downlink control plane minimum   :           71usec
T2a downlink control plane maximum   :          464usec
T2a uplink control plane minimum      :           36usec
T2a uplink control plane maximum     :          392usec
Ta3 uplink user plane minimum         :           84usec
Ta3 uplink user plane maximum        :          120usec
OK
```

SHOW SYSTEM LOGS

Type in command “show syslog” to collect RU’s log messages.

```
arria10# show syslog
Dec 16 23:51:43 arria10 user.notice ptp4l: [23189.980] selected local
clock 000b6b.ffff.000001 as best master
Dec 16 23:51:43 arria10 user.notice phc2sys: [23190.141] Waiting for
ptp4l...
Dec 16 23:51:43 arria10 user.notice ptp4l: [23190.420] selected local
clock 000b6b.ffff.000001 as best master
Dec 16 23:51:44 arria10 user.notice ptp4l: [23190.860] selected local
clock 000b6b.ffff.000001 as best master
Dec 16 23:51:44 arria10 user.notice phc2sys: [23191.141] Waiting for
ptp4l...
Dec 16 23:51:44 arria10 user.notice ptp4l: [23191.330] selected local
clock 000b6b.ffff.000001 as best master
Dec 16 23:51:44 arria10 daemon.info netopeer2-server[2651]:
getsockopt() error (No route to host).
Dec 16 23:51:45 arria10 user.notice ptp4l: [23191.800] selected local
clock 000b6b.ffff.000001 as best master
```

7. TROUBLESHOOTING

SHOW SERVER M-PLANE / S-PLANE

Type in command “show server m-plane” to display status of management plane server.

```
arria10# show server m-plane
      mplane-netopeer2-serverd: active (running)

      mplane-sysrepo-plugind: active (running)

OK
```

Type in command “show server s-plane” to display status of synchronization plane server.

```
arria10# show server s-plane
active (running)
OK
```

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