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PPP Challenge Handshake Authentication Protocol (CHAP)

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Abstract

The Point-to-Point Protocol (PPP) [1] provides a standard method for transporting multi-protocol datagrams over point-to-point links.

PPP also defines an extensible Link Control Protocol, which allows negotiation of an Authentication Protocol for authenticating its peer before allowing Network Layer protocols to transmit over the link.

This document defines a method for Authentication using PPP, which uses a random Challenge, with a cryptographically hashed Response which depends upon the Challenge and a secret key.

Table of Contents

1. Introduction

In order to establish communications over a point-to-point link, each end of the PPP link must first send LCP packets to configure the data link during Link Establishment phase. After the link has been established, PPP provides for an optional Authentication phase before proceeding to the Network-Layer Protocol phase.

By default, authentication is not mandatory. If authentication of the link is desired, an implementation MUST specify the Authentication-Protocol Configuration Option during Link Establishment phase.

These authentication protocols are intended for use primarily by hosts and routers that connect to a PPP network server via switched circuits or dial-up lines, but might be applied to dedicated links as well. The server can use the identification of the connecting host or router in the selection of options for network layer negotiations.

This document defines a PPP authentication protocol. The Link Establishment and Authentication phases, and the Authentication-Protocol Configuration Option, are defined in The Point-to-Point Protocol (PPP) [1].

1.1. Specification of Requirements

In this document, several words are used to signify the requirements of the specification. These words are often capitalized.

MUST — This word, or the adjective "required", means that the definition is an absolute requirement of the specification.

MUST NOT — This phrase means that the definition is an absolute prohibition of the specification.

SHOULD — This word, or the adjective "recommended", means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications must be understood and carefully weighed before choosing a different course.

MAY — This word, or the adjective "optional", means that this item is one of an allowed set of alternatives. An implementation which does not include this option MUST be prepared to interoperate with another implementation which does include the option.

1.2. Terminology

This document frequently uses the following terms:

authenticator
: The end of the link requiring the authentication. The authenticator specifies the authentication protocol to be used in the Configure-Request during Link Establishment phase.

peer
: The other end of the point-to-point link; the end which is being authenticated by the authenticator.

silently discard
: This means the implementation discards the packet without further processing. The implementation SHOULD provide the capability of logging the error, including the contents of the silently discarded packet, and SHOULD record the event in a statistics counter.

2. Challenge-Handshake Authentication Protocol

The Challenge-Handshake Authentication Protocol (CHAP) is used to periodically verify the identity of the peer using a 3-way handshake. This is done upon initial link establishment, and MAY be repeated anytime after the link has been established.

1. After the Link Establishment phase is complete, the authenticator sends a "challenge" message to the peer.

2. The peer responds with a value calculated using a "one-way hash" function.

3. The authenticator checks the response against its own calculation of the expected hash value. If the values match, the authentication is acknowledged; otherwise the connection SHOULD be terminated.

4. At random intervals, the authenticator sends a new challenge to the peer, and repeats steps 1 to 3.

2.1. Advantages

CHAP provides protection against playback attack by the peer through the use of an incrementally changing identifier and a variable challenge value. The use of repeated challenges is intended to limit

the time of exposure to any single attack. The authenticator is in control of the frequency and timing of the challenges.

This authentication method depends upon a "secret" known only to the authenticator and that peer. The secret is not sent over the link.

Although the authentication is only one-way, by negotiating CHAP in both directions the same secret set may easily be used for mutual authentication.

Since CHAP may be used to authenticate many different systems, name fields may be used as an index to locate the proper secret in a large table of secrets. This also makes it possible to support more than one name/secret pair per system, and to change the secret in use at any time during the session.

2.2. Disadvantages

CHAP requires that the secret be available in plaintext form. Irreversably encrypted password databases commonly available cannot be used.

It is not as useful for large installations, since every possible secret is maintained at both ends of the link.

> Implementation Note: To avoid sending the secret over other links in the network, it is recommended that the challenge and response values be examined at a central server, rather than each network access server. Otherwise, the secret SHOULD be sent to such servers in a reversably encrypted form. Either case requires a trusted relationship, which is outside the scope of this specification.

2.3. Design Requirements

The CHAP algorithm requires that the length of the secret MUST be at least 1 octet. The secret SHOULD be at least as large and unguessable as a well-chosen password. It is preferred that the secret be at least the length of the hash value for the hashing algorithm chosen (16 octets for MD5). This is to ensure a sufficiently large range for the secret to provide protection against exhaustive search attacks.

The one-way hash algorithm is chosen such that it is computationally infeasible to determine the secret from the known challenge and response values.

Each challenge value SHOULD be unique, since repetition of a challenge value in conjunction with the same secret would permit an attacker to reply with a previously intercepted response. Since it is expected that the same secret MAY be used to authenticate with servers in disparate geographic regions, the challenge SHOULD exhibit global and temporal uniqueness.

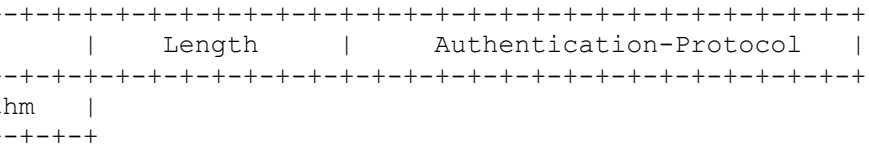
Each challenge value SHOULD also be unpredictable, least an attacker trick a peer into responding to a predicted future challenge, and then use the response to masquerade as that peer to an authenticator.

Although protocols such as CHAP are incapable of protecting against realtime active wiretapping attacks, generation of unique unpredictable challenges can protect against a wide range of active attacks.

A discussion of sources of uniqueness and probability of divergence is included in the Magic-Number Configuration Option [1].

3. Configuration Option Format

A summary of the Authentication-Protocol Configuration Option format to negotiate the Challenge-Handshake Authentication Protocol is shown below. The fields are transmitted from left to right.



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