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PPP-Alternative Protocol (AltPPP) for cdma2000 Wireless IP Network Standard

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REVISION HISTORY

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FOREWORD

(This foreword is not part of this Standard.)

This document was prepared by 3GPP2 TSG-X.

This document contains details of an optimized method to perform PPP connection establishment for cdma2000 wireless IP network. The optimizations are summarized as follows:

- a. The capability to allow the Mobile Station and the Packet Data Serving Node to perform PPP connection establishment procedures in 3 to 4 steps.
- b. The ability to perform PPP Link Control Protocol and Network Control Protocol authentication and configuration option exchanges simultaneously to speed up the PPP connection establishment process.
- c. The ability to perform both IPv4 and IPv6 address configurations simultaneously.
- d. Provides fallback option to regular PPP in case of error during AltPPP procedures or to accommodate legacy Mobile Stations.

The AltPPP protocol is designed to significantly improve PPP connection establishment performance at the initial packet data session establishment for cdma2000 wireless IP networks. After the PPP connection is successfully established, regular PPP protocol is used to maintain, modify, and tear down the packet data session.

SCOPE

This document defines the AltPPP protocol for packet data session setup for cdma2000 wireless IP networks.

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1 Introduction

The Third Generation Partnership Project 2 (3GPP2) defines the Wireless IP Network Standard [1] for the packet data networking on cdma2000^{®1} wireless system. The document [1] defines that establishing and configuring IPv4/v6 connections between the MS and the PDSN are exclusively based on the PPP protocols such as LCP, IPCP and IPv6CP. Authenticating the mobile user over the PPP link is performed by PAP or CHAP.

On the one hand PPP is capable of operating across diverse links and nodes, and there are many configuration options and extensions defined for supporting a large variety of services over PPP. On the other hand, the negotiation scheme in PPP may be too conservative and time consuming in the cases when connection setup time is of utmost importance.

The Alternate PPP Protocol (AltPPP) as specified in this document provides a method for negotiating the link establishment, the authentication status and configuration of other parameters such as IP address, by not using regular LCP and NCP but using a simple negotiation mechanism to reduce the PPP connection setup time.

¹ cdma2000[®] is the trademark for the technical nomenclature for certain specifications and standards of the Organizational Partners (OPs) of 3GPP2. Geographically (and as of the date of publication), cdma2000[®] is a registered trademark of the Telecommunications Industry Association (TIA-USA) in the United States.

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2 References

2.1 Normative References

This section provides references to other specifications and standards that are necessary to implement this document.

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. ANSI and TIA maintain registers of currently valid national standards published by them.

- [RFC1661] IETF RFC 1661, the Point-to-Point Protocol (PPP), July 1994.
- [1] 3GPP2: X.S0011-D v1.0, cdma2000 Wireless IP Network Standard, March 2006.
- [RFC2153] IETF RFC 2153, PPP Vendor Extensions, May 1997.

2.2 Informative References

This section provides references to other documents that may be useful for the reader of this document.

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3 Definitions, Symbols and Abbreviations

This section contains definitions, symbols and abbreviations that are used throughout the document.

3.1 Definitions

3.1.1 Symbols and Abbreviations

AAA	Authentication, Authorization, and Accounting
AltPPP	Alternate PPP Protocol
LCP	Link Control Protocol
NCP	Network Control Protocol
PPP	Point to Point Protocol
CHAP	CHallenge Authentication Protocol
PAP	Password Authentication Protocol
PDSN	Packet Data Serving Node
MS	Mobile Station
ROHC	RObust Header Compression
VJ	Van Jacobson (Header Compression)

4 Protocol Highlights

Existing LCP, PAP/CHAP and NCP: IPCP/IPv6CP are replaced with AltPPP during the initial PPP connection setup. In the best-case scenario, after establishment of the lower-layer connection (i.e. A10 connection), only 3 AltPPP messages are needed for the mobile station to connect to the PDSN. AltPPP supports both IPv4 and IPv6 as the network layer protocol.

AltPPP is an optional feature for both the MS and the PDSN.

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5 AltPPP Overview

This document defines the initial connection setup mechanism between the MS and the PDSN as an alternative from of PPP connection setup. Once the network protocol(s) has (have) been opened, regular PPP protocols are used, that is, termination and additional negotiation are performed by regular LCP and NCP. In other words, a new state machine for AltPPP is used during the PPP connection setup. Once the connection is opened, the standard PPP state machine is used. IP datagram is transmitted over HDLC-like framing specified in RFC1662 (PPP in HDLC-like Framing). If the MS or the PDSN detects that the peer does not support AltPPP protocol, it does not proceed with the AltPPP negotiation but start existing PPP based procedures starting from the LCP phase.

The message format of the AltPPP protocol is compliant with RFC 2153 (PPP Vendor Extensions) and this document defines AltPPP negotiation procedures using the vendor specific part of RFC 2153. In AltPPP, following assumptions are made:

- a. A PPP link and network protocols are opened without LCP and NCP negotiations after AltPPP completes in both the MS and PDSN.
- b. If the both ends (MS and PDSN) can use the same option configuration/sub-options or the PDSN can live within the options that the MS has proposed, the values and options that the MS has proposed will be used except the followings:
 - IP address option: The MS only proposes the IP address options for the MS. The PDSN sends IP address to be assigned to the MS as well as informing PDSN's address.
 - DNS address option: The PDSN assigns the DNS addresses via this option.

This document defines following 4 messages. The Detailed operations and formats are described in section 7 and section 8, respectively.

AltPPP Sync:

The AltPPP Sync message is sent by the PDSN. This message contains the CHAP authentication option along with the challenge value . The EAP option is not used in the AltPPP.

AltPPP Request:

The AltPPP Request message is sent by the MS. This message is sent in response to the AltPPP Sync message. This message contains authentication data such as user name and Challenge response (or password) in addition to LCP, CCP, IPCP and/or IPv6CP configuration options the MS intends to negotiate with the PDSN. Multiple options/Sub options that are supported by the MS can be included in this message.

AltPPP Reply:

The AltPPP Reply message is sent by the PDSN. This message is sent in response to the AltPPP Request message. The accepted/successful options are sent. The PDSN may propose alternative configuration options/sub-options. If authentication is required, the AltPPP Reply message contains Authentication Ack or Failure.

AltPPP Ack:

The AltPPP Ack message is sent by the MS. This message is sent in response to the AltPPP Reply message only if alternative configuration options or sub-options are included in the AltPPP Reply message (A bit is set). This message indicates the alternative options or sub-options proposed by the PDSN are acceptable to the MS and the PPP is successfully established at the MS.

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6 Message Flows

6.1 Successful Connection Setup

The following figure shows the successful connection setup scenario with AltPPP when the PDSN chooses the configuration options from the list of configuration options proposed by the MS (A bit is not set in the AltPPP Reply message).

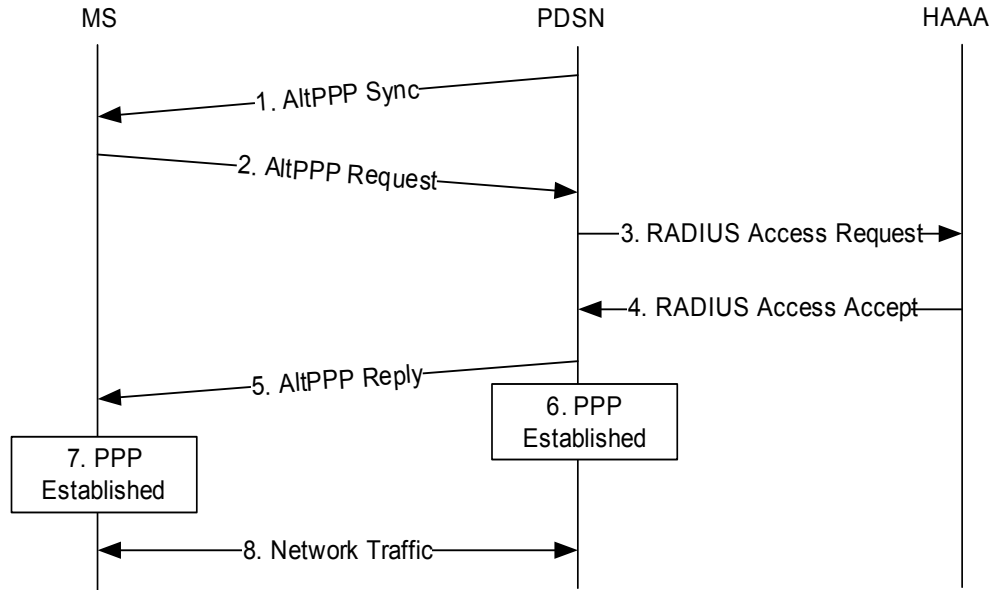


Figure 1 Typical call flow for three-message method

1. The PDSN sends the CHAP authentication option and a Challenge value in the AltPPP Sync message to the MS.

2. The MS sends authentication information and configuration options, e.g. ROHC and VJ as header compression options and 0.0.0.0 for IP address. The MS only includes options (and sub-options) that it can support. It is assumed that the PDSN supports a superset of options (and sub-options) that the MS supports.

3. The PDSN sends the RADIUS Access Request to the HAAA.

4. The HAAA sends the RADIUS Access Accept to the PDSN. 5. The PDSN replies with the acceptable configuration options chosen from MS's indicated options. The PDSN assigns IPv4 address x.x.x.x and VJ options, assuming that the PDSN does not support ROHC in this example. In this case, the PDSN indicates to the MS that an AltPPP Ack message is not required by not setting the A-bit. (See section 8)

6. After PDSN sends the AltPPP Reply w/o setting the A-bit, it reaches the PPP open state.

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7. The MS accepts the configuration options in the AltPPP Reply. After it receives the AltPPP Reply message, it reaches the PPP open state.
8. The PDSN and MS can exchange the network traffic. The PDSN can know the MS successfully configure a PPP link when it receives IP packets from the MS.

The diagram below illustrates the establishment of a data link with an exchange of four messages when the PDSN proposes alternative configuration options/sub-options (A bit is set in the AltPPP Reply message).

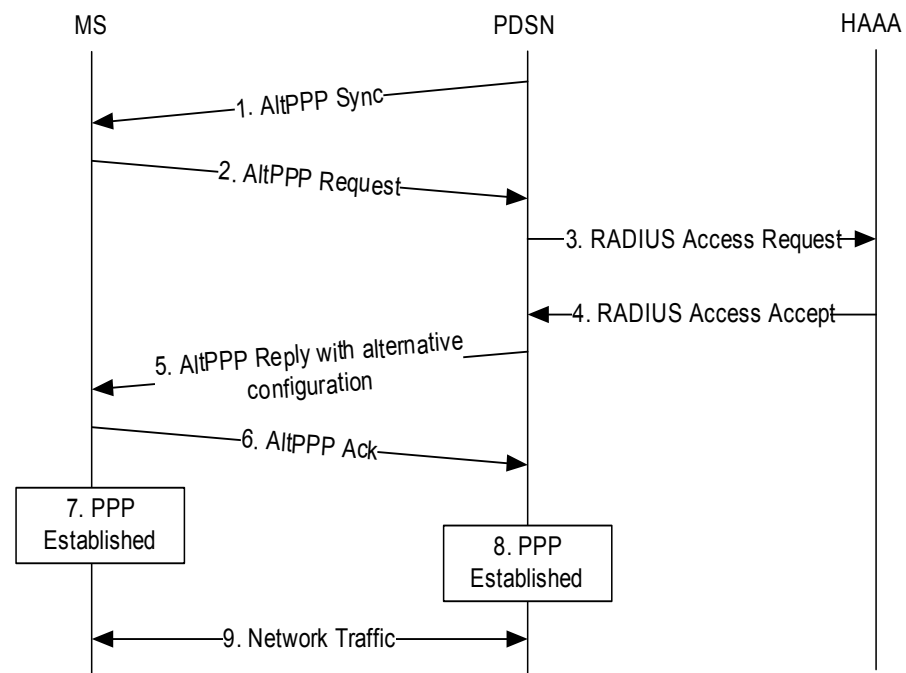


Figure 2 Call flow when the PDSN needs to propose alternative configuration

1. The PDSN sends the CHAP authentication option and a Challenge value in the AltPPP Sync message to the MS.
2. The MS sends authentication information and configuration options, e.g. ROHC and VJ as header compression options and 0.0.0.0 for IP address. The MS does not send unacceptable configuration options.
3. The PDSN sends the RADIUS Access Request to the HAAA.
4. The HAAA sends the RADIUS Access Accept to the PDSN.
5. The PDSN replies with the acceptable configuration options chosen from MS's indicated options and/or alternative configurations, such as alternative sub-options or configuration options for the forward link. The PDSN assigns IPv4 address x.x.x.x and VJ options with alternative sub-options, assuming that the PDSN does not support ROHC and prefers other

sub-options for VJ in this example. In this case, the PDSN indicates to the MS that an AltPPP Ack message is required by setting A-bit. This is necessary since the PDSN is not sure whether the alternative option(s) (and/or sub-options) proposed in the AltPPP Reply message is acceptable to the MS or not.

6. If the MS accepts alternative configurations proposed by the PDSN, it sends the AltPPP Ack to the PDSN. The MS reaches the PPP open state. If the MS does not accept the PDSN's proposals, the MS sends the AltPPP request soliciting another AltPPP Reply message (not shown in the call flow).

7. After MS sends the AltPPP Ack, it reaches the PPP open state.

8. After PDSN receives the AltPPP Ack, it reaches the PPP open state.

9. The PDSN and MS can exchange the network traffic.

6.2 Successful Connection Setup for HRPD using Protocol ID and Service Option

Operators may use a Protocol ID and Service Option [the latest version of C.R1001] to distinguish whether MS is capable of AltPPP before PDSN initiates the AltPPP connection setup procedure. This option is only applicable to the HRPD system.

The following figure shows the successful connection setup scenario with AltPPP in HRPD network using new Protocol ID and Service Option.

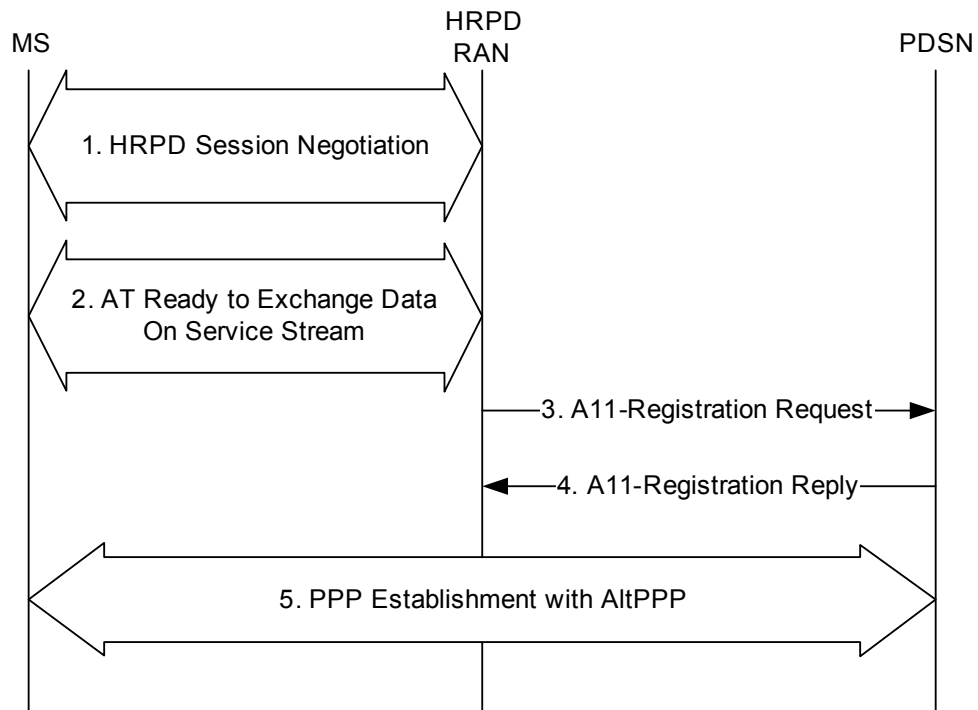


Figure 3 Successful connection scenario using new Protocol ID and Service Option

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1. The MS and HRPD RAN negotiate a HRPD session with Protocol ID 0x06 for AltPPP [C.R1001] with the HRPD RAN as a higher layer protocol or a flow protocol..
2. The MS indicates that it is ready to exchange data on the service stream. Note that this step may occur at any time after step 1.
3. The HRPD RAN sends the A11-Registration Request with Service Option 71 for AltPPP [C.R1001] to the PDSN.
4. The PDSN sends the A11-Registration Reqlly to the HRPD RAN. At this point, the PDSN knows the MS supports AltPPP.
5. The PDSN starts a PPP session establishment with AltPPP (see section 6.1).

6.3 Fallback Case

This section describes the fallback cases, when the either the MS is not AltPPP capable or the PDSN is not AltPPP capable.

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6.3.1 The MS Does Not Support AltPPP

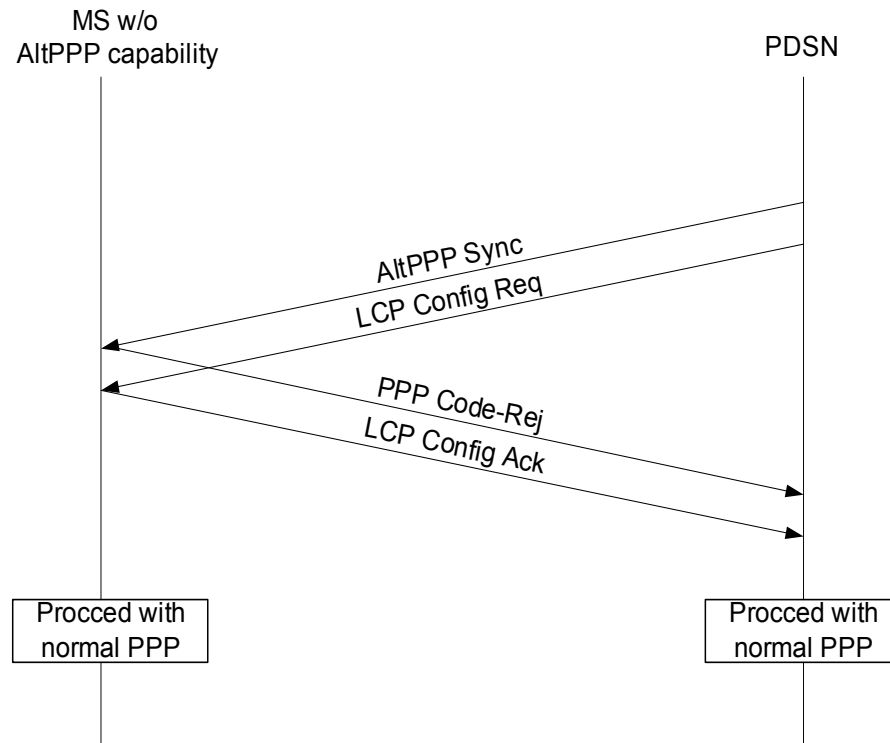


Figure 4 The Fallback Scenario, MS does not support AltPP

1. As soon as the PDSN detects that the main A10 connection is established with a MS and it needs to establish a PPP connection, the PDSN sends an AltPPP Sync message. The PDSN also sends a LCP Configure Request message along with the AltPPP sync message. Both packets are included in the same GRE frame over the A10 connection. The MS receives the AltPPP Sync message and soon after receives the LCP Configure Request message.

2. In this case, the MS is not a AltPPP capable device. Therefore, it will not recognize the AltPPP Sync packet as a valid LCP or NCP packet. As per normal PPP protocol operation the MS sends a PPP Code-Reject packet back to the PDSN if it does not support the PPP vendor specific packet. The Code-Reject packet is formatted as per section 5.6 of RFC 1661. If the MS supports the 3GPP2 vendor specific packets, but it does not support AltPPP, it replies with a 3GPP2 vendor specific packet with Kind value set to 0 indicating AltPPP rejection. Upon receiving the Code-Reject packet or the 3GPP2 vendor specific packet with Kind = 0, the PDSN abandons the AltPPP procedure and proceed with normal PPP procedures. The MS also sends LCP Configure Ack to the PDSN in response to the LCP Configure Request received from the PDSN. The normal PPP setup procedure continues from this point.

6.3.2 PDSN Does Not Support AltPPP

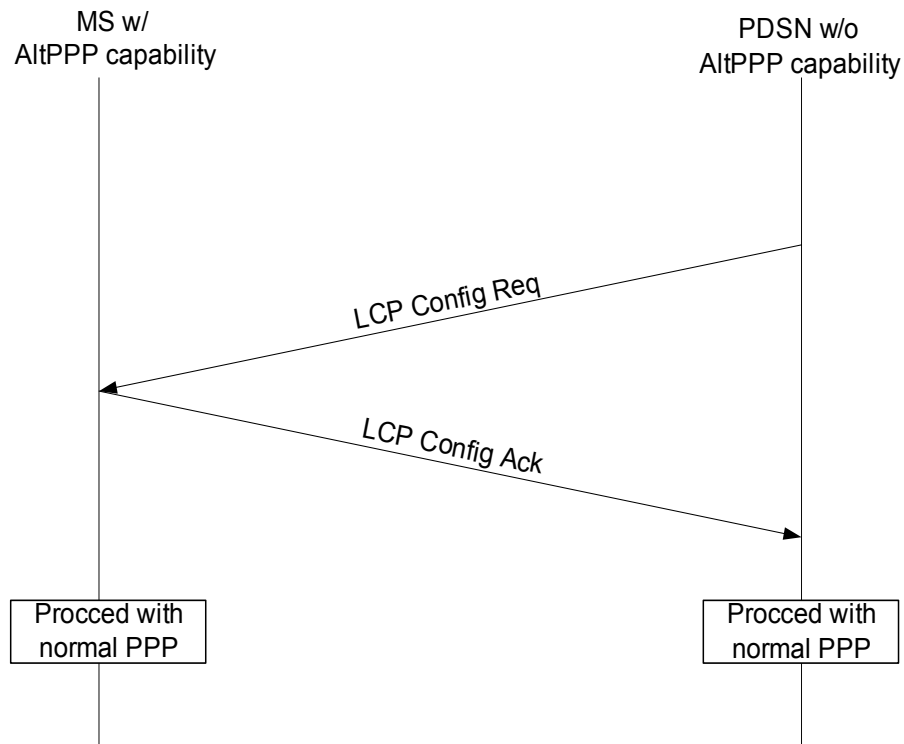


Figure 5 The Fallback Scenario, PDSN does not support AltPPP

1. As soon as the PDSN detects that the main A10 connection is established with a MS and it needs to establish a PPP connection, the PDSN sends an LCP Config Request message as required by [1]. The MS awaits the AltPPP Sync message. But it receives the LCP Configure Request message first.

2. The MS assumes that the PDSN is not an AltPPP capable device or the AltPPP Sync message has been lost in the middle of the link. In this case, the MS immediately begins the normal PPP procedure as required by [1].

7 AltPPP Protocol Description

Figure 7 shows the overview of the phase diagram of AltPPP protocol. Requirements for the MS and the PDSN are described in following sections.

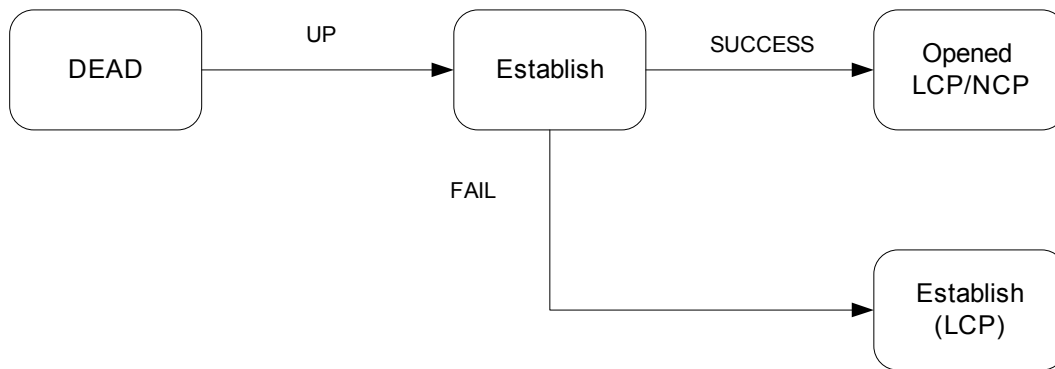


Figure 6 The AltPPP Protocol Phases

Dead Phase: In this phase the MS and the PDSN have not begun the PPP link establishment.

Establish Phase: In this phase the PDSN and the MS have begun the PPP link setup procedure using AltPPP. If the AltPPP procedure is successful, the endpoints transition to the Opened LCP/NCP phase. Otherwise, the endpoints transition to the Establish LCP phase to begin normal PPP link setup procedure.

Opened LCP/NCP phase: In this phase both the end points have reached the PPP open state and are ready to exchange upper layer datagram.

Establish LCP: In this phase the end points begin normal PPP link setup procedure.

The Normal PPP messages if received by either peer are processed using the Normal PPP procedures (RFC 1661). The Normal PPP procedures are out scope of this document and follows RFC 1661.

7.1 The PDSN Requirements

If the PDSN supports AltPPP, the requirements described in this section and subsections shall apply in addition to the requirements in [1].

Figure 7 shows the state transition diagram in the PDSN. The detail of this state transition diagram is shown in section 9.

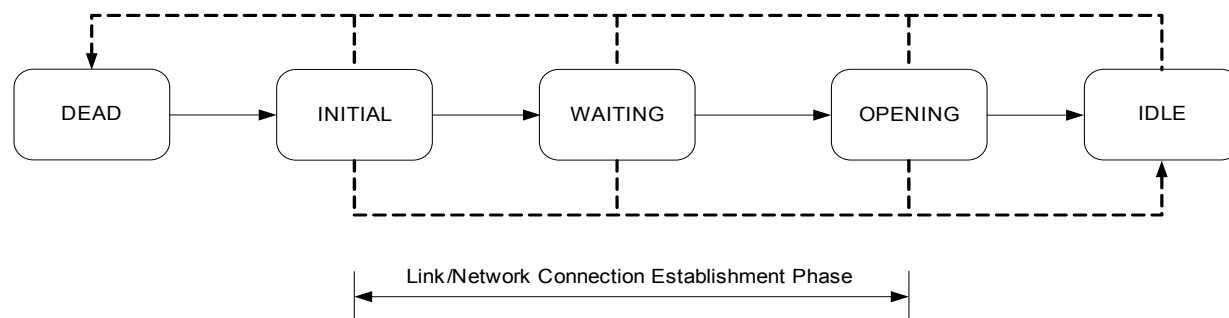


Figure 7 The AltPPP Protocol Phases in the PDSN

The PDSN may decide to stop the AltPPP negotiation at any time in the Link/Network Connection Establishment Phase.

Depending on the operator's policy, the PDSN may be configured to use Service Option 71 for AltPPP operation. In this case, the PDSN shall not start the AltPPP procedure unless it receives Service Option 71 in the A11-Registration Request.

7.1.1 DEAD State

The PDSN shall remain in this state when the main A10 connection is not established for the MS. After the main A10 connection has been established, the PDSN shall transition to the INITIAL state.

7.1.2 INITIAL State

The PDSN shall transition to this state when the main A10 is established for a MS. The PDSN shall send an AltPPP Sync message to the MS and transition to the WAITING state.

The AltPPP Sync message shall contain the CHAP authentication option and the challenge value. The PDSN shall not include EAP option in the AltPPP Sync message.

The PDSN should send a LCP Configure-Request message to the MS immediately after the AltPPP Sync message. If the PDSN sends a LCP Configure-Request message along with the AltPPP Sync message, it shall include the Magic-number option in the LCP Configure-Request message. This is to support the MS which does not support AltPPP protocol. The message format and retransmission procedure of the LCP Configure-Request is PPP compliant (RFC1661) and out of the scope of this document.

The AltPPP Sync message shall be sent before the LCP Configure-Request message to avoid the MS that supports the AltPPP protocol to start the Normal PPP procedure. The AltPPP Sync message and the LCP Configure-Request message shall be concatenated and sent in one GRE frame over the A10 interface to avoid any delay in the PPP connection setup.

7.1.3 WAITING State

The PDSN shall transition to this state upon sending the AltPPP Sync message and optionally the LCP Configure-Request message to the MS. At this state, the PDSN shall wait for the AltPPP Request message from the MS. This state has following two sub-states. The details are described in the following sections:

- a. WAITING INITIAL: In this state, the PDSN waits for the AltPPP Request message from the MS.
- b. WAITING NEGOTIATION: In this state, the PDSN waits for the AltPPP Request message or AltPPP Ack message from the MS after sending an AltPPP Reply message proposing alternative configuration options with A bit set (see section 8).

7.1.3.1 WAITING_INITIAL Sub-state

The PDSN shall transition to this sub-state after sending the first AltPPP Sync message to the MS. In this state, the PDSN shall wait for the AltPPP Request message from the MS.

If the PDSN receives the AltPPP Request message from the MS, the PDSN shall stop the Normal PPP state machine if it has sent the LCP Configure Request to the MS. If authentication is required, the PDSN shall send the RADIUS Access-Request message to the AAA server. The PDSN shall extract the authentication information from the AltPPP Request message and set the RADIUS attributes in the RADIUS Access-Request message as required in [1].

If the MS includes the PAP option, user name and password in the AltPPP Request message, the PDSN shall accept the PAP authentication.

If the PDSN receives the AltPPP Request message from the MS with acceptable options and the authentication is successfully performed (if it is required), it shall send the AltPPP Reply message including acceptable options without A-bit set, and transit to the OPENING State.

If the PDSN receives the AltPPP Request message from the MS with un-acceptable parameters and the authentication is successfully performed (if it is required), it shall send the AltPPP Reply message with A-bit set proposing alternative option configurations and acceptable options, and transit to the WAITING NEGOTIATION state. Alternatively, the PDSN may send the AltPPP Reply with no TLV to indicate the termination of AltPPP procedures.

The criteria of un-acceptable parameters of the AltPPP Request message from the MS depend on operators' policy.

When the MS sends an IP address option with 0.0.0.0, the PDSN shall assign an IP address. In this case, the PDSN does not have to set A bit in the AltPPP Reply message.

If the PDSN needs to tell its IP address to the MS, the PDSN shall send an IP address option in the AltPPP reply message. If the MS requests the IP address assignment, the PDSN shall send two IP address options sending MS's IP address first and PDSN's address second. In this case, the PDSN does not have to set A bit in the AltPPP Reply message.

If the authentication is failed, the PDSN shall send the AltPPP Reply message with the appropriate authentication option (e.g. CHAP) indicating failure and the A-bit set to zero. The PDSN shall not perform option/sub-option negotiation with A-bit set in the AltPPP Reply message.

When a timeout occurs before receiving the AltPPP Request message from the MS, the PDSN should retransmits the AltPPP Sync message for configurable number of times. The procedure of retransmission should follow the regular PPP messages retransmission. The PDSN may use a retransmission procedure based on operators' policy.

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If the LCP Configure-Request message is received from the MS, the PDSN shall stop the AltPPP procedure and move to the IDLE state. The PDSN shall continue the normal PPP procedure in that case. The PDSN shall not send any AltPPP protocol messages during LCP, Authentication and NCP phases. If the PDSN has not sent the LCP Configure Request with AltPPP Sync message initially, it shall send a LCP Configure-Request message to the MS.

7.1.3.2 WAITING_NEGOTIATION Sub-state

The PDSN shall transition to this sub-state after sending the AltPPP Reply message to the MS with the A-bit set. In this state, the PDSN shall wait for the AltPPP Ack message or the AltPPP Request message including further alternative proposals from the MS.

If the PDSN receives the AltPPP Ack message, it shall open the Normal PPP with options negotiated over AltPPP and transition to the IDLE State.

If the PDSN receives the AltPPP Request message, the PDSN shall perform the same procedure as described in the WAITING INITIAL state.

In the case of the timeout of receiving AltPPP Ack or AltPPP Request message from the MS, the PDSN should retransmit the AltPPP Reply message.

The PDSN shall have the mechanism to avoid the Reply-Request-Loop between the PDSN and the MS, i.e., it continues that the PDSN sends the AltPPP Reply message with A-bit set and the MS responds with the AltPPP Request message. The procedure of checking the Reply-Request-Loop is out of scope of this document. If the Reply-Request-Loop is detected, the PDSN should send the AltPPP Reply with no TLV.

7.1.4 OPENING State

a. The PDSN shall transition to this state when it receives the AltPPP Request message from the MS with acceptable options and it has sent the AltPPP Reply without A-bit set.

The PDSN shall start the WAIT_ALTPPP_OPEN timer. While this timer is running, the PDSN anticipates the AltPPP Request message from the MS¹. If the PDSN receives the AltPPP Request message from the MS with acceptable options, it shall resend the AltPPP Reply message including acceptable options without A-bit set and restart the WAIT_ALTPPP_OPEN timer. If the PDSN receives an IPv4 or IPv6 packet from the MS while the WAIT_ALTPPP_OPEN timer is running, the PDSN shall transition to the IDLE STATE. When the WAIT_ALTPPP_OPEN timer expires, the PDSN shall transition to the IDLE state. The WAIT_ALTPPP_OPEN time should be configured so that the PDSN can receive retransmitted AltPPP messages appropriately. The typical value of the retransmission timer is 1 to 3 sec.

7.1.5 IDLE State

The PDSN enters into this state from the WAITING_NEGOTIATION sub state or the OPENING state after opening the PPP state machine due to one of the following reasons:

- a. The PDSN received the AltPPP Ack message from the MS.
- b. The WAIT_ALTPPP_OPEN timer expired.

¹ The PDSN may receive another AltPPP Request message with acceptable config options from the MS if the previously sent AltPPP Reply message was lost.

- c. The PDSN received IPv4 or IPv6 packets from the MS while the WAIT_ALTPPP_OPEN timer is running.

The PDSN shall immediately open the Normal PPP (i.e. LCP and NCPs) with options negotiated over AltPPP. The PDSN may send IP packets in this state. If needed the PDSN may send Mobile IPv4 Agent Advertisement or IPv6 Router Advertisement to the MS at this time.

In this state the PDSN and the MS shall not send AltPPP messages and silently discard received AltPPP messages if received.

7.2 The MS Requirements

If the MS supports AltPPP, the requirements described in this section and subsections shall apply in addition to the requirements in [1].

Figure 8 shows the state transition diagram in the MS. The detail of the state transition diagram is shown in Section 9.2.

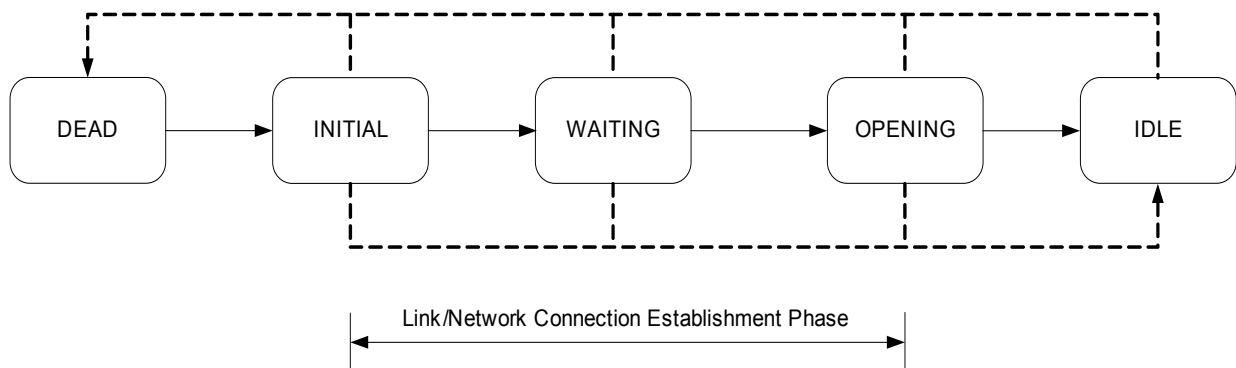


Figure 8 The AltPPP Protocol Phases in the MS

The MS may decide to stop the AltPPP negotiation at any time in the Link/Network Establishment Phase and begin normal PPP procedure.

The MS may support Protocol ID 0x06 for AltPPP operation.. If the HRPD RAN does not support the Protocol ID 0x06, the Protocol ID for normal PPP is used. Regardless of the Protocol ID 0x06 is successfully negotiated or not, the MS may use the AltPPP if the PDSN starts the PPP negotiation with AltPPP.

7.2.1 DEAD State

The MS remains in this state when no packet data session (no link layer) has been established between the MS and PDSN. The AltPPP procedure has not been started.

7.2.2 INITIAL State

The MS shall transition to this state when the lower layer link is up. The MS starts the AltPPP procedures.

The MS shall start the timer (WAIT_ALTPPP_SYNC) and wait for an AltPPP Sync message from the PDSN without sending any packets. If the MS receives the LCP Configure-Request

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message from the PDSN during the WAIT_ALTPPP_SYNC, the MS shall start the normal PPP procedure.

If the WAIT_ALTPPP_SYNC expires, the MS shall stop the AltPPP procedure (move to the IDLE state) and send an LCP Configure-Request message to the PDSN. This will begin normal PPP negotiation. The WAIT_ALTPPP_SYNC timer should be configured less than 3 seconds.

If the MS receives the AltPPP Sync message from the PDSN, the MS shall stop the WAIT_ALTPPP_SYNC timer, and send an AltPPP Request message to the PDSN with the acceptable configuration options (LCP, CCP, IPCP and/or IPv6CP configuration options) for the MS. If the authentication is required, the MS shall include the authentication information in the AltPPP Request message. If the MS wants to use PAP, it shall also include the PAP option in the AltPPP Request message. If the authentication is not required, the MS shall not include any authentication option or information. After sending the AltPPP Request message the MS shall transit to the WAITING state.

If MS receives the LCP Configure Request message after receiving the AltPPP Sync message without detecting the mobility (i.e., SID/NID/PZID or Subnet change), the MS should store the value of the Magic number in the LCP Configure Request during the AltPPP processing. The MS shall not perform any further actions to this LCP Configure Request (i.e. the MS shall not initiate normal PPP)

7.2.3 WAITING State

The MS shall transition to this state when it has sent the AltPPP Request message back to the PDSN. In this state the MS waits for the AltPPP Reply message from the PDSN.

If the MS receives the AltPPP Reply message with accepted configuration options from the PDSN without A-bit set, the MS shall open the Normal PPP with options negotiated over AltPPP and transition to the IDLE state.

If the MS receives the AltPPP Reply message with A-bit set, the MS shall examine if the PDSN has proposed any alternative config options. If yes, the MS shall verify whether PDSN's alternative proposals are acceptable or not. If the proposals are acceptable, the MS shall send an AltPPP Ack message to the PDSN and transition to the OPENING state. . If the alternative config options are not acceptable, the MS may send the AltPPP Request proposing further alternative proposals to the PDSN and stay in this state.

If the MS has requested an IP address assignment (for Simple IP) and receives two IP address options in the AltPPP reply message, the MS shall consider the first IP address as the address assigned to itself and the second is the address of the PDSN.

If the MS has not requested the IP address assignment (for Mobile IP) and receives an IP address option in the AltPPP reply message, the MS shall consider the IP address as the address of the PDSN.

If the timeout of receiving the AltPPP Reply message occurs, the MS shall retransmit the same AltPPP Request message.

If the maximum number of retransmissions for the AltPPP Request message has exceeded, the MS shall send a close event to the Normal PPP (i.e. sends PPP Terminate-Request).

If the MS receives the AltPPP Reply message with no-TLV, it shall consider the PPP establishment procedure using AltPPP has failed.

If the MS receives the LCP Configure-Request message from the PDSN with detecting the mobility (i.e., Magic-number, SID/NID/PZID or Subnet change) in this state, the MS shall stop the AltPPP phase (move to the IDLE state) and shall start normal PPP procedure. The MS shall use the Magic-number contained in the LCP Configure Request for mobility detection. If the Magic-number is different from the one stored in the MS, the MS shall consider the LCP Configure

Request is sent from a PDSN other than the one it initially communicated with. The MS shall not send any AltPPP protocol messages if the new PDSN sent an LCP config request.

If the MS receives the AltPPP Reply message with the authentication option indicating failure, it shall consider the PPP establishment procedure using AltPPP has failed.

7.2.4 OPENING State

The MS shall transition to this state after it sends the AltPPP Ack message to the PDSN. In this state the mobile shall start the WAIT_ALTPPP_OPEN timer. While this timer is running, the MS anticipates the AltPPP Reply message with A-bit set from the PDSN¹. If the MS receives the AltPPP Reply message with A-bit set, the MS shall send an AltPPP Ack message to the PDSN and restart the WAIT_ALTPPP_OPEN timer. If the MS receives an IPv4 or IPv6 packet from the PDSN while the WAIT_ALTPPP_OPEN timer is running, the MS shall transition to the IDLE STATE. When the WAIT_ALTPPP_OPEN timer expires, the MS shall transition to the IDLE state.

7.2.5 IDLE State

The MS shall transition to this state due to one of the following reasons:

- a. The WAIT_ALTPPP_OPEN timer expired.
- b. The MS received IPv4 or IPv6 packets from the PDSN while the WAIT_ALTPPP_OPEN timer is running.
- c. The MS receives the AltPPP Reply message without A-bit set.

In this state the MS shall immediately open the normal PPP state machine with the configuration options negotiated over AltPPP. The MS may send IP packets in this state. In this state, AltPPP messages shall not be sent by the MS. If the MS receives an AltPPP Sync message from the PDSN, it shall respond to the PDSN with a AltPPP Request message as specified in section 7.2.2. If the AltPPP reply message is received, the MS shall silently discard it.

Each the received Normal PPP message is processed by the Normal PPP procedures. This is out scope of this document and it follows RFC 1661.

¹ The MS may receive another AltPPP Reply message with A-bit set from the PDSN if the previously sent AltPPP Ack message was lost.

8 Message Format

The AltPPP uses the PPP vendor specific packet as defined in RFC 2153 to configure the AltPPP messages. The AltPPP messages shall be sent as LCP packets with PPP Protocol ID set to C021 (hex) the format is shown in Figure 9.

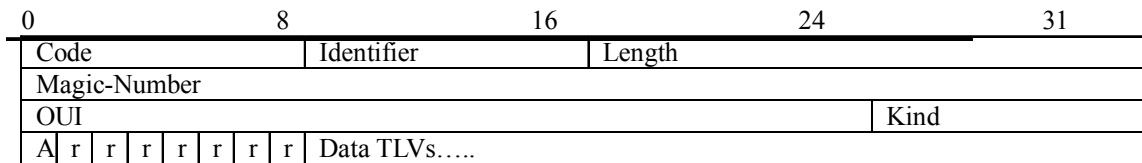


Figure 9 The AltPPP Message Format

Code

0

Identifier

The Identifier field shall be changed for each Vendor Specific Packet sent.

Length

≥ 13 (octets)

Magic-Number

The Magic-Number field is four octets and aids in detecting links that are in the looped-back condition. Until the Magic-Number Configuration Option has been successfully negotiated, the Magic-Number shall be transmitted as zero. See the Magic-Number Configuration Option for further explanation.

OUI

0xCF0002 (3GPP2)

Kind

4: Sync
5: Request
6: Reply
7: Ack

A: Acknowledgement request bit

0: AltPPP Ack message is not required.
1: AltPPP Ack message is required.

r: Reserved bits

Data TLVs:

The Data TLVs field is zero or more octets, as indicated by the Total Length Field. The format of the Data TLVs field is specified in Figure 10. An AltPPP message may carry more than one Data TLV field.

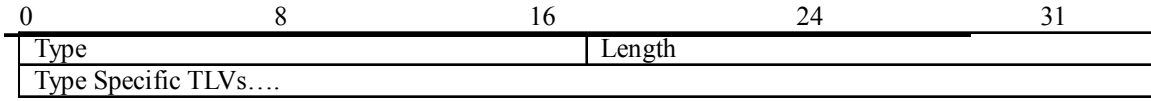


Figure 10 The AltPPP Data TLV format

Type:

The Type field is two octets. PPP Protocol Values for options that this Data TLV encapsulates is identified. For example, LCP is c021.

Length:

The Total Length field is two octets, and indicates the length of the Data TLV Field, including Type, Length Type Specific TLVs field.

Type Specific TLVs:

The format for this field is the same as the protocol options that are associated with the PPP protocol in the type field. Data TLV field may carry more than one type specific TLVs.

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9 Detailed State Transition Diagrams

This section shows the detailed state transitions for the PDSN and the MS. Not all state transitions for error cases are shown.

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9.1 State Transitions in the PDSN

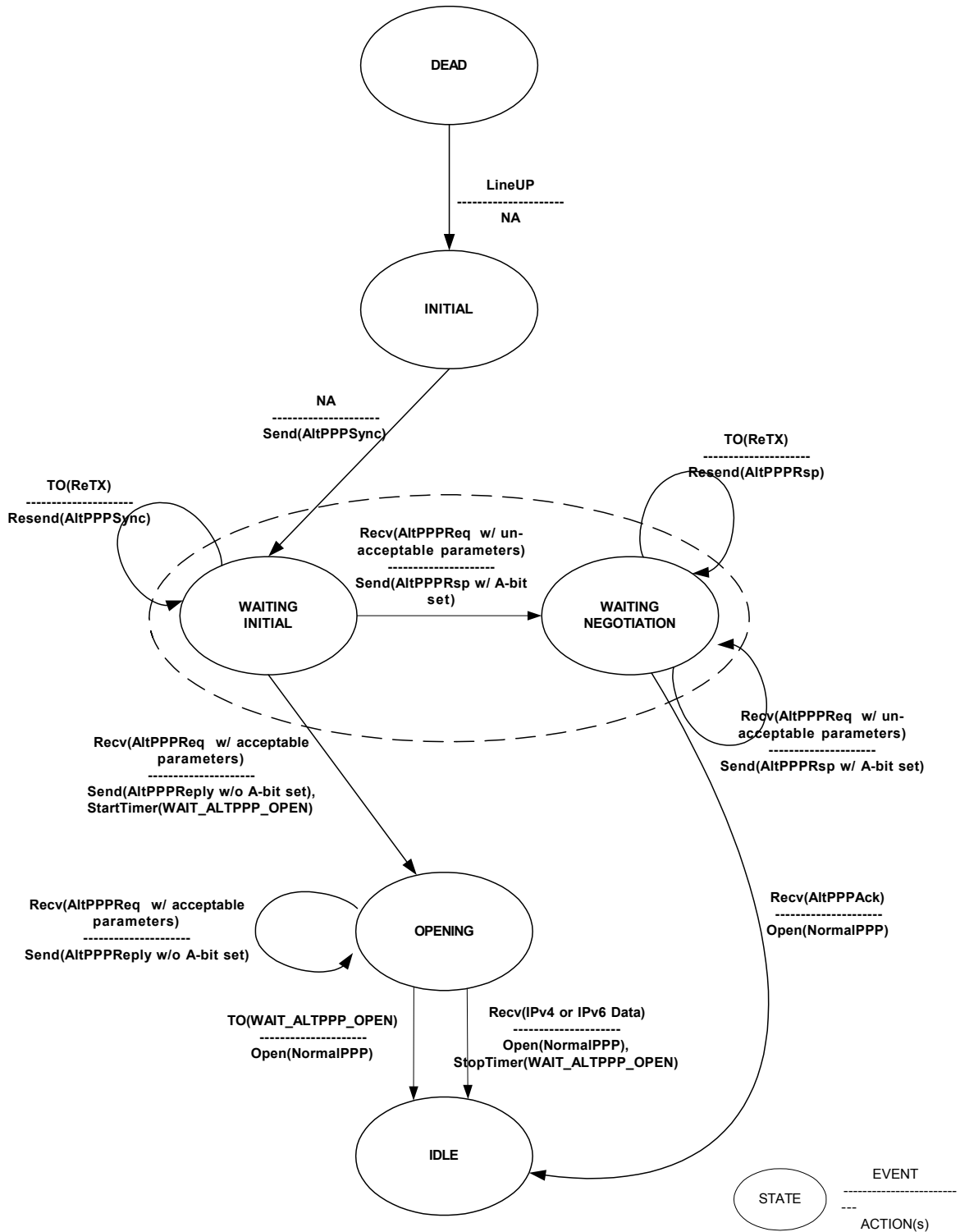
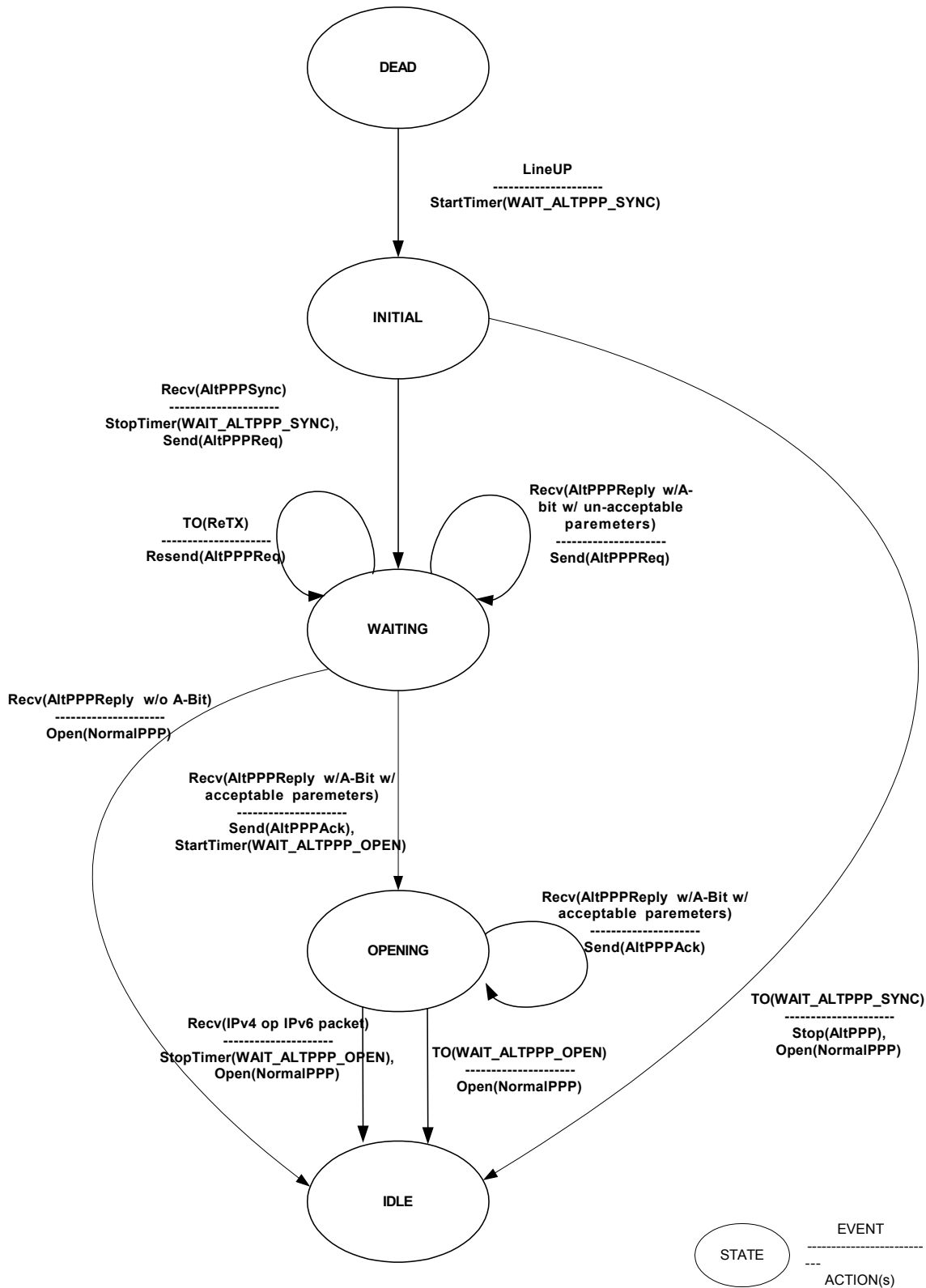


Figure 11 Detailed state transition in the PDSN

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9.2 State Transitions in the MS



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Figure 12 Detailed state transition in the MS

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