

5G Wireline Transport over PPP  
[draft-padebettu-5g-wireline-transport-over-ppp-00](#)

Abstract

To support connecting 5G residential gateways(5G-RG) to 5G Core (5GC) over wireline access, the control packets and data packets of the 5G-RG should be transported over the wireline access network (W-AN) to Access Gateway Function(W-AGF).

The Point-to-Point Protocol (PPP) [[RFC1661](#)] provides a standard method for transporting multi-protocol datagrams over point-to-point links. PPP defines an extensible Link Control Protocol, and proposes a family of Network Control Protocols for establishing and configuring different network-layer protocols.

This document defines the 5G Wireline Control Protocol(5WCP) for establishing and configuring the 5G Wireline Data protocol(5W Data) over PPP for Wireline Access for 5G Networks. The method inherits multiplexing of traffic for multiple 5G-RGs per VLAN from PPPoE [[RFC2516](#)] and defines multiplexing multiple PDU Sessions per 5G-RG.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <https://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on March 3, 2021.

## Copyright Notice

Copyright (c) 2020 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](https://trustee.ietf.org/license-info) and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

## Table of Contents

<a href="#">1.</a>	Introduction . . . . .	<a href="#">3</a>
<a href="#">2.</a>	Requirements Language . . . . .	<a href="#">4</a>
<a href="#">3.</a>	Acronyms . . . . .	<a href="#">4</a>
<a href="#">4.</a>	5G Wireline Transport over PPP . . . . .	<a href="#">4</a>
<a href="#">4.1.</a>	5G Wireline Control Protocol for 5G AS/NAS . . . . .	<a href="#">4</a>
<a href="#">4.2.</a>	Sending 5G Wireline Datagrams . . . . .	<a href="#">6</a>
<a href="#">4.3.</a>	5G Wireline Control Protocol Procedures . . . . .	<a href="#">7</a>
<a href="#">4.3.1.</a>	5WCP Registration Procedure . . . . .	<a href="#">7</a>
<a href="#">4.3.2.</a>	5WCP De-registration Procedure . . . . .	<a href="#">8</a>
<a href="#">4.3.3.</a>	5WCP Authentication Procedure . . . . .	<a href="#">8</a>
<a href="#">4.3.4.</a>	5WCP Identity Procedure . . . . .	<a href="#">9</a>
<a href="#">4.3.5.</a>	5WCP Configuration Update Procedure . . . . .	<a href="#">9</a>
<a href="#">4.3.6.</a>	5WCP Service Request Procedure . . . . .	<a href="#">9</a>
<a href="#">4.3.7.</a>	5WCP Notification Procedure . . . . .	<a href="#">9</a>
<a href="#">4.3.8.</a>	5WCP Security Mode Procedure . . . . .	<a href="#">10</a>
<a href="#">4.3.9.</a>	5WCP UL/DL Procedure . . . . .	<a href="#">10</a>
<a href="#">4.3.10.</a>	5WCP 5GMM Status Procedure . . . . .	<a href="#">10</a>
<a href="#">4.3.11.</a>	5WCP PDU Session Establishment Procedure . . . . .	<a href="#">11</a>
<a href="#">4.3.12.</a>	5WCP PDU Session Modification Procedure . . . . .	<a href="#">11</a>
<a href="#">4.3.13.</a>	5WCP PDU Session Release Procedure . . . . .	<a href="#">12</a>
<a href="#">4.3.14.</a>	5WCP 5GSM Status Procedure . . . . .	<a href="#">12</a>
<a href="#">5.</a>	Security Considerations . . . . .	<a href="#">12</a>
<a href="#">6.</a>	IANA Considerations . . . . .	<a href="#">12</a>
<a href="#">7.</a>	Acknowledgments . . . . .	<a href="#">13</a>
<a href="#">8.</a>	References . . . . .	<a href="#">13</a>
<a href="#">8.1.</a>	Normative References . . . . .	<a href="#">13</a>
<a href="#">8.2.</a>	Informative References . . . . .	<a href="#">14</a>
	Author's Address . . . . .	<a href="#">14</a>



## 1. Introduction

Wireless Wireline convergence with 5G ("fifth generation") mobile network introduces 5G Access Gateway Function (W-AGF is defined in [TS.23.316-3GPP]) as Wireline Access Network (W-AN). W-AGF transports the Control Packets from the 5G capable Residential Gateway(5G-RG) to the 5G Control Plane(5GCP) and transports the Data Packets from the 5G-RG to the 5G User Plane Function(UPF). 5G-RG is connected to the W-AGF over the wireline access based on TR-101 [BBF.TR.101].

The wireline transport defined for the 5G-RG is based on existing wireline technologies for faster implementation and adaptation. 5G defines end-to-end QoS which requires the wireline transport to carry the 5G QoS information inline with the data.

5G NAS [TS.24.501-3GPP] is the control channel which registers, authenticates and authorizes the end-point, providing the information (IP Address, Gateway, DNS, etc. )for transporting the data from the 5G-RG over the link.

PPP has three main components:

1. A method for encapsulating multi-protocol datagrams.
2. A Link Control Protocol (LCP) for establishing, configuring, and testing the data-link connection.
3. A family of Network Control Protocols for establishing and configuring different network-layer protocols.

In order to establish communications over a point-to-point link, each end of the PPP link must first send LCP packets to configure and test the data link. After the link has been established from negotiating optional facilities as needed by the LCP, PPP must send 5G NAS control packets to choose and configure the 5G NAS network-layer protocol. Once 5G NAS has reached the Opened state, 5G datagrams can be sent over the link.

The link will remain configured for communications until explicit LCP or 5G NAS packets close the link down, or until some external event occurs (an inactivity timer expires or network administrator intervention).



## **2. Requirements Language**

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

## **3. Acronyms**

This document uses the following acronyms:

3GPP	3rd Generation Partnership Project
5GC	5th Generation Core (network)
5GCP	5G Control Plane
W-AGF	Wireline Access Gateway Function
NAS	Non-Access Stratum
PDU	Protocol Data Unit
QFI	QoS Flow Identifier
QoS	Quality of Service
RG	Residential Gateway
5G-RG	5G capable Residential Gateway
RQI	Reflective QoS Indicator
WWC	Wireless Wireline Convergence

## **4. 5G Wireline Transport over PPP**

The 5G Wireline Control Protocol (5WCP) is responsible for configuring, enabling, and disabling the 5G Wireline protocol modules on both ends of the point-to-point link. 5WCP uses the same packet exchange mechanism as the Link Control Protocol (LCP) [[RFC1661](#)]. 5WCP packets may not be exchanged until PPP has reached the Network-Layer Protocol phase. 5WCP packets received before this phase is reached MUST be silently discarded.

### **4.1. 5G Wireline Control Protocol for 5G AS/NAS**

5WCP is exactly same as the LCP [[RFC1661](#)] with the following exceptions:

#### **Data Link Layer Protocol Field**

Exactly one 5WCP packet is encapsulated in the Information field of PPP Data Link Layer frames where the Protocol field indicates type hex 80##/8037 (5G Wireline Control Protocol).

#### **Code field**



Only Codes 1 through 7 (Configure-Request, Configure-Ack, Configure-Nak, Configure-Reject, Terminate-Request, Terminate-Ack and Code-Reject) are used. Other Codes should be treated as unrecognized and should result in Code-Rejects.

#### Configuration Option Types

5WCP has no Configuration Options.

The format of 5WCP packets is defined here.

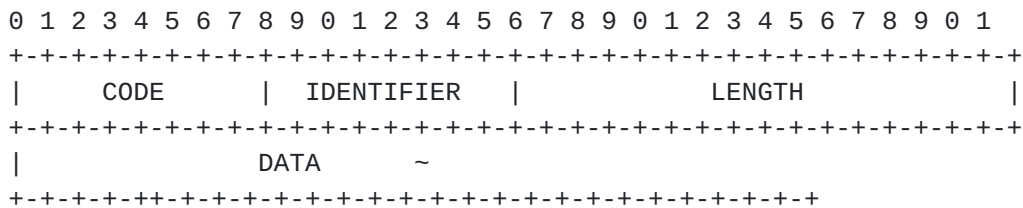


Figure 1: 5G Wireline Control Protocol Packet Format.

The description of each field is as follows:

CODE is one octet, and valid values are only 1 through 7

IDENTIFIER is one octet, and aids in matching requests and replies.

LENGTH is two octets, and is the length of the packet, including the Code, Identifier, Length and Data fields. Length MUST NOT exceed the MRU of the link.

DATA is the 5WCP Payload

The format of 5WCP Payload is defined here.

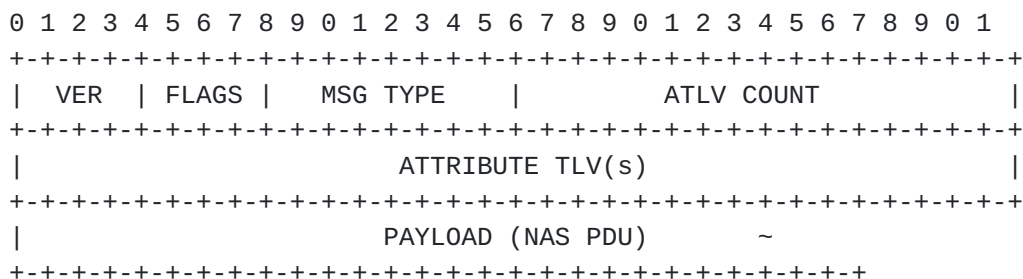


Figure 2: 5G Wireline Control Payload Format.

The description of each field is as follows:





VER is the version. It MUST be set to 1.

FLAGS is for future extensibility. It MUST be set to 0.

MSG TYPE as defined in Section 9.7 of [\[TS.24.501-3GPP\]](#)

ATLV COUNT is the total number of ATTRIBUTE TLV(s) in the header

ATTRIBUTE TLV

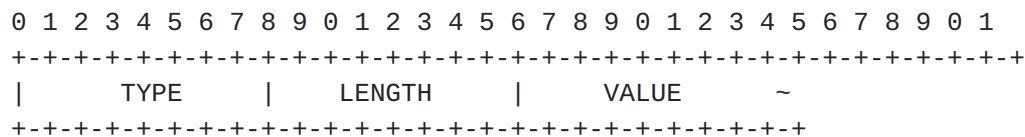


Figure 3: Attribute TLV Format.

PAYLOAD is the NAS PDU as defined in [\[TS.24.501-3GPP\]](#)

#### 4.2. Sending 5G Wireline Datagrams

Before any 5G Wireline Data packets may be communicated, PPP must reach the Network-Layer Protocol phase, and the 5G Wireline Control Protocol must reach the Opened state.

Exactly one 5G Wireline Data packet is encapsulated in the PPP Data Link Layer frames where the Protocol field indicates type hex 00## / 0037 (5G Wireline Data).

The maximum length of an IP packet transmitted over a PPP link is same as the maximum length of the Information field of a PPP data link layer frame.

The format of 5G Wireline Data is defined here.

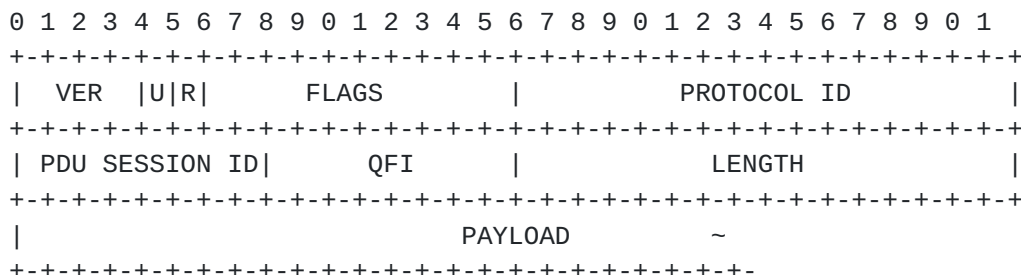


Figure 4: 5G Wireline Data Packet Format.

The description of each field is as follows:



VER is the version. It MUST be set to 1.

U is set to 1 for PDU Session of type UNSTRUCTURED as defined in Section 9.11.4.1 of [TS.24.501-3GPP]

R is set to 1 if Reflective QoS is enabled for the PDU Session

FLAGS is set to 0.

PROTOCOL ID is the 16 bit identifier of the data payload type encoded using values from the IANA PPP DLL protocol numbers registry. (<https://www.iana.org/assignments/ppp-numbers/ppp-numbers.xhtml#ppp-numbers-2>)

The following values are examples for PROTOCOL ID:

0x0021: Internet Protocol, Version 4 (IPv4)

0x0057: Internet Protocol, Version 6 (IPv6)

QFI is set to the QoS Flow Indicator.

LENGTH includes all header fields and Payload length in BYTES.

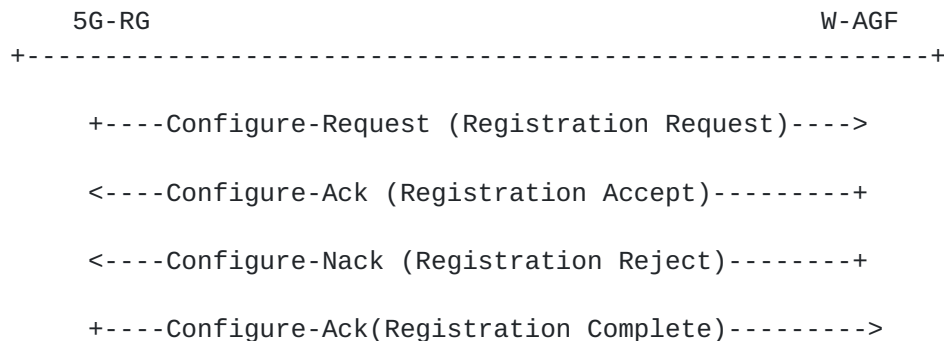
PAYLOAD is encoded as per the protocol ID.

### **4.3. 5G Wireline Control Protocol Procedures**

The following sections describe the detailed 5WCP procedures that map to 5G NAS Procedures as described in [TS.24.501-3GPP]

#### **4.3.1. 5WCP Registration Procedure**

The 5WCP Registration Procedure is described below:





#### [4.3.2.](#) 5WCP De-registration Procedure

The 5WCP De-registration Procedure is described below:

##### [4.3.2.1.](#) 5GCP initiated De-registration Procedure

```

5G-RG                                     W-AGF
+-----+
<--Terminate-Request (De-registration Request)--+
+---Terminate-Ack (De-registration Accept)----->

```

##### [4.3.2.2.](#) 5G-RG initiated De-registration Procedure

```

5G-RG                                     W-AGF
+-----+
+--Terminate-Request (De-registration Request)-->
<-----Terminate-Ack (De-registration Accept)----+

```

#### [4.3.3.](#) 5WCP Authentication Procedure

The 5WCP Authentication Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
<---Configure-Request (Authentication Request)---+
+-----Configure-Ack (Authentication Response)----->
<-----Configure-Ack (Authentication Result)-----+
+-----Configure-Nack (Authentication Failure)----->
<-----Configure-Nack (Authentication Reject)-----+

```



**4.3.4. 5WCP Identity Procedure**

The 5WCP Identity Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
<-----Configure-Request (Identity Request)-----+
+-----Configure-Ack (Identity Response)----->

```

**4.3.5. 5WCP Configuration Update Procedure**

The 5WCP Configuration Update Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
<--Configure-Request (Configuration Update Command)--+
+--Configure-Ack (Configuration Update Complete)----->

```

**4.3.6. 5WCP Service Request Procedure**

The 5WCP Service Request Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
+-----Configure-Request (Service Request)----->
<-----Configure-Ack (Service Accept)-----+
<-----Configure-Nack (Service Reject)-----+

```

**4.3.7. 5WCP Notification Procedure**

The 5WCP Notification Procedure is described below:





```

5G-RG                                     W-AGF
+-----+
<-----Configure-Request (Notification)-----+
+----Configure-Ack (Notification Response)----->

```

#### [4.3.8.](#) 5WCP Security Mode Procedure

The 5WCP Security Mode Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
<---Configure-Request (Security Mode Command)---+
+---Configure-Ack (Security Mode Complete)----->
+---Configure-Nack (Security Mode Reject)----->

```

#### [4.3.9.](#) 5WCP UL/DL Procedure

The 5WCP UL/DL Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
<-----Configure-Request (DL NAS Transport)-----+
+-----Configure-Ack ----->

+-----Configure-Request (UL NAS Transport)----->
<-----Configure-Ack -----+

```

#### [4.3.10.](#) 5WCP 5GMM Status Procedure

The 5WCP 5GMM Status Procedure is described below:



```

5G-RG                                     W-AGF
+-----+
<-----Configure-Request (5GMM Status)-----+
+-----Configure-Ack ----->

+-----Configure-Request (5GMM Status)----->
<-----Configure-Ack -----+

```

#### [4.3.11.](#) 5WCP PDU Session Establishment Procedure

The 5WCP PDU Session Establishment Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
+-Configure-Request(PDU Session Establishment Request)->
<---Configure-Ack(PDU Session Establishment Accept)----+
<---Configure-Nack(PDU Session Establishment Reject)----+

```

#### [4.3.12.](#) 5WCP PDU Session Modification Procedure

The 5WCP PDU Session Modification Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
+-Configure-Request(PDU Session Modification Request)->
<---Configure-Nack(PDU Session Modification Reject)----+

<-Configure-Request(PDU Session Modification Command)-+
+---Configure-Ack(PDU Session Modification Complete)-->
+-Configure-Nack(PDU Session Modification Cmd Reject)->

```



#### [4.3.13.](#) 5WCP PDU Session Release Procedure

The 5WCP PDU Session Release Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
+---Configure-Request(PDU Session Release Request)--->
<-----Configure-Nack(PDU Session Release Reject)-----+
<---Configure-Request(PDU Session Release Command)---+
+-----Configure-Ack(PDU Session Release Complete)----->

```

#### [4.3.14.](#) 5WCP 5GSM Status Procedure

The 5WCP 5GSM Status Procedure is described below:

```

5G-RG                                     W-AGF
+-----+
<-----Configure-Request (5GSM Status)-----+
+-----Configure-Ack ----->
+-----Configure-Request (5GSM Status)----->
<-----Configure-Ack -----+

```

### [5.](#) Security Considerations

5G NAS procedures used for session life cycle maintenance employ ciphering and integrity protection as defined in [[TS.33.501-3GPP](#)].

There is no impact on the security of a fixed access network and it will be equivalent to current practice.

### [6.](#) IANA Considerations

IANA is requested to create a registry on the Point-to-Point (PPP) Protocol Field Assignments IANA Web page as follows:



Registry Name: PPP DLL Protocol Numbers

Registration Procedure:

0xxx-3xxx	IETF Review	Network Layer Protocols
8xxx-bxxx	IETF Review	Network Control Protocols

Code-Points

Value (in hex)	Protocol Name	Reference
0037	5G Wireline Data	[This Document]
8037	5G Wireline Control	[This Document]

## 7. Acknowledgments

Some of the text in this document is taken from previous documents produced by the Point-to-Point Protocol Working Group of the Internet Engineering Task Force (IETF).

The author would also like to thank Ron Bonica for all his help and John Gibbons for reviewing the document.

## 8. References

### 8.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in [RFC 2119](#) Key Words", [BCP 14](#), [RFC 8174](#), DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.
- [RFC1661] Simpson, W., Ed., "The Point-to-Point Protocol (PPP)", STD 51, [RFC 1661](#), DOI 10.17487/RFC1661, July 1994, <<https://www.rfc-editor.org/info/rfc1661>>.
- [TS.24.501-3GPP] 3rd Generation Partnership Project (3GPP), "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3, 3GPP TS 24.501 v16.5.1", July 2020.





[TS.24.007-3GPP]

3rd Generation Partnership Project (3GPP), "Wireless and wireline convergence access support for the 5G System (5GS) v16.3.0", July 2020.

## **8.2. Informative References**

[RFC1332] McGregor, G., "The PPP Internet Protocol Control Protocol (IPCP)", [RFC 1332](#), DOI 10.17487/RFC1332, May 1992, <<https://www.rfc-editor.org/info/rfc1332>>.

[RFC2516] Mamakos, L., Lidl, K., Evarts, J., Carrel, D., Simone, D., and R. Wheeler, "A Method for Transmitting PPP Over Ethernet (PPPoE)", [RFC 2516](#), DOI 10.17487/RFC2516, February 1999, <<https://www.rfc-editor.org/info/rfc2516>>.

[TS.23.501-3GPP]

3rd Generation Partnership Project (3GPP), "System Architecture for 5G System; Stage 2, 3GPP TS 23.501 v16.5.1", August 2020.

[TS.23.502-3GPP]

3rd Generation Partnership Project (3GPP), "Procedures for the 5G System (5GS); 3GPP TS 23.502 v16.5.1", August 2020.

[TS.23.316-3GPP]

3rd Generation Partnership Project (3GPP), "Wireless and wireline convergence access support for the 5G System (5GS) v16.4.0", July 2020.

[TS.33.501-3GPP]

3rd Generation Partnership Project (3GPP), "Security architecture and procedures for 5G System, 3GPP TS 33.501 v16.3.0", July 2020.

[BBF.TR.101]

Broadband Forum (BBF), "Migration to Ethernet-Based Broadband Aggregation, BBF TR 101 issue:2", July 2011.

## **Author's Address**

Venkatesh Padebettu  
Juniper Networks Inc.  
Exora Business Park  
Bangalore, KA 560103  
India

Email: [vpadebettu@juniper.net](mailto:vpadebettu@juniper.net)

