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Triggering DHCPv6 Reconfiguration from Relay Agents

Abstract

This document defines two new DHCPv6 messages: Reconfigure-Request and Reconfigure-Reply. The Reconfigure-Request message is sent by a DHCPv6 relay agent to notify a DHCPv6 server about a configuration information change, so that the DHCPv6 server can send a Reconfigure message accordingly. The Reconfigure-Reply message is used by the server to acknowledge the receipt of the Reconfigure-Request message.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc6977.

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1. Introduction

This document specifies two new DHCPv6 messages [RFC3315]: Reconfigure-Request and Reconfigure-Reply.

Section 3 describes a typical problem scenario encountered that triggers the DHCPv6 server to issue a Reconfigure message when the configuration data is supplied by the relay agent. This problem may be encountered in other contexts. It is out of scope of this document to list all these cases.

Section 4 describes the proposed solution that relies on the use of Reconfigure-Request and Reconfigure-Reply messages. The Reconfigure-Request message is sent by a DHCPv6 relay agent to notify a DHCPv6 server about a configuration-information change, so that the DHCPv6 server can send a Reconfigure message accordingly. The Reconfigure-Reply message is used by the server to acknowledge the receipt of Reconfigure-Request.

Section 5 specifies the Link Address Option used by the relay agent to indicate the link on which the client is located to the server.

Section 6 provides the detailed specification of the procedure to trigger Reconfigure messages by DHCPv6 relay agents.

2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

3. Problem Statement

For cases where the DHCPv6 relay agent possesses some information that would be useful to the DHCPv6 client, [RFC6422] specifies a mechanism whereby the DHCPv6 relay agent can provide such information to the DHCPv6 server, which can, in turn, pass this information on to the DHCP client. This is achieved by use of RSOO (Relay-Supplied Options option), which carries configuration data to the DHCPv6 server. The data conveyed in an RSOO is then sent back by the DHCPv6 server to the requesting DHCPv6 client.

An example of RSOO usage is shown in Figure 1; only a subset of exchanged DHCPv6 and RADIUS messages is represented. Figure 1 shows a broadband network scenario in which the Network Access Server (NAS) embeds a DHCPv6 relay agent.

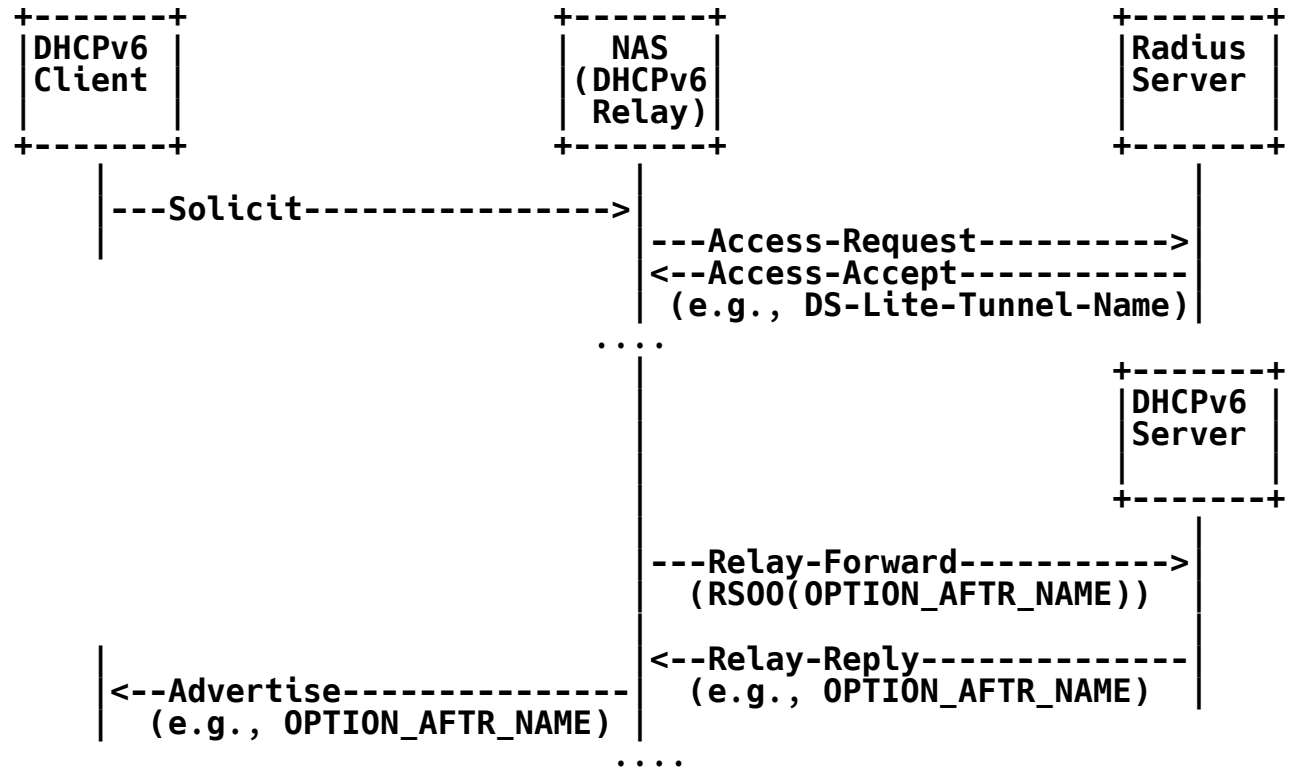

Figure 1: An Example of the RSOO Usage

A configuration change may result in an exchange of CoA (Change-of-Authorization) [RFC5176] messages between the NAS/DHCPv6 relay agent and Dynamic Authorization Client (DAC) server as shown in Figure 2. In this example, the NAS answers with a CoA-Ack message to notify the DAC that the CoA-Request has been successfully handled.

Note that the change of the configuration in the DHCPv6 relay agent can be triggered by any other out-of-band mechanism.

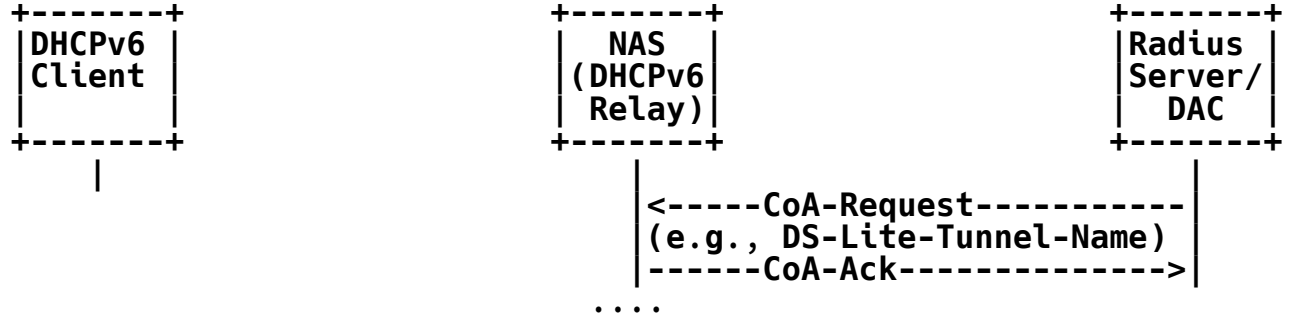

Figure 2: Change of Configuration

Whenever the configuration information sent by the DHCPv6 relay agent to the DHCPv6 server changes, the DHCPv6 server has no means of detecting the change so that it can send a Reconfigure message accordingly. A solution is sketched in Section 4.

4. Solution Overview

To solve the problem described in Section 3, this document proposes a new DHCP message called Reconfigure-Request. In the example depicted in Figure 3, a Reconfigure-Request message is sent by the DHCPv6 relay agent to a DHCPv6 server as soon as the configuration data conveyed in an RSOO has changed. Upon receipt of this message, and if it is configured to support such a mode, the DHCPv6 server must build Reconfigure-Reply and Reconfigure messages. Reconfigure-Reply is used to acknowledge the receipt of Reconfigure-Request. The Reconfigure message encapsulated in Relay-Reply is sent to the DHCPv6 relay, which in turn will forward the message to the appropriate DHCPv6 client.

This setup assumes the relay has a record of the client, so that it has enough information to send the Reconfigure-Request message to the server. How the state is recorded in the relay is out of scope of this document. For better resilience of the proposed solution, means to recover state in the event of failure (e.g., use of stable storage, DHCPv6 Bulk Leasequery [RFC5460]) need to be supported. These state recovery solutions are not discussed in this document.

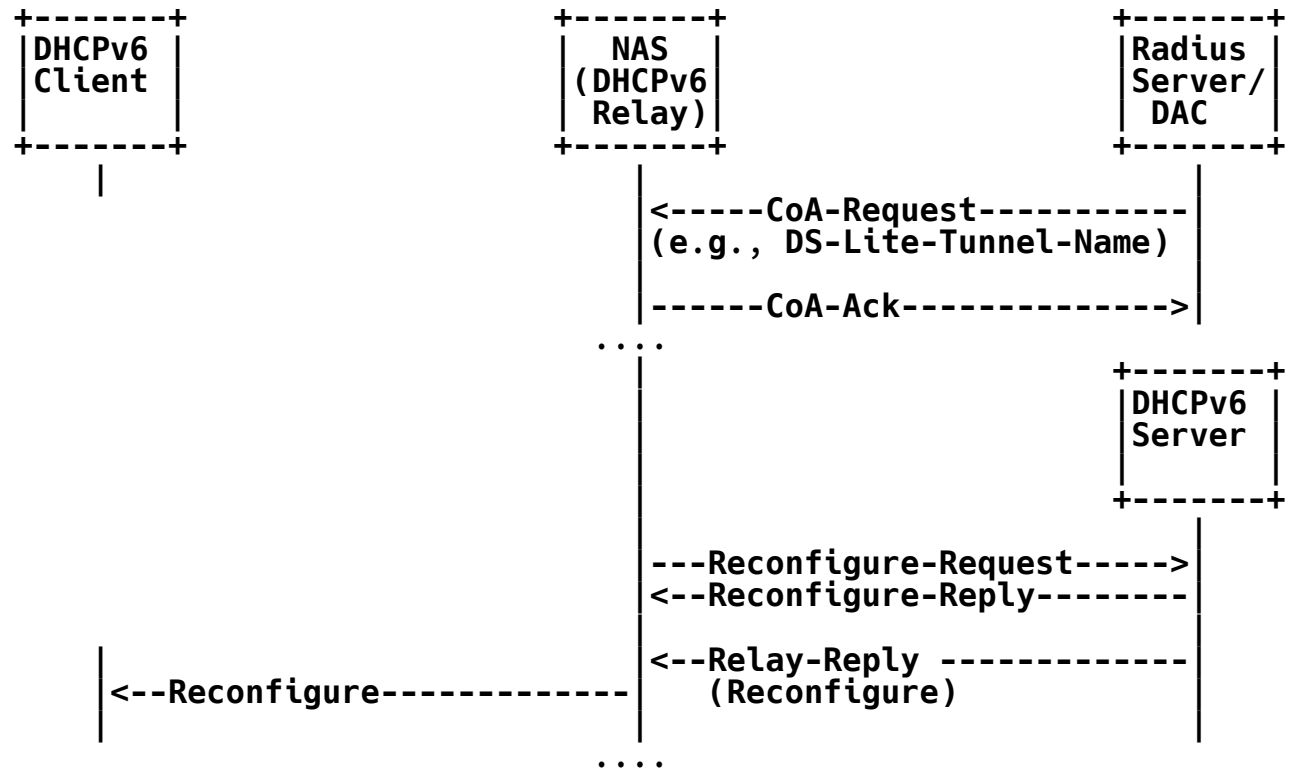

Figure 3: Flow Example with Reconfigure-Request

The support of Reconfigure-Reply messages simplifies the retransmission procedure of the relay as it provides an explicit indication from the server (see Section 6.3 for more details). An alternative approach is the relay monitors' Reconfigure messages received from the server to conclude whether or not the Reconfigure-Request was successfully handled. Nevertheless, this implicit approach may fail to achieve its goals in some cases: for example, the server accepts the request but it delays generating the corresponding Reconfigure messages due to its rate-limiting policies, the request was partially failed for some clients, etc. To avoid useless reconfigure cycles (e.g., due to the loss of Reconfigure-Reply messages), the approach adopted in this document allows the relay to correct the content of a retransmitted Reconfigure-Request based on some observed events (e.g., the client has retrieved the updated configuration). If the relay has no client to be reconfigured, it stops sending Reconfigure-Request messages.

The Reconfigure-Request message can also be used in scenarios other than those that assume the use of RSOO. It is out of scope of this document to describe all these scenarios.

5. Link Address Option

Figure 4 shows the format of the Link Address Option.

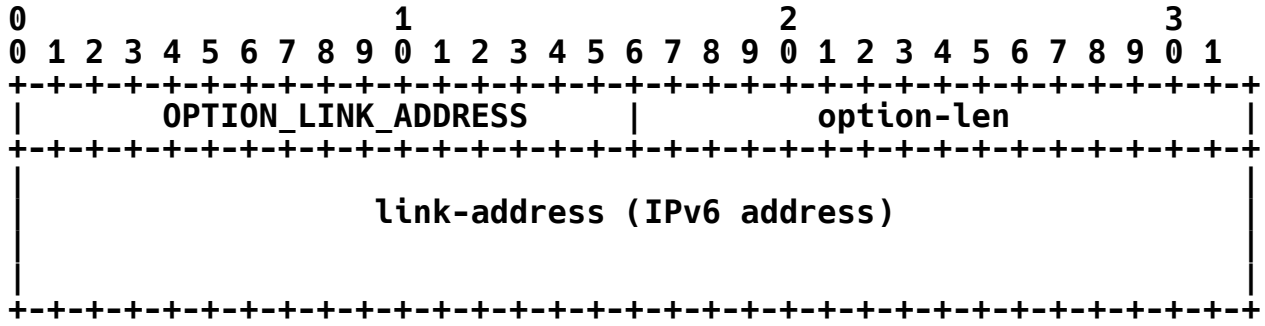

Figure 4: Message Format of Link Address Option

The description of the fields are as follows:

option-code: OPTION_LINK_ADDRESS (80)

option-len: 16 (octets)

link-address: An IPv6 address used by the server to identify the link on which the client is located.

The Link Address Option is used by the relay agent to indicate to the server the link on which the client is located. The relay agent MUST use a link-address value that is equivalent to the value used when relaying messages from the client to the server. Two link-address values are said to be equivalent if both values are IPv6 addresses that are on-link for the network link to which the client is connected.

To defend against poor implementations that do not correctly evaluate equivalence, the relay agent SHOULD use the same value that was sent to the DHCPv6 server when relaying messages from the client to the server, as in Section 20.1.1 of [RFC3315].

6. Detailed Specification

6.1. Messages Format

Two new message type codes are defined:

- RECONFIGURE-REQUEST (18)
- RECONFIGURE-REPLY (19)

Reconfigure-Request and Reconfigure-Reply use the same format as defined in Section 6 of [RFC3315].

6.2. Messages Validation

6.2.1. Reconfigure-Request

Clients MUST silently discard any received Reconfigure-Request messages.

Servers MUST discard any received Reconfigure-Request messages that meet any of the following conditions:

- the message does not include a Client Identifier Option [RFC3315].
- the message does not include a Link Address Option (Section 5).
- the message includes a Server Identifier Option [RFC3315] but the contents of the Server Identifier Option do not match the server's identifier.

6.2.2. Reconfigure-Reply

Clients and servers MUST silently discard any received Reconfigure-Reply messages.

The relay MUST silently discard any received Reconfigure-Reply messages that meet any of the following conditions:

- the "transaction-id" field in the message does not match the value used in the original message.
- the message does not include a Server Identifier Option.
- the message does not include a Status Code Option [RFC3315].

6.3. Creation and Transmission of a Reconfigure-Request

For any event (e.g., modification of the configuration information) that requires the server to issue a Reconfigure message, the relay agent determines the client(s) affected by the change and then builds a Reconfigure-Request message: the relay agent sets the "msg-type" field to RECONFIGURE-REQUEST, generates a transaction ID, and inserts it in the "transaction-id" field.

The relay agent MUST include one or more Client Identifier Options [RFC3315] and a Link Address Option (Section 5) so that the DHCPv6

server can identify the corresponding client and the link on which the client is located.

The relay agent MAY include a Relay Identifier Option [RFC5460].

The relay agent MAY supply the updated configuration in the RSOO [RFC6422]. The relay agent MAY supply a Reconfigure Message Option to indicate which form of Reconfigure to use. The relay agent MAY include any option (e.g., Interface Identifier [RFC3315]) that it might insert when relaying a message received from a client.

When several clients on the same link are affected by a configuration change, the relay MUST include several Client Identifier Options; each of these options identifies a specific client. If including the Client Identifier Options of all impacted clients exceeds the maximum message size (see Section 7), the relay MUST generate several Reconfigure-Request messages required to carry all Client Identifier Options. Rate-limit considerations are discussed in Section 7.

The relay sets the destination address of the Reconfigure-Request message to the IP address it would have sent a Relay-Forward message (see Section 20 of [RFC3315]).

In case multiple servers are configured to the relay agent, several Reconfigure-Request messages are to be built. The behavior of the relay agent to disambiguate responses when multiple servers are configured is implementation specific. For example, an implementation may generate a distinct "transaction-id" per server while another implementation may use the content of the "transaction-id" field and the Server Identifier Option to disambiguate the responses.

The relay transmits Reconfigure-Request messages according to Section 14 of [RFC3315], using the following parameters:

```
IRT (Initial retransmission time):      1 sec
MRT (Maximum retransmission time):     10 secs
MRC (Maximum retransmission count):     5
MRD (Maximum retransmission duration):  0
```

The relay MAY remove clients from the client identifier list in subsequent retransmissions, but MUST NOT add clients to the client identifier list. This decision is local to the relay (e.g., it may be based on observed events such as one or more clients were reconfigured on their own).

The relay may receive Reconfigure encapsulated in Relay-Reply before Reconfigure-Reply. The relay SHOULD NOT interpret it as if the

Reconfigure-Request was successfully handled by the server. The relay SHOULD use Reconfigure-Reply, not the Reconfigure message, to determine if the request was successful (see the discussion in Section 4).

6.4. Intermediate Relay Agents Behavior

The relay agent MUST be configurable to accept or reject Reconfigure-Request messages received from other relay agents. If no indication is explicitly configured to the relay, the default behavior is to accept Reconfigure-Request messages.

If the relay is configured not to allow Reconfigure-Request messages, the relay MUST silently discard any Reconfigure-Request message it receives. If the relay is configured to accept Reconfigure-Request messages, these messages are relayed as specified in Section 20.1.1 of [RFC3315].

6.5. Server Behavior

The server MUST be configurable to accept or reject Reconfigure-Request messages. If no indication is explicitly configured to the server, the default behavior is to reject Reconfigure-Request messages.

Upon receipt of a valid Reconfigure-Request message from a DHCPv6 relay agent (see Section 6.2), the server determines the client(s) for which a Reconfigure message is to be sent.

The server constructs a Reconfigure-Reply message by setting the "msg-type" field to RECONFIGURE-REPLY and copying the transaction ID from the Reconfigure-Request message into the "transaction-id" field. The server includes its server identifier in a Server Identifier Option. The server MUST include a Status Code Option [RFC3315] indicating whether the request has been successfully processed, failed, or partially failed.

- If the server fails to process the request, the server MUST set the Status Code Option to the appropriate status code (e.g., UnspecFail, NotAllowed, etc.). In particular,
  - UnspecFail MUST be returned if the Reconfigure-Request message is malformed.
  - NotAllowed MUST be returned if the server is not configured to allow Reconfigure-Request.

* NotConfigured MUST be returned if the server has no record of the link [RFC5007].

o If the Reconfigure-Request is successfully validated, the server MUST return a Status Code Option indicating "Success". In addition, the server MUST include a list of all the Client Identifier Options of the clients to which Reconfigure messages will not be sent (e.g., the server has no record of the client or the client did not negotiate for Reconfigure support). Note that this means that "Success" will be returned even if Reconfigure messages will not be sent to any of the clients.

If RSOO is supplied, the server might use its content to double check whether a Reconfigure is required to be sent to the client. This assumes the server stored the content of RSOO it used to generate the configuration data sent to requesting clients.

The server might use the content of the Reconfigure Message Option supplied by the relay agent to determine which form of Reconfigure to use.

Then, the server MUST follow the procedure defined in Section 19.1 of [RFC3315] to construct a Reconfigure message.

Rate-limit considerations are discussed in Section 7.

6.6. Receipt of a Reconfigure-Reply

Depending on the status code enclosed in a received Reconfigure-Reply message, the relay may decide to terminate the request (e.g., NotAllowed, NotConfigured, and Success) or try a different corrected Reconfigure-Request (e.g., UnspecFail).

When multiple servers are configured, the relay should expect to receive several Reconfigure-Reply messages. As mentioned in Section 6.3, the relay should be able to disambiguate these responses and associate them with a given server. The relay agent assumes the request is successfully handled for a client if there is at least one Reconfigure-Reply message in which the corresponding Client Identifier Option does not appear.

7. Rate-Limiting Considerations

The relay MUST rate-limit Reconfigure-Request messages to be sent to the server. The relay MUST be configured with required rate-limit parameters. The maximum Reconfigure-Request packet size SHOULD be configurable and the default value MUST be 1280 octets.

The server MUST rate-limit Reconfigure messages triggered by Reconfigure-Request messages. The server MUST be configured with required rate-limit parameters.

8. IANA Considerations

IANA has assigned the following new DHCPv6 Message types in the registry maintained in http://www.iana.org/assignments/dhcpv6-parameters:

RECONFIGURE-REQUEST

RECONFIGURE-REPLY

IANA has assigned the following new DHCPv6 Option Codes in the registry maintained in http://www.iana.org/assignments/dhcpv6-parameters:

OPTION_LINK_ADDRESS

9. Security Considerations

Security considerations elaborated in [RFC3315] (in particular Section 21.1) and [RFC6422] must be taken into account. In addition, DHCPv6 servers MAY be configured to reject relayed Reconfigure-Request messages or restrict relay chaining (see [RFC5007] for more discussion about the rationale of this recommended behavior). Section 6.5 specifies the error code to return when the server is configured to reject Reconfigure-Request messages.

Relay agents SHOULD implement appropriate means to prevent using Reconfigure-Request messages as a denial-of-service attack on the DHCPv6 servers.

Because the Reconfigure-Request message provides a mechanism for triggering the DHCPv6 Reconfigure message, and the DHCPv6 Reconfigure message can raise security threats (e.g., to control the timing of a DHCPv6 renewal), the DHCPv6 server MUST have some mechanism for determining that the relay agent is a trusted entity. DHCPv6 servers and relay agents MUST implement relay message authentication as described in Section 21.1 of [RFC3315]. DHCPv6 servers MAY also implement a control policy based on the content of a received Relay Identifier Option [RFC5460]. Administrators are strongly advised to configure one of these security mechanisms.

In an environment where the network connecting the relay agent to the DHCPv6 server is physically secure and does not contain devices not controlled by the server administrator, it may be sufficient to trust

the Relay Agent Identifier provided by the relay agent. In networks where the security of the machines with access to the data path is not under the control of the server administrator, IPsec [RFC4301] is necessary to prevent spoofing of Reconfigure-Request messages. DHCPv6 servers MUST silently discard Reconfigure-Request messages originating from unknown relay agents.

10. Acknowledgements

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11. References

11.1. Normative References

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11.2. Informative References

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[RFC5007] Brzozowski, J., Kinnear, K., Volz, B., and S. Zeng, "DHCPv6 Leasequery", RFC 5007, September 2007.

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