

## Binary Labels in the Domain Name System

### Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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### 1. Introduction and Terminology

This document defines a "Bit-String Label" which may appear within domain names. This new label type compactly represents a sequence of "One-Bit Labels" and enables resource records to be stored at any bit-boundary in a binary-named section of the domain name tree.

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 [KWORD].

### 2. Motivation

Binary labels are intended to efficiently solve the problem of storing data and delegating authority on arbitrary boundaries when the structure of underlying name space is most naturally represented in binary.

### 3. Label Format

Up to 256 One-Bit Labels can be grouped into a single Bit-String Label. Within a Bit-String Label the most significant or "highest level" bit appears first. This is unlike the ordering of DNS labels themselves, which has the least significant or "lowest level" label first. Nonetheless, this ordering seems to be the most natural and efficient for representing binary labels.



slash and a length. The base indicators are "b", "o" and "x", denoting base 2, 8 and 16 respectively. The length counts the significant bits and MUST be between 1 and 32, inclusive, after a dotted quad, or between 1 and 256, inclusive, after one of the other forms. If the length is omitted, the implicit length is 32 for a dotted quad or 1, 3 or 4 times the number of binary, octal or hexadecimal digits supplied, respectively, for the other forms.

In augmented Backus-Naur form [ABNF],

bit-string-label = "\"[" bit-spec "]"

bit-spec = bit-data [ "/" length ]  
          / dotted-quad [ "/" slength ]

bit-data = "x" 1\*64HEXDIG  
          / "o" 1\*86OCTDIG  
          / "b" 1\*256BIT

dotted-quad = decbyte "." decbyte "." decbyte "." decbyte

decbyte = 1\*3DIGIT

length = NZDIGIT \*2DIGIT

slength = NZDIGIT [ DIGIT ]

OCTDIG = %x30-37

NZDIGIT = %x31-39

If a <length> is present, the number of digits in the <bit-data> MUST be just sufficient to contain the number of bits specified by the <length>. If there are insignificant bits in a final hexadecimal or octal digit, they MUST be zero. A <dotted-quad> always has all four parts even if the associated <slength> is less than 24, but, like the other forms, insignificant bits MUST be zero.

Each number represented by a <decbyte> must be between 0 and 255, inclusive.

The number represented by <length> must be between 1 and 256 inclusive.

The number represented by <slength> must be between 1 and 32 inclusive.

When the textual form of a Bit-String Label is generated by machine, the length **SHOULD** be explicit, not implicit.

### 3.2.1. Examples

The following four textual forms represent the same Bit-String Label.

```
\[b11010000011101]  
\[o64072/14]  
\[xd074/14]  
\[208.116.0.0/14]
```

The following represents two consecutive Bit-String Labels which denote the same relative point in the DNS tree as any of the above single Bit-String Labels.

```
\[b11101].\[o640]
```

### 3.3. Canonical Representation and Sort Order

Both the wire form and the text form of binary labels have a degree of flexibility in their grouping into multiple consecutive Bit-String Labels. For generating and checking DNS signature records [DNSSEC] binary labels must be in a predictable form. This canonical form is defined as the form which has the fewest possible Bit-String Labels and in which all except possibly the first (least significant) label in any sequence of consecutive Bit-String Labels is of maximum length.

For example, the canonical form of any sequence of up to 256 One-Bit Labels has a single Bit-String Label, and the canonical form of a sequence of 513 to 768 One-Bit Labels has three Bit-String Labels of which the second and third contain 256 label bits.

The canonical sort order of domain names [DNSSEC] is extended to encompass binary labels as follows. Sorting is still label-by-label, from most to least significant, where a label may now be a One-Bit Label or a standard (code 00) label. Any One-Bit Label sorts before any standard label, and a 0 bit sorts before a 1 bit. The absence of a label sorts before any label, as specified in [DNSSEC].

For example, the following domain names are correctly sorted.

```
foo.example
\[b1].foo.example
\[b100].foo.example
\[b101].foo.example
bravo.\[b10].foo.example
alpha.foo.example
```

#### 4. Processing Rules

A One-Bit Label never matches any other kind of label. In particular, the DNS labels represented by the single ASCII characters "0" and "1" do not match One-Bit Labels represented by the bit values 0 and 1.

#### 5. Discussion

A Count of zero in the wire-form represents a 256-bit sequence, not to optimize that particular case, but to make it completely impossible to have a zero-bit label.

#### 6. IANA Considerations

This document defines one Extended Label Type, termed the Bit-String Label, and requests registration of the code point 000001 binary in the space defined by [EDNS0].

#### 7. Security Considerations

All security considerations which apply to traditional ASCII DNS labels apply equally to binary labels. The canonicalization and sorting rules of section 3.3 allow these to be addressed by DNS Security [DNSSEC].

## 8. References

- [ABNF] Crocker, D. and P. Overell, "Augmented BNF for Syntax Specifications: ABNF", RFC 2234, November 1997.
- [DNSIS] Mockapetris, P., "Domain names - implementation and specification", STD 13, RFC 1035, November 1987.
- [DNSSEC] Eastlake, D., 3rd, C. Kaufman, "Domain Name System Security Extensions", RFC 2065, January 1997
- [EDNS0] Vixie, P., "Extension mechanisms for DNS (EDNS0)", RFC 2671, August 1999.
- [KWORD] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," BCP 14, RFC 2119, March 1997.

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