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ApertoDNS Protocol: A Modern Dynamic DNS Update Protocol
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Abstract

This document specifies the ApertoDNS Protocol, a modern RESTful protocol for dynamic DNS (DDNS) updates. It provides a secure, provider-agnostic alternative to legacy protocols, with native support for IPv4, IPv6, bulk updates, automatic IP detection, and standardized authentication mechanisms.

The protocol uses well-known URIs (RFC 8615), JSON payloads (RFC 8259), and bearer token authentication (RFC 6750) to enable interoperable dynamic DNS services across different providers.

Status of This Memo

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1. Note to Readers

Discussion of this document takes place on the DNS Operations Working Group mailing list (dnsop@ietf.org).

Source for this draft and an issue tracker can be found at <https://github.com/apertodns/apertodns-protocol>.

2. Introduction

Dynamic DNS (DDNS) services allow users with dynamically assigned IP addresses to maintain a consistent hostname that automatically updates when their IP address changes. This capability is essential for home users, small businesses, and IoT devices that need to be reachable despite lacking static IP addresses.

While RFC 2136 [RFC2136] defines DNS UPDATE for programmatic DNS modifications, most consumer-facing DDNS services use simpler HTTP-based protocols. The de facto standard for consumer DDNS emerged organically without formal specification.

This lack of standardization has led to:

- * Inconsistent implementations across providers
- * Security vulnerabilities from ad-hoc designs
- * Limited feature sets (e.g., no native IPv6 support)
- * Vendor lock-in due to proprietary extensions
- * No formal capability negotiation

This document specifies the ApertoDNS Protocol as a modern, secure, and fully interoperable alternative designed for the current Internet landscape.

2.1. Protocol Versioning

The protocol version specified in discovery responses (e.g., "1.2.0") refers to the semantic version of the protocol specification itself. This document represents the first IETF standardization of a protocol that has been in production use since 2024. The version number in the discovery endpoint reflects the feature set available, while the Internet-Draft version (e.g., "-00") tracks the IETF document revision process separately.

2.2. 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.

2.3. Goals

The ApertoDNS Protocol is designed with the following goals:

- * ***Provider-agnostic***: Any DDNS provider can implement this protocol using their own domain and branding
- * ***Secure by default***: HTTPS required, bearer token authentication
- * ***Modern***: JSON responses, proper HTTP semantics, native IPv6
- * ***Discoverable***: Self-describing via discovery endpoint
- * ***Extensible***: Capability negotiation allows future enhancements

- * ***Backward compatible***: Optional legacy endpoint for existing clients

3. Terminology

This document uses the following terms:

DDNS: Dynamic DNS. A service that automatically updates DNS records when a client's IP address changes.

Provider: An organization or service implementing this protocol to offer DDNS services to users.

Hostname: A fully qualified domain name (FQDN) managed by the provider and associated with a user account.

Token: An authentication credential issued by the provider, used to authorize API requests.

Auto-detection: Server-side determination of the client's IP address from the incoming HTTP request, used when the client specifies "auto" as the IP value.

Client: Software or device that makes requests to a DDNS provider to update DNS records.

A-label: The ASCII-Compatible Encoding (ACE) form of an Internationalized Domain Name label, as defined in [RFC5891].

4. Protocol Overview

The ApertoDNS Protocol is a RESTful API using JSON over HTTPS. All protocol endpoints are located under the well-known URI path `/.well-known/apertodns/v1/`.

4.1. Base URL

Conforming implementations **MUST** serve all endpoints under:

`https://{provider-domain}/.well-known/apertodns/v1/`

The use of well-known URIs [RFC8615] ensures consistent endpoint discovery across providers.

4.2. Content Type

All request and response bodies **MUST** use the `application/json` media type [RFC8259] unless otherwise specified.

4.3. Response Format

All responses MUST include a boolean success field at the top level:

```
{  
  "success": true,  
  "data": { ... }  
}
```

Or for errors:

```
{  
  "success": false,  
  "error": {  
    "code": "error_code",  
    "message": "Human-readable description"  
  }  
}
```

5. Conformance Requirements

This section defines the requirements for conforming implementations.

5.1. Conformance Levels

This protocol defines two conformance levels:

Core Conformance: A conforming implementation MUST implement the following endpoints: /info, /health, and /update. A conforming implementation MUST support bearer token authentication. A conforming implementation MUST serve all endpoints over HTTPS.

Full Conformance: In addition to core conformance requirements, a fully conforming implementation MUST implement: /bulk-update, /status/{hostname}, and /domains endpoints.

5.2. Capability Advertisement

Implementations MUST accurately advertise their capabilities in the /info endpoint response. Implementations MUST NOT advertise capabilities they do not support.

5.3. Interoperability

Implementations SHOULD accept requests from any conforming client. Implementations MUST NOT require proprietary extensions for basic DDNS functionality.

6. Authentication

6.1. Supported Methods

Protected endpoints require authentication via one of the following methods:

1. **Bearer Token** (RECOMMENDED) [RFC6750]: Authorization: Bearer {token}
2. **API Key Header**: X-API-Key: {token}
3. **HTTP Basic** (legacy only): Authorization: Basic {credentials}

Implementations **MUST** support bearer token authentication.
Implementations **MAY** support additional methods.

6.2. Token Format

Tokens **SHOULD** follow the format:

{provider}_{environment}_{random}

Where:

- * {provider}: Provider identifier (e.g., "apertodns", "example")
- * {environment}: Token environment ("live", "test", "sandbox")
- * {random}: Cryptographically secure random string (minimum 32 characters recommended)

Example: apertodns_live_Kj8mP2xL9nQ4wR7vY1zA3bC6dE0fG5hI

This format enables:

- * Easy identification of token source during debugging
- * Environment separation (production vs. testing)
- * Consistent token handling across providers

6.3. Token Transmission

Tokens **MUST** be transmitted only in HTTP headers. Tokens **MUST NOT** appear in URLs, query parameters, or request bodies where they might be logged.

7. Endpoints

7.1. Discovery Endpoint (/info)

GET /.well-known/apertodns/v1/info

The discovery endpoint returns provider information, capabilities, and configuration. This endpoint MUST NOT require authentication.

7.1.1. Response Fields

Field	Type	Required	Description
protocol	string	YES	MUST be "apertodns"
protocol_version	string	YES	Semantic version (e.g., "1.2.0")
provider	object	YES	Provider information
capabilities	object	YES	Supported features
authentication	object	YES	Supported auth methods
endpoints	object	YES	Available endpoint paths
rate_limits	object	NO	Rate limiting configuration
server_time	string	NO	Current server time (ISO 8601)

Table 1

7.1.2. Capability Fields

The capabilities object MUST include the following fields:

Field	Type	Description
ipv4	boolean	IPv4 address updates supported
ipv6	boolean	IPv6 address updates supported
auto_ip_detection	boolean	Automatic IP detection supported
bulk_update	boolean	Bulk update endpoint available
max_bulk_size	integer	Maximum hostnames per bulk request

Table 2

The capabilities object MAY include the following OPTIONAL fields:

Field	Type	Description
webhooks	boolean	Provider-specific webhook support available

Table 3

When webhooks is true, the provider offers webhook notifications for DNS update events such as IP address changes. The webhook API is implementation-specific and not standardized by this protocol version. Providers offering webhooks SHOULD document their webhook API separately.

The capabilities object MAY include additional fields for future extensions. Unknown capability fields SHOULD be ignored by clients.

7.1.3. Example Response

```
{
  "success": true,
  "data": {
    "protocol": "apertodns",
    "protocol_version": "1.2.0",
    "provider": {
      "name": "Example DDNS",
      "website": "https://example.com",
      "documentation": "https://example.com/docs",
      "support_email": "support@example.com"
    },
    "capabilities": {
      "ipv4": true,
      "ipv6": true,
      "auto_ip_detection": true,
      "bulk_update": true,
      "webhooks": true,
      "max_bulk_size": 100
    },
    "authentication": {
      "methods": ["bearer_token", "api_key_header"],
      "token_format": "{provider}_{environment}_{random}"
    },
    "endpoints": {
      "info": "/.well-known/apertodns/v1/info",
      "health": "/.well-known/apertodns/v1/health",
      "update": "/.well-known/apertodns/v1/update",
      "bulk_update": "/.well-known/apertodns/v1/bulk-update",
      "status": "/.well-known/apertodns/v1/status/{hostname}",
      "domains": "/.well-known/apertodns/v1/domains"
    },
    "rate_limits": {
      "update": {"requests": 60, "window_seconds": 60},
      "bulk_update": {"requests": 10, "window_seconds": 60}
    },
    "server_time": "2025-01-01T12:00:00.000Z"
  }
}
```

7.2. Health Endpoint (/health)

GET /.well-known/apertodns/v1/health

Returns service health status. This endpoint MUST NOT require authentication and SHOULD be used for monitoring.

7.2.1. Example Response

```
{
  "success": true,
  "data": {
    "status": "healthy",
    "timestamp": "2025-01-01T12:00:00.000Z"
  }
}
```

The status field MUST be one of: "healthy", "degraded", or "unhealthy".

7.3. Update Endpoint (/update)

```
POST /.well-known/apertodns/v1/update
Authorization: Bearer {token}
Content-Type: application/json
```

Updates DNS records for a single hostname. This endpoint MUST require authentication.

7.3.1. Request Fields

Field	Type	Required	Description
hostname	string	YES	Fully qualified domain name
ipv4	string	NO	IPv4 address or "auto"
ipv6	string	NO	IPv6 address or "auto"
ttl	integer	NO	Time to live in seconds (60-86400)

Table 4

At least one of ipv4 or ipv6 SHOULD be provided. If neither is provided, implementations SHOULD use auto-detection for IPv4.

The special value "auto" instructs the server to detect the client's IP address from the incoming request.

7.3.2. Example Request

```
{
  "hostname": "home.example.com",
  "ipv4": "auto",
  "ttl": 300
}
```

7.3.3. Example Response

```
{
  "success": true,
  "data": {
    "hostname": "home.example.com",
    "ipv4": "203.0.113.50",
    "previous_ipv4": "203.0.113.49",
    "ttl": 300,
    "changed": true,
    "timestamp": "2025-01-01T12:00:00.000Z"
  }
}
```

The changed field indicates whether the IP address was actually modified (false if the new IP matches the existing record).

7.4. Bulk Update Endpoint (/bulk-update)

```
POST /.well-known/apertodns/v1/bulk-update
Authorization: Bearer {token}
Content-Type: application/json
```

Updates multiple hostnames in a single request. Providers advertising `bulk_update: true` in capabilities MUST implement this endpoint.

7.4.1. Example Request

```
{
  "updates": [
    { "hostname": "home.example.com", "ipv4": "auto" },
    { "hostname": "office.example.com", "ipv4": "203.0.113.51" }
  ]
}
```

7.4.2. Example Response

```
{
  "success": true,
  "data": {
    "summary": {
      "total": 2,
      "successful": 2,
      "failed": 0
    },
    "results": [
      {
        "hostname": "home.example.com",
        "success": true,
        "ipv4": "203.0.113.50",
        "changed": true
      },
      {
        "hostname": "office.example.com",
        "success": true,
        "ipv4": "203.0.113.51",
        "changed": true
      }
    ]
  }
}
```

7.5. Status Endpoint (/status/{hostname})

```
GET /.well-known/apertodns/v1/status/{hostname}
Authorization: Bearer {token}
```

Returns current DNS record status for a hostname.

7.5.1. Example Response

```
{
  "success": true,
  "data": {
    "hostname": "home.example.com",
    "ipv4": "203.0.113.50",
    "ipv6": "2001:db8::1",
    "ttl": 300,
    "last_updated": "2025-01-01T12:00:00.000Z"
  }
}
```

7.6. Domains Endpoint (/domains)

```
GET /.well-known/apertodns/v1/domains
Authorization: Bearer {token}
```

Returns list of domains and hostnames available to the authenticated user.

7.6.1. Example Response

```
{
  "success": true,
  "data": {
    "domains": [
      {
        "domain": "example.com",
        "hostnames": ["home.example.com", "office.example.com"]
      }
    ]
  }
}
```

8. Error Handling

8.1. HTTP Status Codes

Implementations MUST use appropriate HTTP status codes as defined in [RFC9110]:

Status	Usage
200	Successful request
400	Invalid request (bad hostname, invalid IP)
401	Missing or invalid authentication
403	Not authorized for requested resource
404	Resource not found
429	Rate limit exceeded
500	Server error

Table 5

8.2. Error Response Format

```
{
  "success": false,
  "error": {
    "code": "error_code",
    "message": "Human-readable description"
  }
}
```

8.3. Standard Error Codes

Code	HTTP Status	Description
unauthorized	401	Missing authentication
invalid_token	401	Invalid or expired token
forbidden	403	Not authorized for resource
not_found	404	Hostname not found
rate_limited	429	Too many requests
invalid_hostname	400	Invalid hostname format
invalid_ip	400	Invalid IP address format
hostname_not_owned	403	User does not own hostname

Table 6

8.4. Rate Limiting Headers

When rate limiting is applied, responses SHOULD include:

- * Retry-After: Seconds until rate limit resets
- * X-RateLimit-Limit: Maximum requests per window
- * X-RateLimit-Remaining: Remaining requests in window
- * X-RateLimit-Reset: Unix timestamp when window resets

9. Legacy Compatibility

For backward compatibility with existing DDNS clients, providers MAY implement:

```
GET /nic/update?hostname={hostname}&myip={ip}
Authorization: Basic {credentials}
```

9.1. Legacy Response Codes

Responses MUST be plain text (not JSON):

+=====+	
Response	Meaning
+=====+	
good {ip}	Update successful
+-----+	
nochg {ip}	No change needed
+-----+	
badauth	Authentication failed
+-----+	
notfqdn	Invalid hostname
+-----+	
nohost	Hostname not found
+-----+	
abuse	Account blocked
+-----+	

Table 7

This endpoint is provided for compatibility only. New implementations SHOULD use the modern JSON endpoints.

10. Comparison with RFC 2136

RFC 2136 [RFC2136] defines DNS UPDATE, a protocol for dynamic updates to DNS zones. The ApertoDNS Protocol differs in several key aspects:

Aspect	RFC 2136	ApertoDNS Protocol	
Transport	DNS (UDP/TCP)	HTTPS	
Format	DNS wire format	JSON	
Auth	TSIG/SIG(0)	Bearer tokens	
Discovery	None	/info endpoint	
IPv6	Supported	Native support	
Bulk ops	Per-message	Dedicated endpoint	

Table 8

The ApertoDNS Protocol is designed for consumer DDNS services where simplicity and HTTP integration are priorities, while RFC 2136 is suited for direct DNS zone manipulation.

11. Security Considerations

11.1. Transport Security

All endpoints MUST be served over HTTPS using TLS 1.2 or higher. Implementations MUST NOT support plaintext HTTP for any protocol endpoint.

Implementations SHOULD support TLS 1.3 and SHOULD disable older cipher suites known to be weak.

11.2. Token Security

- * Tokens MUST be generated using cryptographically secure random number generators (CSPRNG)
- * Tokens SHOULD have configurable expiration
- * Providers SHOULD support token revocation
- * Tokens MUST NOT be logged in server access logs
- * Tokens MUST NOT appear in URLs or error messages

11.3. Hostname Validation

Before processing any update request, implementations MUST verify that the authenticated user owns or has permission to modify the requested hostname. Failure to validate ownership could allow unauthorized DNS modifications.

11.4. Rate Limiting

Providers SHOULD implement rate limiting to prevent:

- * Brute-force token guessing
- * Denial of service attacks
- * Excessive DNS propagation load

Rate limits SHOULD be advertised in the discovery endpoint and communicated via response headers.

11.5. DNS Rebinding Prevention

Implementations MUST validate that IP addresses in update requests are not private, loopback, or link-local addresses unless explicitly configured to allow such addresses.

11.6. Input Validation

All user input MUST be validated:

- * Hostnames MUST conform to DNS naming rules
- * IP addresses MUST be valid IPv4 or IPv6 format
- * TTL values MUST be within acceptable ranges

11.7. Internationalized Domain Names

When handling Internationalized Domain Names (IDNs), the following requirements apply as specified in [RFC5891]:

- * Clients SHOULD convert IDN hostnames to their A-label (ASCII Compatible Encoding) form before sending requests
- * Servers MUST accept hostnames in A-label form
- * Servers MAY accept hostnames in U-label (Unicode) form and convert them to A-labels internally

- * Servers MUST store and return hostnames in a consistent form

For example, a client wishing to update an IDN hostname (U-label form) SHOULD send the request with the A-label form (e.g., "xn--r8jz45g.example.com").

Implementations that accept U-label input MUST perform IDNA2008 validation as specified in [RFC5891] before processing the request.

12. Privacy Considerations

This section addresses privacy considerations as recommended by [RFC6973].

12.1. Data Minimization

Providers SHOULD minimize the collection and retention of personal data. Specifically:

- * IP address history SHOULD have configurable retention periods
- * Update timestamps MAY be retained for operational purposes
- * Providers SHOULD document their data retention policies

12.2. User Control

Users SHOULD have mechanisms to:

- * View their stored data
- * Delete their accounts and associated data
- * Export their data in a portable format

12.3. Traffic Analysis

DDNS updates inherently reveal:

- * That a user's IP address has changed
- * The timing of IP address changes
- * The association between a hostname and IP address

Providers should be aware that this information could be used to track user behavior or network changes.

12.4. Encryption

All communications MUST be encrypted via HTTPS, preventing passive observation of update requests and tokens.

13. IANA Considerations

13.1. Well-Known URI Registration

This document requests registration of the following well-known URI suffix:

URI Suffix: apertodns

Change Controller: IETF

Specification Document: This document

Related Information: None

The well-known URI /.well-known/apertodns/ is used as the base path for all protocol endpoints.

14. References

14.1. Normative References

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- [RFC6973] Cooper, A., Tschofenig, H., Aboba, B., Peterson, J., Morris, J., Hansen, M., and R. Smith, "Privacy Considerations for Internet Protocols", RFC 6973, DOI 10.17487/RFC6973, July 2013, <<https://www.rfc-editor.org/rfc/rfc6973>>.

Appendix A. Acknowledgments

Thanks to the dynamic DNS community for decades of service enabling home users and small businesses to maintain stable hostnames with dynamic IP addresses.

Appendix B. Implementation Status

Note to RFC Editor: Please remove this appendix before publication.

This section records the status of known implementations of the protocol defined by this specification.

B.1. ApertoDNS

Organization: ApertoDNS

Implementation: Reference implementation

Description: Full protocol support including all endpoints, bulk updates, webhooks, and legacy compatibility

Level of Maturity: Production

Coverage: Complete

Licensing: Proprietary service, open protocol

Contact: support@apertodns.com

URL: <https://apertodns.com>

Appendix C. OpenAPI Specification

A complete OpenAPI 3.0.3 specification for this protocol is available at:

<https://github.com/apertodns/apertodns-protocol/blob/main/openapi.yaml>

This specification can be used to:

- * Generate client libraries in various programming languages
- * Create interactive API documentation
- * Validate implementations for conformance

Appendix D. Example Update Flow

The following illustrates a typical update flow:

1. Client discovers provider capabilities: ~~~ GET /.well-known/apertodns/v1/info ~~~
2. Client authenticates and requests update: ~~~ POST /.well-known/apertodns/v1/update Authorization: Bearer example_live_abc123 Content-Type: application/json

{"hostname": "home.example.com", "ipv4": "auto"} ~~~
3. Provider validates token and hostname ownership
4. Provider updates DNS record
5. Provider returns result: ~~~json { "success": true, "data": { "hostname": "home.example.com", "ipv4": "203.0.113.50", "changed": true } } ~~~
6. DNS propagates the new record

Appendix E. Changes from Legacy DDNS Protocols

For implementers familiar with legacy HTTP-based DDNS protocols (commonly referred to as "dyndns2" in client implementations such as ddclient), key differences include:

- * JSON responses instead of plain text
- * Bearer token authentication instead of HTTP Basic
- * Explicit capability negotiation via /info endpoint
- * Dedicated endpoints for different operations
- * Standardized error codes and response formats
- * Native IPv6 support with separate fields
- * Bulk update support for multiple hostnames
- * Well-known URI path for consistent discovery

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