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# Multicast DNS-Based Service Discovery for Encrypted DNS Services
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## Abstract

This document defines a multicast DNS (mDNS) and DNS-Based Service Discovery (DNS-SD) mechanism for discovering encrypted DNS services in local networks. It specifies new service types (_dot, _doh, _doq) and associated TXT record parameters to enable zero-configuration discovery of DNS over TLS (DoT), DNS over HTTPS (DoH), and DNS over QUIC (DoQ) resolvers. This extension addresses critical privacy gaps in local networks while maintaining backward compatibility with RFC 6763.

## Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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# 1. Introduction

## 1.1. The Local Network Privacy Challenge

While encrypted DNS protocols such as DNS over TLS (DoT)[RFC7858], DNS over HTTPS (DoH)[RFC8484], and DNS over QUIC (DoQ)[RFC9250] have gained widespread adoption for public Internet resolution, local network environments often remain vulnerable to surveillance and manipulation of DNS traffic. Many devices and applications in home, enterprise, and industrial networks still rely on plaintext DNS, exposing sensitive metadata such as device activities, service dependencies, and user behavior patterns. Traditional discovery mechanisms (e.g., DHCP, Router Advertisements) lack the flexibility to negotiate fine-grained encrypted DNS configurations and fail in infrastructure-less environments where centralized servers are unavailable.

## 1.2. mDNS/DNS-SD as a Solution for Privacy-Aware Discovery

Multicast DNS (mDNS, [RFC6762]) and DNS-Based Service Discovery (DNS-SD, [RFC6763]) provide an ideal foundation for encrypted DNS service discovery due to their:

Zero-configuration operation: Devices autonomously advertise and discover services without requiring a central server.

Topology independence: Functions in isolated networks (e.g., home labs, industrial control systems) even without Internet connectivity.

Real-time updates: Service availability changes propagate within seconds, unlike DHCP’s lease-based delays.

Rich parameter negotiation: TXT records allow flexible exchange of protocol details (ports, ALPN preferences, certificate fingerprints).

## 1.3. Key Use Cases

This specification enables:

IoT and Smart Home Privacy: Devices (e.g., cameras, voice assistants) automatically discover and use encrypted DNS without manual configuration.

Enterprise Network Segmentation: Departments can advertise isolated DNS services (e.g., _dot.finance.corp.local) with policy enforcement.

Offline and Air-Gapped Networks: Secure DNS resolution in environments where Internet access is restricted but internal name resolution is still required (e.g., industrial control systems, military networks).

### 1.4. Relationship to Existing Standards

While [RFC9463] provides DHCP/RA-based encrypted DNS discovery, this mDNS-based approach offers complementary advantages:

| Capability | DHCP/RA | mDNS/DNS-SD (This Spec) |
|---|---|---|
| Infrastructure | Requires DHCP server/router | Works without infrastructure |
| Update Latency | Minutes-hours (lease time) | Seconds (event-driven) |
| Parameter Flexibility | Limited by option space | Rich TXT key-value pairs |
| Use Cases | Managed networks | Ad-hoc/IoT/dynamic networks |

Table 1: Relationship to Existing Standards

This document defines new DNS-SD service types (_dot._tcp, _doh._tcp, _doq._udp) and standardized TXT record parameters to enable seamless discovery of encrypted DNS services while maintaining backward compatibility with [RFC6763].

## 2. Terminology and Requirements

### 2.1. Requirements Language

Key words: "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", "OPTIONAL" per BCP 14 [RFC2119] [RFC8174]

### 2.2. Defined Terms

* EDNS: Encrypted DNS (DoT, DoH, DoQ collectively)

* ADN: Authentication Domain Name (FQDN for certificate validation)

* Service Instance: Unique identifier for an EDNS resolver (e.g., Finance DoT._dot._tcp.local)

## 3. Service Type Definitions

### 3.1. Encrypted DNS Service Types

| Service Type | Protocol | Transport | IANA Assignment |
|---|---|---|---|
| _dot._tcp | DoT | TCP | REQUIRED |
| _doh._tcp | DoH | TCP | REQUIRED |
| _doq._udp | DoQ | UDP | REQUIRED |

Table 2: Encrypted DNS Service Types

### 3.2. Service Instance Name Format

<Instance>.<Service>.<Domain>

* Instance: Human-readable identifier (e.g., CorpDNS, HomeGateway)

* Service: One of _dot._tcp, _doh._tcp, _doq._udp

* Domain: local (default) or custom domain

Example: SecurityDoH._doh._tcp.local

## 4. DNS Resource Records

### 4.1. PTR Records (Service Discovery)

```
; Service enumeration
_services._dns-sd._udp.local. PTR _dot._tcp.local
_services._dns-sd._udp.local. PTR _doh._tcp.local
_services._dns-sd._udp.local. PTR _doq._udp.local
```

### 4.2. SRV Records (Service Location)

<Instance>.<Service>.<Domain> [Class] [TTL] SRV <Priority> <Weight> <Port> <Target>

* Target: Hostname offering the service (A/AAAA must resolve)

Example:

HomeDoT._dot._tcp.local. 120 IN SRV 0 5 853 router.home.local.

### 4.3. TXT Records (Service Parameters)

Defined Keys:

| Key | Format | Description | Example |
|---|---|---|---|
| path | String | DoH URI path (required for DoH) | path=/dns-query |
| alpn | Comma-list | Supported ALPN protocols | alpn=h2,h3 |
| pri | Number | Selection priority (0-65535) | pri=10 |
| fp_sha256 | Hex string | Certificate SHA-256 fingerprint | fp_sha256=9F86D0... |
| domain | FQDN | ADN for certificate validation | domain=dns.corp.example |

Table 3: TXT Records (Service Parameters)

Full Example:

HomeDoH._doh._tcp.local. 120 IN TXT "path=/dns" "alpn=h2"
"domain=dns.home.net" "fp_sha256=9F86D081884C7D659A2FEAA0C55AD015A3BF
4F1B2B0B822CD15D6C15B0F00A08"

## 5. Discovery Process

### 5.1. Service Advertisement

1. EDNS resolver sends mDNS broadcast:

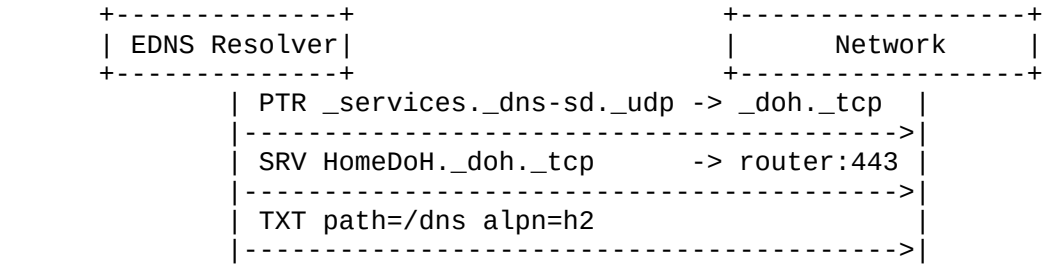


Figure 1: EDNS resolver sends mDNS broadcast

## 5.2. Client Discovery

1. Client queries for service types:

```
; Query available EDNS services
_services._dns-sd._udp.local. IN PTR
```

2. Query specific instances:

```
; Query DoH instances
_doh._tcp.local. IN PTR
```

3. Resolve selected service:

```
HomeDoH._doh._tcp.local. IN SRV
HomeDoH._doh._tcp.local. IN TXT
router.home.local. IN A
router.home.local. IN AAAA
```

# 6. Security Considerations

## 6.1. Spoofing Countermeasures

* mDNS Response Validation: Clients MUST verify source IP matches query target

* Rate Limiting: Implement mDNS response rate limiting Section 11 of [RFC6762]

* TLS Enforcement: Clients MUST validate server certificates against ADN or fingerprint

### 6.2. Certificate Validation Models

| Trust Model | Verification Method | Use Case |
|---|---|---|
| Public PKI | ADN (domain= key) + CA validation | General-purpose networks |
| Fingerprint Pinning | fp_sha256 exact match | High-security/ IoT devices |
| Private PKI | ADN + custom trust anchors | Enterprise networks |

Table 4: Certificate Validation Models

### 6.3. Privacy Implications

* Metadata Leakage: mDNS queries reveal client interest in encrypted DNS

* Mitigation: Clients SHOULD use service type enumeration (_services._dns-sd) before specific queries

## 7. IANA Considerations

### 7.1. New DNS-SD Service Types

This document requests IANA to register the following service types in the "DNS-SD Service Type Bindings" registry located at <https://www.iana.org/assignments/dns-sd/dns-sd.xhtml#service-types>.

| Service Name | Transport Protocol | Reference | Assignment Policy |
|---|---|---|---|
| _dot | tcp | RFC-TBD | Standard |
| _doh | tcp | RFC-TBD | Standard |
| _doq | udp | RFC-TBD | Standard |

Table 5: New DNS-SD Service Types

The registration templates for these service types are as follows:

Service Name: _dot

Transport Protocol(s): tcp

Assignee: IESG <iesg@ietf.org>

Contact: IESG <iesg@ietf.org>

Description: DNS over TLS (DoT) Resolver Service Discovery

Reference: RFC-TBD

Assignment Notes: This service type is used for discovering encrypted DNS services as defined in RFC-TBD.

Service Name: _doh

Transport Protocol(s): tcp

Assignee: IESG <iesg@ietf.org>

Contact: IESG <iesg@ietf.org>

Description: DNS over HTTPS (DoH) Resolver Service Discovery

Reference: RFC-TBD

Assignment Notes: This service type is used for discovering encrypted DNS services as defined in RFC-TBD.

Service Name: _doq

Transport Protocol(s): udp

Assignee: IESG <iesg@ietf.org>

Contact: IESG <iesg@ietf.org>

Description: DNS over QUIC (DoQ) Resolver Service Discovery

Reference: RFC-TBD

Assignment Notes: This service type is used for discovering encrypted DNS services as defined in RFC-TBD.

### 7.2. TXT Record Key Registry

This document requests IANA to create a new registry titled "EDNS-SD TXT Record Keys" under the "DNS-Based Service Discovery (DNS-SD) Parameters" registry.

The registration policy for this registry is "Expert Review" as defined in [RFC8126].

The initial contents of this registry are as follows:

| Key | Meaning | Reference |
|---|---|---|
| path | HTTP URI path (for DoH) | RFC-TBD |
| alpn | Supported ALPN protocols | RFC-TBD |
| pri | Service selection priority | RFC-TBD |
| fp_sha256 | Certificate SHA-256 fingerprint | RFC-TBD |
| domain | Authentication Domain Name (ADN) | RFC-TBD |

Table 6: TXT Record Key Registry

New assignments in this registry require Expert Review as defined in [RFC8126]. The expert should consider whether the proposed key is well-defined, does not duplicate existing functionality, and is relevant to encrypted DNS service discovery.

## 8. Examples

### 8.1. Full DoT Service Advertisement

```
          ; Service type announcement
          _services._dns-sd._udp.local. PTR _dot._tcp.local


; Service instance
HomeDoT._dot._tcp.local. SRV 0 5 853 router.home.local.
HomeDoT._dot._tcp.local. TXT "domain=dns.home.net" "fp_sha256=9F86D08188..."
router.home.local. A 192.168.1.1
router.home.local. AAAA fd12:3456::1
```

### 8.2. DoH Service with Custom Path

```
OfficeDoH._doh._tcp.local. SRV 0 10 443 dnsgateway.corp.local.
OfficeDoH._doh._tcp.local. TXT "path=/internal/dns" "alpn=h2,h3" "pri=5"
```

### 8.3. Client Discovery Sequence

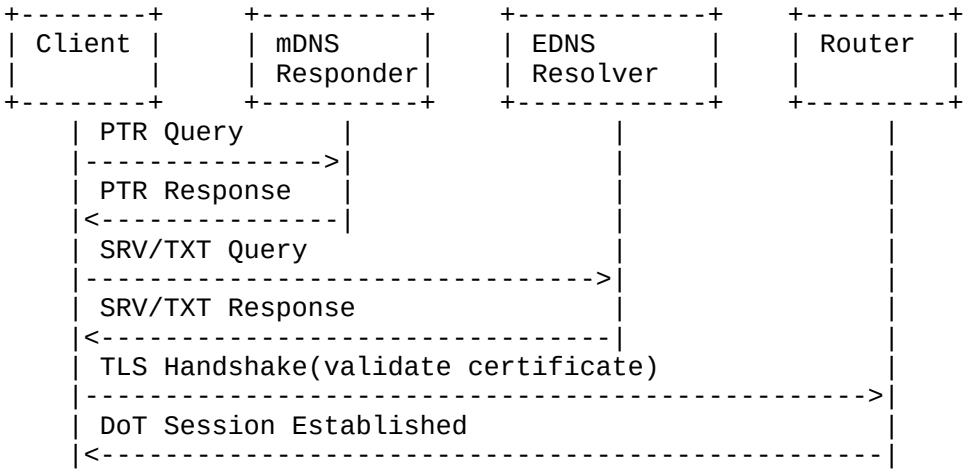


Figure 2: Client Discovery Sequence

## 9. References

### 9.1. Normative References

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[RFC9460] Schwartz, B., Bishop, M., and E. Nygren, "Service Binding and Parameter Specification via the DNS (SVCB and HTTPS Resource Records)", RFC 9460, DOI 10.17487/RFC9460, November 2023, <https://www.rfc-editor.org/info/rfc9460>.

[IOT-DNS] ISOC, "IoT Device DNS Privacy Report", 2023.

## 9.3. Other References

[RFC-TBD] Liu, D., Yan, Z., Geng, G., and G. Zeng, "Multicast DNS-Based Service Discovery for Encrypted DNS Services (EDNS-SD)", RFC TBD, 2025, <https://www.rfc-editor.org/rfc/rfcTBD>.

## acknowledgements

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