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RECOMMENDATION FOR RF CLUSTER CONNECTOR

ANTENNA TO RADIO MODULE PINOUT ALIGNMENT

Recommendation on RF Cluster Connector

PHASE 2
(Antenna to Radio Module PINOUT ALIGNMENT)

by NGMN Alliance

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Abstract

This whitepaper addresses the evaluation critierias and processes used to select a common RF cluster connectors. By making evaluating agreed selective criteria andl parameters, providing guidance on selective processes and practices, and by recommending methods of voting.

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1 Introduction and Purpose of Document

This phase 2 document is to align vendor 8T8R antenna and 8T8R radio modules with a unique naming system and pinout order on repeatable basis to simplify rigging of installations to mimimising the potential for cross feeder/connection issues.

The goal is to have one simple naming convention which allows different vendors to manufacture only one product variant to simplify deployment logistics and future site maintenance.

1.1 Phase 1 multi pin connector selection

NGNM participants selected for industry harmonization and initial 5G deployments Type C connector as the most suitable standardize connector type.

Type C connector is generally known in the telecoms industry as MQ4 and MQ5.

- Reference to NGMN document is: 190827-NGMN-RF-Cluster-Whitepaper-V1.13

1.2 Phase 2

- The overall concept goal is to have a simple RF port mapping solution to avoid cross jumper cabling connection issues. By “simple”, the scope is during installation no further on-site documentation required and the RF port mapping should be **self-explanatory**. This could be reached only if naming system and RF port mapping of the cluster connector is unified and published at NGMN level.
- **Phase 2 is a succession of Phase 1** and must be based on the recommendation of the Phase 1 cluster connector selected, i.e. MQ4 / MQ5.
- Recommendation for ***MQ4/MQ5 CC is only on TDD 8T8R***, the FDD topic has still some technical uncertainties which are to be clarified in a later phase of this project, therefore FDD is not in scope for phase 2.
- After a long extensive debate regarding “co-polar vs. cross-polar pin-out” and balancing pro/cons – as the main RAN vendor radio’s default port mapping is “co-polar” and the high volume of these antenna types already deployed within the existing eco-system (CMCC) ***co-polar should be retained.***
- It is essential an alignment is agreed as soon as possible as the APAC region have being deploying 8T8R deployments for many years and now on increase in Europe and AMEA.
  Decision and recommendations is now required.
- To simplify installation methodology and avoid deployment mistakes, any decision is better than no decision. **All parties should follow the recommendations.**

1.3 Interpretation

For the scope of this document, certain words are used to indicate requirements, while others indicate directive enforcement. Key words used numerous time in the paper are:

- ***Shall:*** indicates requirements or directives strictly to be followed in order to conform to this paper and from which no deviation is permitted.
- ***Shall, if supported:*** indicates requirements or directives strictly to be followed in order to conform to this whitepaper, if this requirement or directives are supported and from which no deviation is permitted.

- ***Should:*** indicates that among several possibilities, one is recommended as particularly suitable without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (*should* equals *is recommended*).
- ***May:*** is used to indicate a course of action permissible within the limits of this whitepaper
- ***Can:*** is used for statements of capability.
- ***Mandatory:*** indicates compulsory or required information, parameter or element.
- ***Optional:*** indicates elective or possible information, parameter or element.

1.4 References

This white paper incorporates provisions from other publications. These are cited in the text and the referenced publications are listed below. Where references are listed with a specific version or release, subsequent amendments or revisions of these publications apply only when specifically incorporated by amendment or revision of this whitepaper. For references listed without a version or release, the latest edition of the publication referred to applies.

1. IEEE Std. 145-1993 or following versions Standard definitions of Terms for Antennas.
2. 3GPP TS 37.104, v14.1.0, 2016-09 Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) radio transmission and reception.
3. IEC 60529 Degrees of Protection Provided By Enclosures (IP CODE).
4. IEC 62037-6 Passive RF and microwave devices, intermodulation level measurement - Part 6: Measurement of passive intermodulation in antennas
5. AISG-Antenna-Port-Color-Coding-v3.2.1

2 Abbreviations and Antenna Terms Definitions

2.1 Abbreviations

The abbreviations used in this whitepaper are explained in the following table:

Abbreviation	Definition
3GPP	3rd Generation Partnership Project
ETSI	European Telecommunication Standards Institute
FDD	Frequency Division Duplex
IEC	International Electrotechnical Commission
IEEE	Institute Electricals and Electronics Engineers
MIMO	Multiple Input/Multiple Output
N/A or n/a	Not Available or Not Applicable
NGMN	Next Generation Mobile Networks Alliance
PIM	Passive Inter Modulation
RL	Return Loss
TDD	Time Division Duplex

Table 2.1-1—Acronyms and abbreviations table.

2.2 RF Cluster terms

The following sections of this section reports the definition of commonly used RF Cluster terms.

3 Antenna

3.1 Pinout description

There are numerous naming conventions and pinout rules used today in industry which have different historical purposes, none have been directly dedicated for 8T8R. Several key conventions are detailed below:

A. **CROSS-POLAR: AISG port coding convention**
B. **CO-POLAR LEFT ALIGNED**
C. **CO-POLAR RIGHT ALIGNED**

A. CROSS-POLAR: AISG port coding convention

Counting the array connectors: from left to right, alternating ports +45° and -45°

***Reference* AISG document is: AISG-Antenna-Port-Color-Coding-v3.2.1**

From document:

Port Number

„The RF ports shall be marked with unique port numbers. RF port numbering shall start with 1 and increment by 1 for each following RF port without resetting the number to 1."

„Within the same colour combination, port numbering begins from the nearest array position to the Coding Reference Point bottom up as **first direction and left-to-right as second direction in the order +45° to -45°**, RHC to LHC, or V to H."

Array Position

„If the antenna includes two or more arrays supporting the same frequency range, then the relative position of the arrays shall be marked by using the abbreviation or full text format given in table 8.2.1. The use of upper and/or lower case is acceptable.:

„In addition to the left/right port marking, the left/right orientation of the array position shall be marked on the antenna (see Annex D)."

Horizontal definition			
Abbreviation format	**Full text format**	**Abbreviation format**	**Full text format**
T	Top	**L**	**Left**
MT	Mid Top	**CL**	**Centre Left**
M	Mid	**C**	**Centre**
MB	Mid Bottom	**CR**	**Centre Right**
B	Bottom	**R**	**Right**

B. CO-POLAR LEFT ALIGNED

"CO-POLAR LEFT ALIGNED": counting the array connectors: from left to right, first all ports +45°, then all ports -45°

C. CO-POLAR RIGHT ALIGNED

"CO-POLAR RIGHT ALIGNED": counting the array connectors: from right to left, first all ports +45°, then all ports -45°

3.2 Pinout alignment

Proposed pin-out (physical port mapping to antenna column) for Cluster connector is ***CO-POLAR RIGHT ALIGNED.***

Labelling according **AISG*** **physical array location** need to be **prominent** and **clear** (also valid for TDD 8T8R antennas with 8+1 connectors). Numerical AISG port numbers labelling should be kept for production Q&A processes but isn't intended to be used for site installation teams.
It was also proposed as recommendation to reduce the font size on the antenna bottom plate.

- **AISG port names for 8T8R TDD : L-, CL-, CR-, R-; L+, CL+, CR+, R+, CAL**

4 Cluster Jumper

There is no need for any additional labelling due to Cluster Connector MQ4/5, 4 pin and 5 pin Cluster Connector unique mating.

Labelling is **mandatory** according to **AISG on fan-out** Side of Cluster jumper**. It was decided use "neutral" labels with white background to avoid any conflict with any AISG colour coding.**

- **AISG labels for 8T8R TDD Cluster Jumper (black font on white background, only fan-out side): L-, CL-, CR-, R-; L+, CL+, CR+, R+, CAL**

5 RRU side

AISG labelling should be mandatory for indicating the physical default mapping.
Port order can be for either Copolar or Crosspolar but must be appropriately labelled.

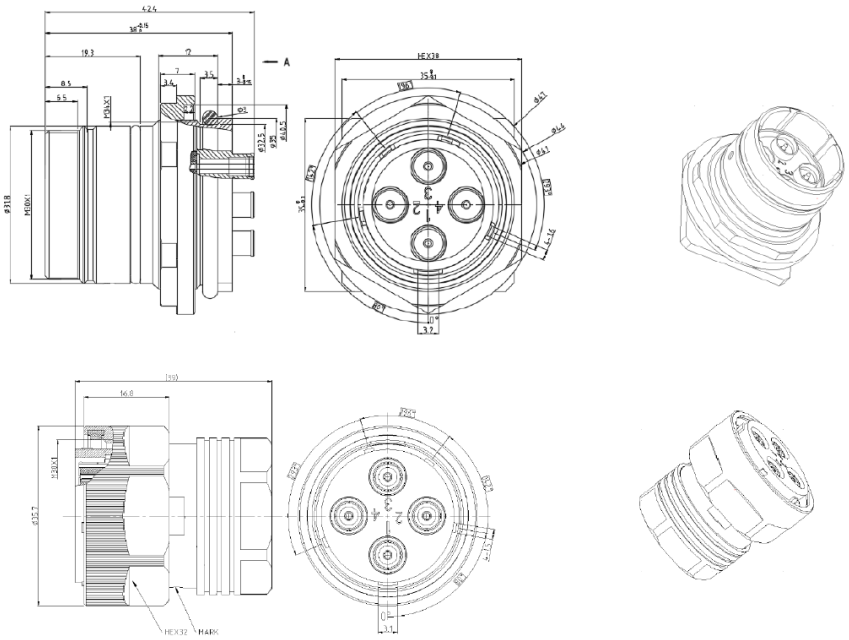
A Cluster Connector on the radio unit presently does not appear feasible due to the filter structure and design impact where presently all individual connectors map directly to the Pas blocks.

6 PIN Order on MQ4 and MQ5

According AISG naming rules

Initial pin number "1" position is down, if the main notch is down and other positions numbered clockwise (front view, male connector)

MQ4



MQ5

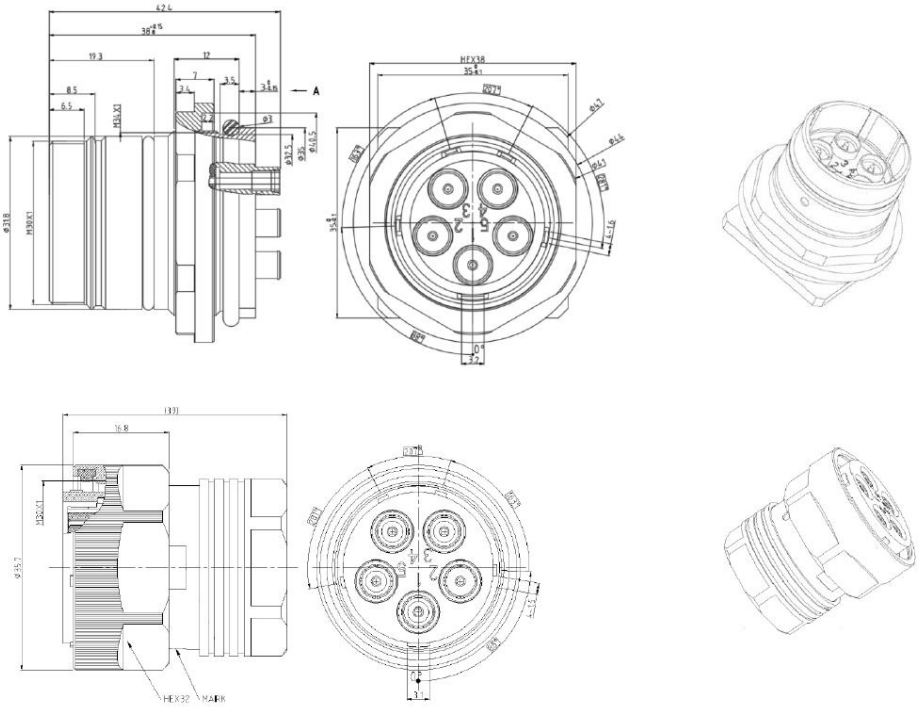


Fig 1 MQ4 & MQ5 Connectors

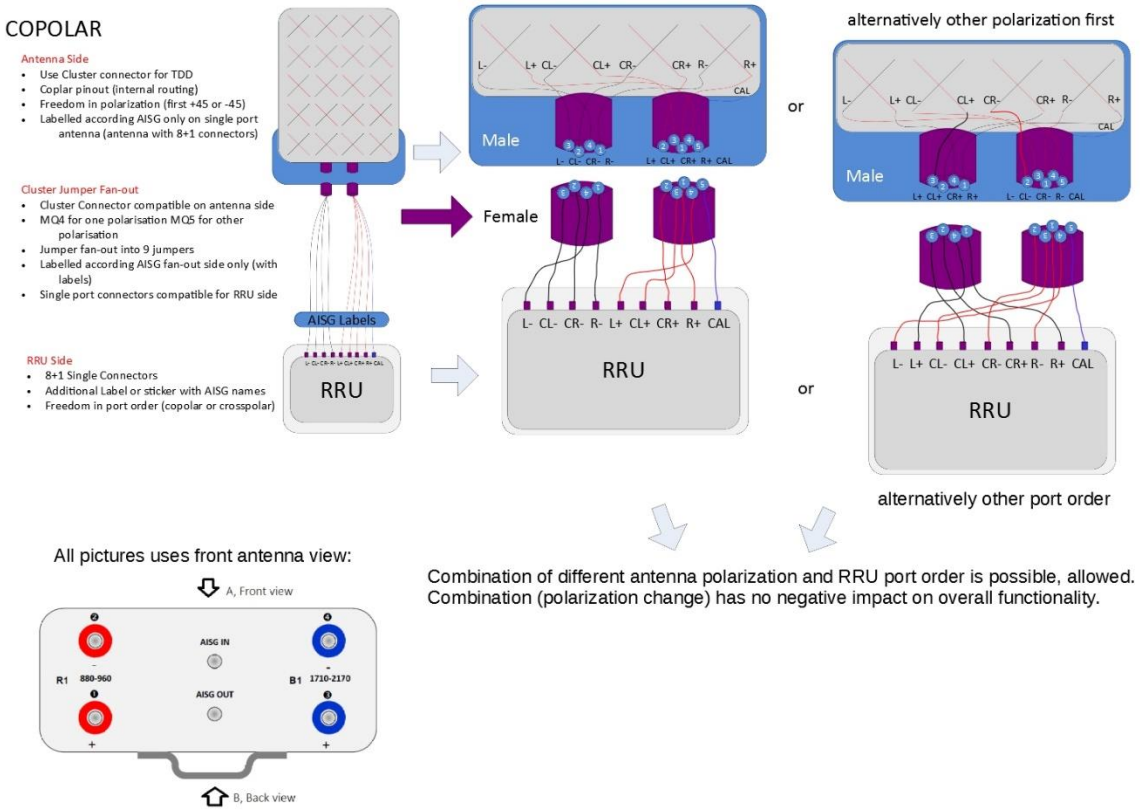


Fig 2 Co-polar RF Connection mapping

MQ Port	Antenna Port
MQ4-1	R-
MQ4-2	CR-
MQ4-3	CL-
MQ4-4	L-
MQ5-1	R+
MQ5-2	CR+
MQ5-3	CL+
MQ5-4	L+
MQ5-5	CAL

Table 1 MQ4/5 connector to antenna array mappings