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| **Change Request** | | | | | | | |
| **Document** | **ORAN-WG6.AAL-GAnP** | **ver** | **00.01.00** | **CR** | **NVD-002** | **rev** | **2** | |

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| --- | --- | --- | --- |
| ***Title:*** | O-DU AAL inline profiles for 5G eMBB Physical layer | | |
| ***Source to WG:*** | NVIDIA | | |
| ***Target WG :*** | **WG6** | | |
| ***Category:*** | **B** | ***CR Creation Date*** | October 21, 2020 |
|  | *Use one of the following* ***categories****:* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* ***F*** *(correction)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | |

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| ***Reason for Change:*** | To include O-DU AAL inline profiles for various DL and UL PHY channels/signals for 5G NR |
| ***Summary of change:*** | New text and figure are proposed and can be reviewed by track change in the text below |
| ***Consequences if not aproved:*** | If not included, O-DU AAL will lack appropriate profile definitions to support for inline acceleration |

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| ***Clauses affected:*** | <list specific document sections impacted by the CR> | | | | |
|  | **Y** | **N** |  | |  |
| ***Other specs*** |  | **X** | Other core specifications: | <fill in related CRs if “Y”> | |
| ***affected:*** |  | **x** | Test specifications: | <fill in related CRs if “Y”> | |
| ***(show related CRs)*** |  | **X** | O&M Specifications: | <fill in related CRs if “Y”> | |
| ***Supporting material:***  ***Other comments:*** | <provide file name or URL of any material supporting this CR> | | | | |

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| ***Status:*** |  | ***CR Closed Date:*** |  |
| ***Outcome:*** |  | ***Duplication:*** |  |
| ***Outcome explanation:*** |  | | |

The proposed changes are indicated by Track Changes in the text below.

# AAL Profiles

#### AAL\_PDSCH\_High-PHY

Figure 4.1.1.4-1 highlights the set of accelerated functions that defines the AAL\_PDSCH\_High-PHY profile, which includes the processing of PDSCH TB(s) and associated DM-RS.

The set of accelerated functions associated with the processing of PDSCH TB(s) is as follows:

* TB CRC attachment
* CB segmentation and CRC attachment
* LDPC encoding
* Rate Matching
* CB concatenation
* Scrambling
* Modulation
* Layer mapping
* Precoding[[1]](#footnote-2)
* RE mapping
* IQ compression1

The set of accelerated functions associated with the processing of PDSCH DM-RS is as follows:

* PDSCH DM-RS sequence generation
* Modulation
* Precoding1
* RE mapping
* IQ compression1

The AAL\_PDSCH\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY PDSCH (with 7-2x PHY functional split) and the IQ data (post processing) is transferred directly from the accelerator to the Fronthaul interface.



**Figure 4.1.1.4-1 AAL\_PDSCH\_High-PHY profile**

#### AAL\_PDCCH\_High-PHY

Figure 4.1.1.5-1 highlights the set of accelerated functions that defines the AAL\_PDCCH\_High-PHY profile, which includes the processing of PDCCH DCI and associated DM-RS.

The set of accelerated functions associated with the processing of PDCCH TB(s) is as follows:

* CRC attachment
* Polar encoding
* Rate Matching
* Scrambling
* Modulation (QPSK)
* Precoding1
* RE mapping
* IQ compression1

The set of accelerated functions associated with the processing of PDCCH DM-RS is as follows:

* PDCCH DM-RS sequence generation
* Modulation
* Precoding1
* RE mapping
* IQ compression1

The AAL\_PDCCH\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY PDCCH (with 7-2x PHY functional split) and the IQ data (post processing) is transferred directly from the accelerator to the Fronthaul interface.



**Figure 4.1.1.5-1 AAL\_PDCCH\_High-PHY profile**

#### AAL\_PBCH\_High-PHY

Figure 4.1.1.6-1 highlights the set of accelerated functions that defines the AAL\_PBCH\_High-PHY profile, which includes the processing of PBCH TB and associated DM-RS, PSS and SSS, or in other words, the processing of SSB.

The set of accelerated functions associated with the processing of PBCH TB is as follows:

* PBCH payload generation
* Scrambling
* TB CRC attachment
* Polar encoding
* Rate Matching
* Data scrambling
* Modulation (QPSK)
* Precoding1
* RE mapping
* IQ compression1

The set of accelerated functions associated with the processing of PBCH DM-RS/PSS/SSS are as follows:

* PDCCH DM-RS/PSS/SSS sequence generation
* Modulation
* Precoding1
* RE mapping
* IQ compression1

The AAL\_PBCH\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY PBCH (with 7-2x PHY functional split) along with the other components of SSB (e.g. PBCH DM-RS, PSS and SSS) and the IQ data (post processing) is transferred directly from the accelerator to the Fronthaul interface.



**Figure 4.1.1.6-1 AAL\_PBCH\_High-PHY profile**

#### AAL\_CSI-RS\_High-PHY

Figure 4.1.1.7-1 highlights the set of accelerated functions that defines the AAL\_CSI-RS\_High-PHY profile, which includes the following:

* CSI-RS sequence generation
* Modulation
* Precoding1
* RE mapping
* IQ compression1

The AAL\_CSI-RS\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY CSI-RS (with 7-2x PHY functional split) and the IQ data (post processing) is transferred directly from the accelerator to the Fronthaul interface.



**Figure 4.1.1.7-1 AAL\_CSI-RS\_High-PHY profile**

#### AAL\_PT-RS-DL\_High-PHY

Figure 4.1.1.8-1 highlights the set of accelerated functions that defines the AAL\_PT-RS-DL\_High-PHY profile, which includes the following:

* PT-RS sequence generation
* Modulation
* Precoding1
* RE mapping
* IQ compression1

The AAL\_PT-RS-DL\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY PT-RS-DL (with 7-2x PHY functional split) and the IQ data (post processing) is transferred directly from the accelerator to the Fronthaul interface.



**Figure 4.1.1.8-1 AAL\_PT-RS-DL\_High-PHY profile**

#### AAL\_PUSCH\_High-PHY

Figure 4.1.1.9-1 highlights the set of accelerated functions that defines the AAL\_PUSCH\_High-PHY profile, which includes the processing of PUSCH data (with or without UCI).

The set of accelerated functions associated with the processing of PUSCH data is as follows:

* IQ decompression1
* RE demapping
* Channel estimation
* Channel equalization
* Transform precoding (optional- only required for DFT-s-OFDM waveform)
* Demodulation
* Descrambling
* Rate dematching
* LDPC decoding
* CRC check

The AAL\_ PUSCH\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY PUSCH (with 7-2x PHY functional split). Frequency domain IQ samples are directly transferred over fronthaul interface from O-RU to the accelerator and the decoded bits (post processing) are transferred from the accelerator to L2.



**Figure 4.1.1.9-1 AAL\_PUSCH\_High-PHY profile**

#### AAL\_PUCCH\_High-PHY

Figures 4.1.1.10-1 to 4.1.1.10-3 highlight the set of accelerated functions that defines the AAL\_ PUCCH\_High-PHY profile, which includes the processing of UCI.

The set of accelerated functions associated with the processing of PUCCH UCI depends on the PUCCH format being configured by the application.[[2]](#footnote-3)

##### PUCCH format 0

The set of accelerated functions associated with the processing of PUCCH UCI using PUCCH format 0 is as follows:

* IQ decompression1
* RE demapping
* Sequence detection



**Figure 4.1.1.10-1 AAL\_PUCCH\_High-PHY profile (PUCCH format 0)**

##### PUCCH format 1

The set of accelerated functions associated with the processing of PUCCH UCI using PUCCH format 1 is as follows:

* IQ decompression1
* RE demapping
* Channel estimation
* Channel equalization
* Demodulation



**Figure 4.1.1.10-2 AAL\_PUCCH\_High-PHY profile (PUCCH format 1)**

##### PUCCH format 2/3/4

The set of accelerated functions associated with the processing of PUCCH UCI using PUCCH format 2/3/4 is as follows:

* IQ decompression1
* RE demapping
* Channel estimation
* Channel equalization
* Transform precoding (optional- only required for DFT-s-OFDM waveform)
* Demodulation
* Descrambling
* Rate dematching
* Polar/Block decoding
* CRC check



**Figure 4.1.1.10-3 AAL\_PUCCH\_High-PHY profile (PUCCH format 2/3/4)**

The AAL\_ PUCCH\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY PUCCH (with 7-2x PHY functional split). Frequency domain IQ samples are directly transferred over fronthaul interface from O-RU to the accelerator and the decoded bits (post processing) are transferred from the accelerator to L2.

#### AAL\_PRACH\_High-PHY

Figure 4.1.1.11-1 highlights the set of accelerated functions that defines the AAL\_ PRACH\_High-PHY profile.

The set of accelerated functions associated with the processing of PRACH preamble is as follows:

* IQ decompression1
* RE demapping
* Root sequence generation and correlation
* IFFT
* Noise estimation
* Peak search for power delay profile
* Preamble detection and delay/timing advance estimation



**Figure 4.1.1.11-1 AAL\_PRACH\_High-PHY profile**

The AAL\_ PRACH\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY PRACH (with 7-2x PHY functional split). Frequency domain IQ samples are directly transferred over fronthaul interface from O-RU to the accelerator and the detected preamble(s) (post processing) is/are transferred from the accelerator to L2.

#### AAL\_SRS\_High-PHY

Figure 4.1.1.12-1 highlights the set of accelerated functions that defines the AAL\_ SRS\_High-PHY profile.

The set of accelerated functions associated with the processing of SRS is as follows:

* IQ decompression1
* RE demapping
* Channel estimation



**Figure 4.1.1.12-1 AAL\_SRS\_High-PHY profile**

The AAL\_ SRS\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY SRS (with 7-2x PHY functional split). Frequency domain IQ samples are directly transferred over fronthaul interface from O-RU to the accelerator and the uplink channel estimate (post processing) is transferred from the accelerator to L2.

#### AAL\_PT-RS-UL\_High-PHY

Figure 4.1.1.13-1 highlights the set of accelerated functions that defines the AAL\_ PT-RS-UL\_High-PHY profile.

The set of accelerated functions associated with the processing of PT-RS-UL sequence is as follows:

* IQ decompression1
* RE demapping
* Sequence detection



**Figure 4.1.1.13-1 AAL\_PT-RS-UL\_High-PHY profile**The AAL\_ PT-RS-UL\_High-PHY profile is executed in inline acceleration mode, which implies that the set of accelerated functions is constituted of the entire U-plane processing of high-PHY PT-RS-UL (with 7-2x PHY functional split). Frequency domain IQ samples are directly transferred over fronthaul interface from O-RU to the accelerator and the detected sequence (post processing) is transferred from the accelerator to L2.

1. Configurable functional block, depends on implementation and/or system configuration [↑](#footnote-ref-2)
2. The PUCCH format for AAL\_PUCCH\_High-PHY profile is configurable. [↑](#footnote-ref-3)