The Present and Future of BIND 9

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First Things First

- BIND 9.16.0 based on 9.15 dev branch
- Due out ~~December 2019~~
  ~~January 2020~~
  February 19, 2020

- Major features:
  - New network system
  - DNSSEC Key and Signing Policy
  - DLV obsolete, validator code simplified

Question:

Evan Hunt
@nuthaven

Howdy, @bind9 users, can I ask a favor?

For a talk I'm preparing, I'd really like to gather some non-developer perspectives on this question:

What are BIND's particular strengths and weaknesses as a DNS implementation?

Thanks.

1:55 AM · Jan 21, 2020 · TweetDeck

Still interested in answers; each@isc.org or @nuthaven.

The Good

- RFC conformance
- Versatility
- Familiarity
- Ubiquity
- Tools
- Documentation
- Professional support

The Less Good

- Too many features
- Not enough features
- Configuration
  - Too many options
  - Requires editing files
- Development slow due to complex code base

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Simplifying DNSSEC configuration

- DLV obsolete
- More consistent trust anchor configuration
- Key and Signing Policies in named ("dnssec-policy")

DLV obsolete

- isc.dlv.org replaced with an empty zone September 2017.
- Automatic DLV configuration disabled in 9.12.
- Manual DLV configuration disabled in 9.16.
- All relevant code removed from validator.

Trust anchor configuration

- "trusted-keys" and "managed-keys" statements are deprecated, replaced by "trust-anchors".
- "trust-anchors" can set both static and initializing keys, in either DNSKEY or DS format.
- Trust anchors are all now stored internally in DS format.
- Validator shrunk by 700 LOC, McCabe complexity reduced 35%.

Key and Signing Policies (KASP)

- New “dnssec-policy” statement enables configuration of key size and rollover policies for a zone.
- Key rolls fully automated within named.
- … including KSKs (soon).

Signing options (before KASP):

```
zone "example.com" {
    auto-dnssec maintain;
    inline-signing yes;
    dnskey-sig-validity 14;
    dnssec-dnskey-kskonly yes;
    dnssec-loadkeys-interval 3600s;
    dnssec-secure-to-insecure no;
    dnssec-update-mode maintain;
    max-zone-ttl 24h;
    sig-signing-type 65445;
    sig-validity-interval 14 3;
    update-check-ksk yes;
};
```

Signing options (before KASP, more realistic):

```
zone "example.com" {
    auto-dnssec maintain;
    inline-signing yes;
};
```

… with keys generated and maintained by external tools.

Signing options (before KASP):

- Keys must be generated using dnssec-keygen.
- Key rollovers and retirements must be scheduled using dnssec-settime.
- Both of these can be automated according to a key/signing policy by using dnssec-keymgr in a cron job, however:
  - No automatic checking of key state transitions.
  - Requires attention to timing.
  - No CDS/CDNSKEY support.
  - KSK rollovers manual.

Signing options (after KASP):

```
zone "example.com" {
    dnssec-policy default;
};
```

Signing options (after KASP):

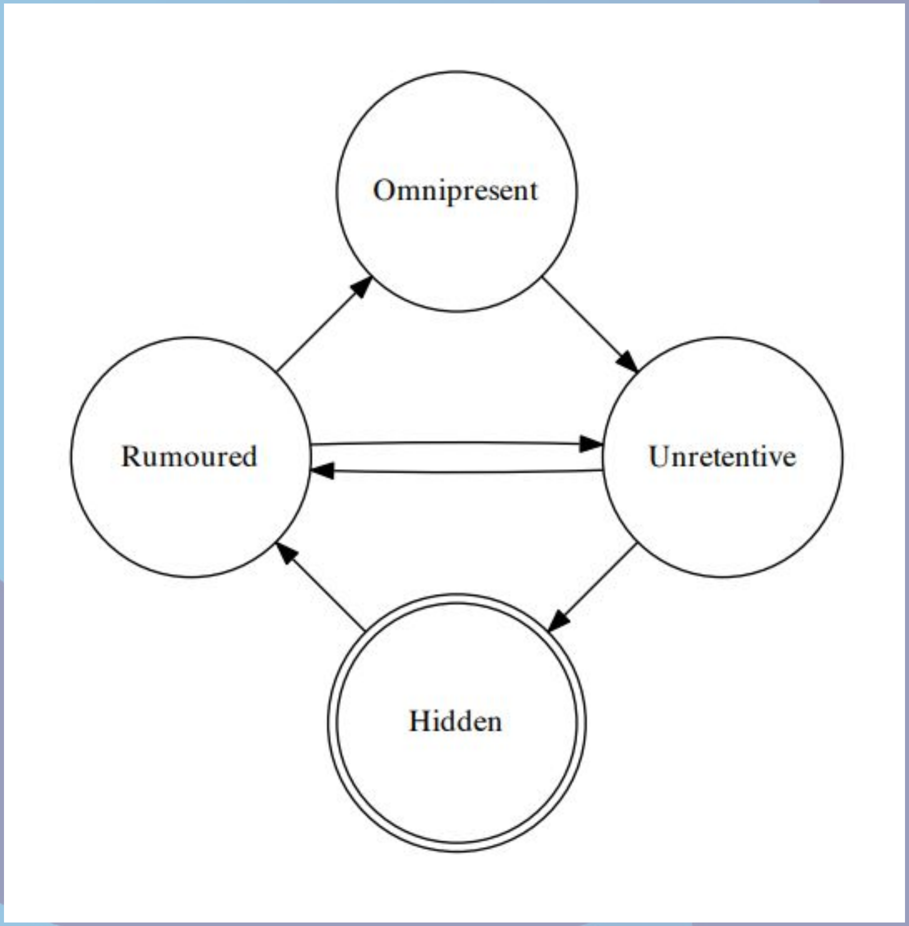
```
dnssec-policy example {
    keys {
        zsk lifetime 365d algorithm ecdsa256;
        ksk lifetime unlimited
            algorithm ecdsa256;
    };
};

zone "example.com" {
   dnssec-policy example;
};
```

Signing options (after KASP):

- Keys are generated by named as needed.
- “auto-dnssec” and “inline-signing” are implicit; most other signing options merged into dnssec-policy.
- State transitions are monitored, illegal changes prevented - much less attention to timing needed.
- Algorithm rolls can be initiated by editing named.conf - and will occur automatically.

Key state machine



- Rumoured: Not fully propagated; too new to be cached everywhere.
- Omnipresent: Propagated to all secondaries, visible to all validators.
- Unretentive: Phased out, expiring from caches.
- Hidden: Not yet published or fully unpublished.

State machine logic:

$$
\begin{aligned}
&rule1(x): \\
&\quad \exists y \in K\ (D_y^{\uparrow +}) \\[1em]
&rule2(x): \\
&\quad \exists y \in X\ (D_y^{+} K_y^{+} R_y^{+}) && \vee \\
&\quad \exists y, z \in X\ (D_y^{\uparrow} K_y^{+} R_y^{+} D_z^{\downarrow} K_z^{+} R_z^{+} \wedge y \overset{D}{\succ} z) && \vee \\
&\quad \exists y, z \in X\ (D_y^{+} K_y^{\uparrow +} R_y^{\uparrow} D_z^{+} K_z^{\downarrow} R_z^{\downarrow -} \wedge y \overset{K}{\succ} z) && \vee \\
&\quad \forall y \in X\ (D_y^{-} \vee \exists z \in X\ (K_z^{+} R_z^{+} (D_y = D_z))) \\[1em]
&rule3(x): \\
&\quad \exists y \in X\ (K_y^{+} S_y^{+}) && \vee \\
&\quad \exists y, z \in X\ (K_y^{\uparrow} S_y^{+} K_z^{\downarrow} S_z^{+} \wedge y \overset{K}{\succ} z) && \vee \\
&\quad \exists y, z \in X\ (K_y^{+} S_y^{\uparrow} K_z^{+} S_z^{\downarrow} \wedge y \overset{S}{\succ} z) && \vee \\
&\quad \forall y \in X\ (K_y^{-} \vee \exists z \in X\ (S_z^{+} (K_y = K_z)))
\end{aligned}
$$

Chain of trust:

- At least one DS is published.
- At least one DNSKEY mathcing at least one DS is published.
- All records are signed by at least one key visible to all validators.

State files

- Keys generated by named include a third file, K*.state (in addition to K*.key and K*.private).
- State files are publicly readable.
- Key metadata residing in private file is now duplicated in state file (though still kept in private file as well for legacy reasons).
- Additional metadata indicates key state and transitions.

State file (KSK)

```
; This is the state of key 33330, for example.com.
Algorithm: 13
Length: 256
Lifetime: 16070400
Predecessor: 17530
KSK: yes
ZSK: yes
Generated: 20200207005010 (Thu Feb  6 16:50:10 2020)
Published: 20200111165010 (Sat Jan 11 08:50:10 2020)
Active: 20200111195010 (Sat Jan 11 11:50:10 2020)
Retired: 20200715195010 (Wed Jul 15 12:50:10 2020)
DNSKEYChange: 20200111195010 (Sat Jan 11 11:50:10 2020)
ZRRSIGChange: 20200111195010 (Sat Jan 11 11:50:10 2020)
KRRSIGChange: 20200111195010 (Sat Jan 11 11:50:10 2020)
DSChange: 20200111235010 (Sat Jan 11 15:50:10 2020)
DNSKEYState: omnipresent
ZRRSIGState: omnipresent
KRRSIGState: omnipresent
DSState: omnipresent
GoalState: omnipresent
```

State file (ZSK)

```
; This is the state of key 44585, for example.com.
Algorithm: 13
Length: 256
Lifetime: 31536000
Successor: 61247
KSK: no
ZSK: yes
Generated: 20190811005009 (Sat Aug 10 17:50:09 2019)
Published: 20190811005009 (Sat Aug 10 17:50:09 2019)
Active: 20190811005009 (Sat Aug 10 17:50:09 2019)
Retired: 20200207005009 (Thu Feb  6 16:50:09 2020)
DNSKEYChange: 20190811005009 (Sat Aug 10 17:50:09 2019)
ZRRSIGChange: 20190811005009 (Sat Aug 10 17:50:09 2019)
DNSKEYState: omnipresent
ZRRSIGState: omnipresent
GoalState: hidden
```

Not yet working:

- NSEC3 configuration.
- Querying parent to monitor DS status prior to KSK rollover.
- Signaling mechanism to inform named that DS has been submitted to parent.
- Key state monitoring via rndc.
- Purging retired keys.
- CDS/CDNSKEY.

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More legacy, more problems

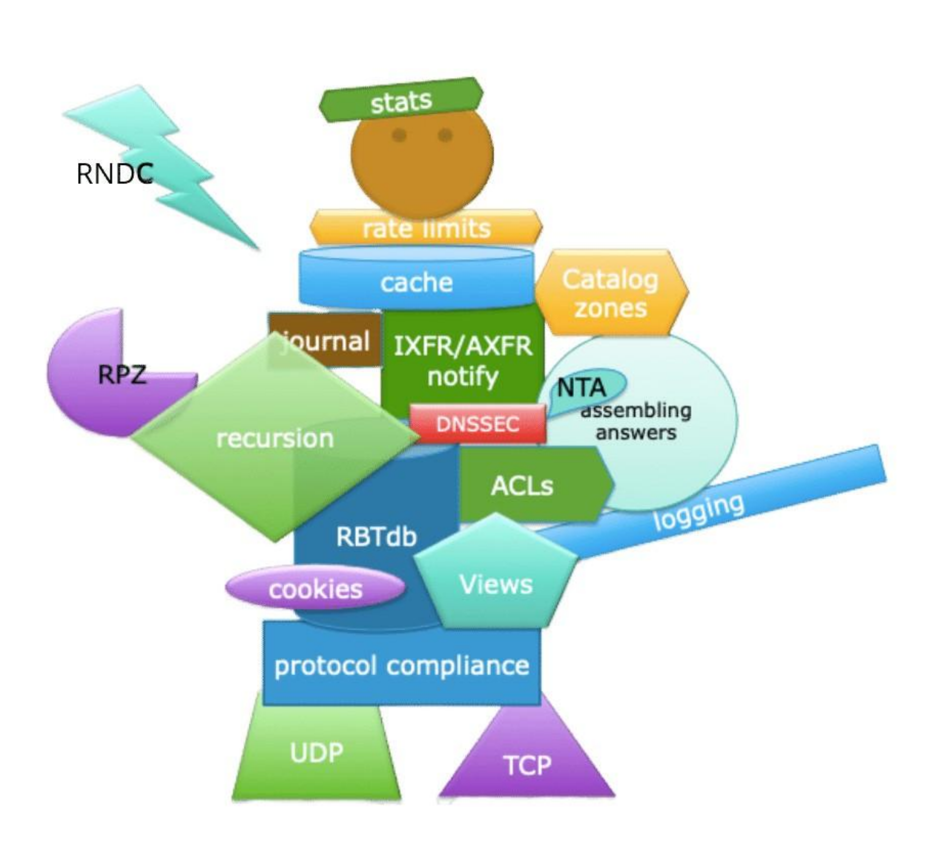
- Original BIND architecture was designed to be both single- and multi-threaded.
- Ran on absolutely everything.
- Provides many of its own OS services, such as memory management and socket/event libraries.
- Not optimized for modern hardware.
- New capabilities added, old capabilities rarely removed.

BIND architecture

...as seen by non-developers.

Image credit:

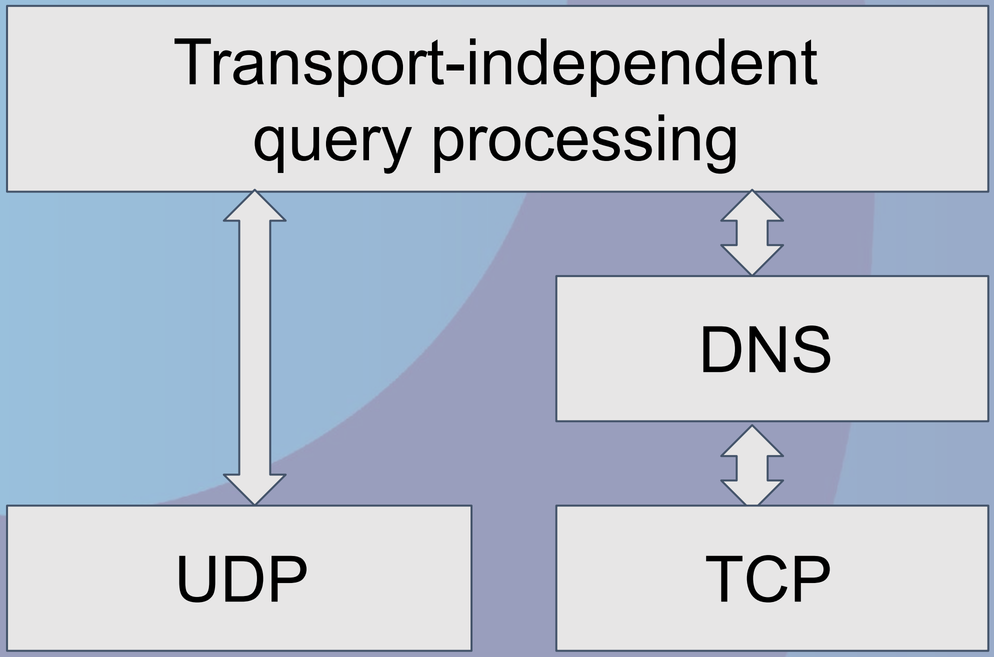
Vicky Risk



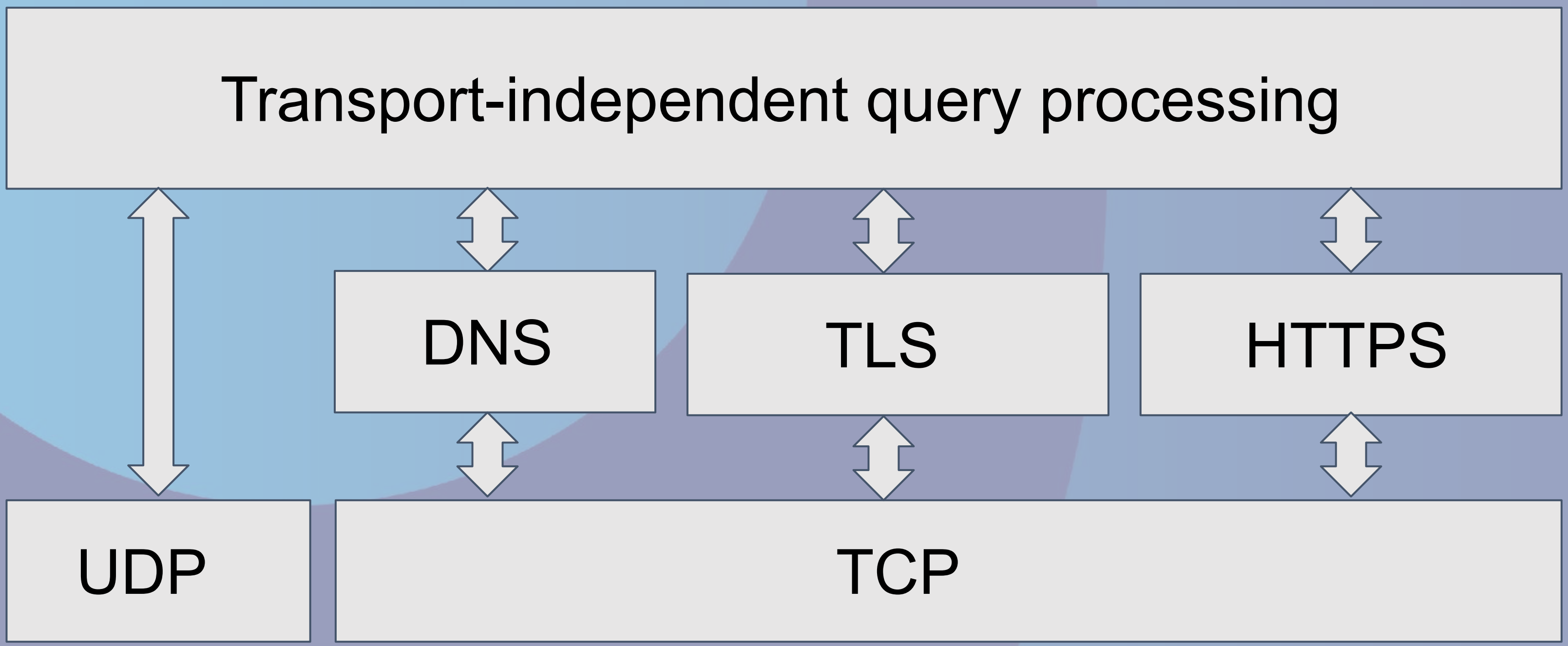
Network manager

- New asynchronous socket API for BIND.
- Based on libuv (Unicorn Velociraptor), but designed for flexibility.
- Much more efficient design.
- Modular and extensible.

Network manager modules



Future network manager modules



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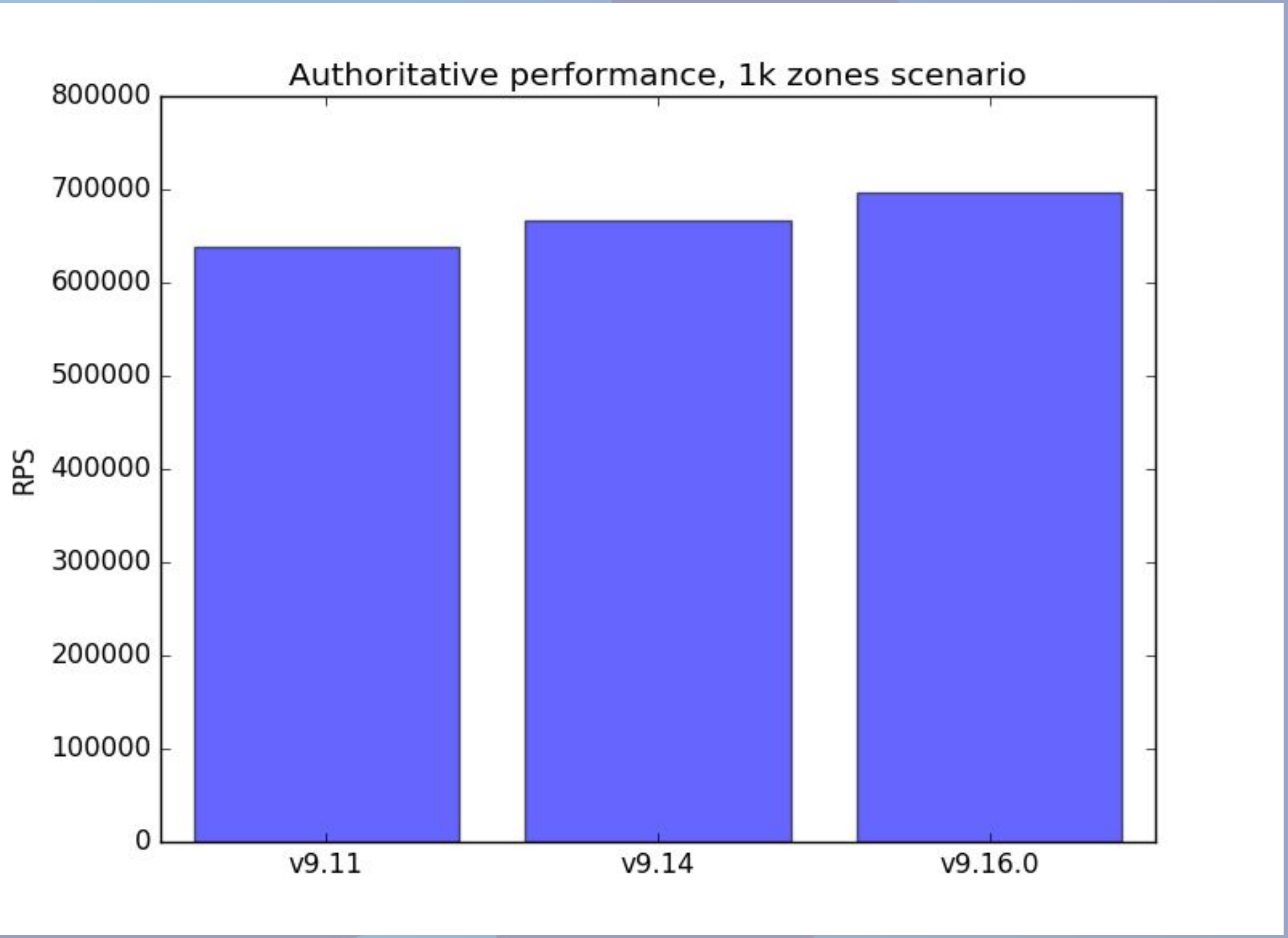
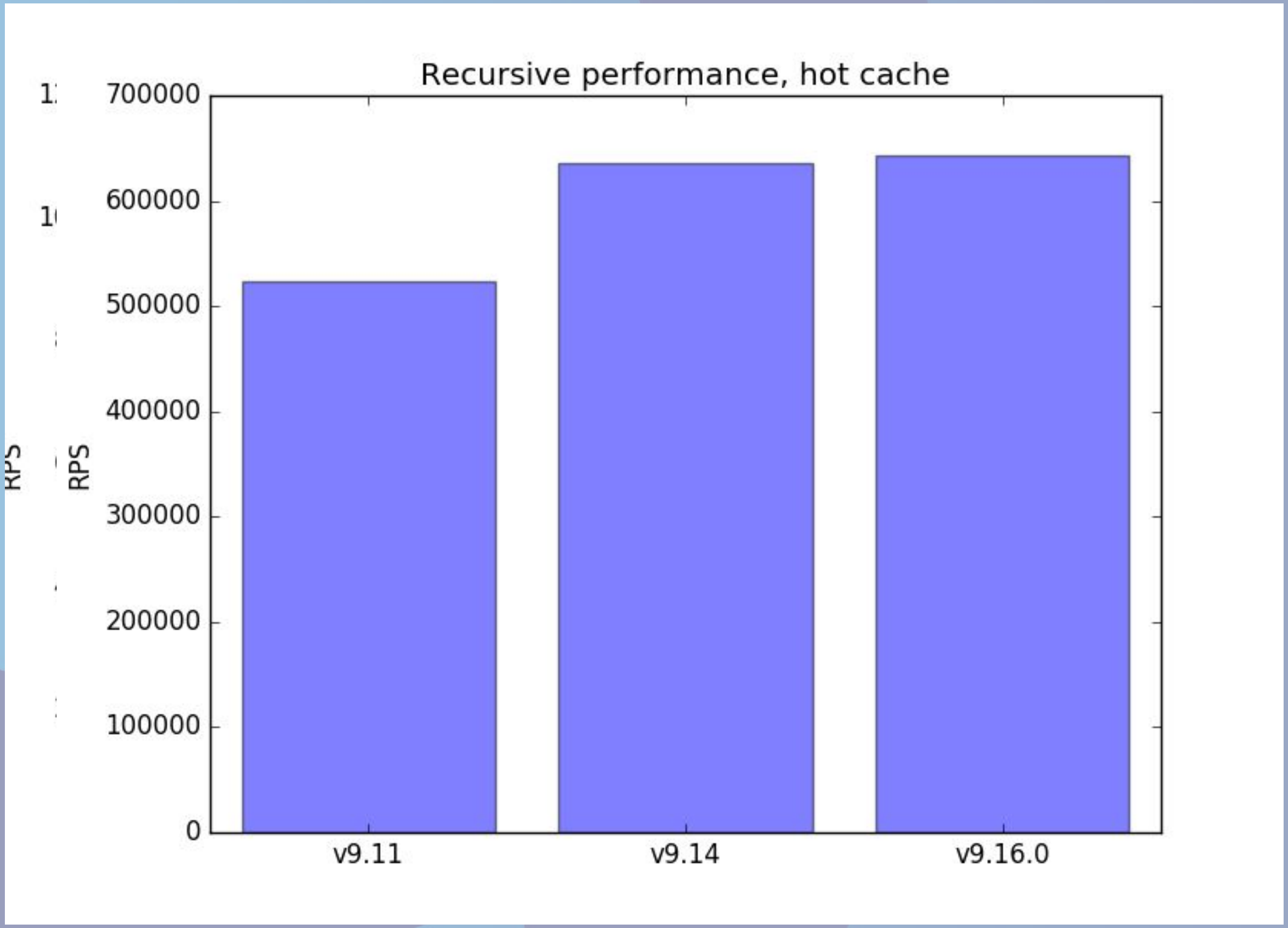
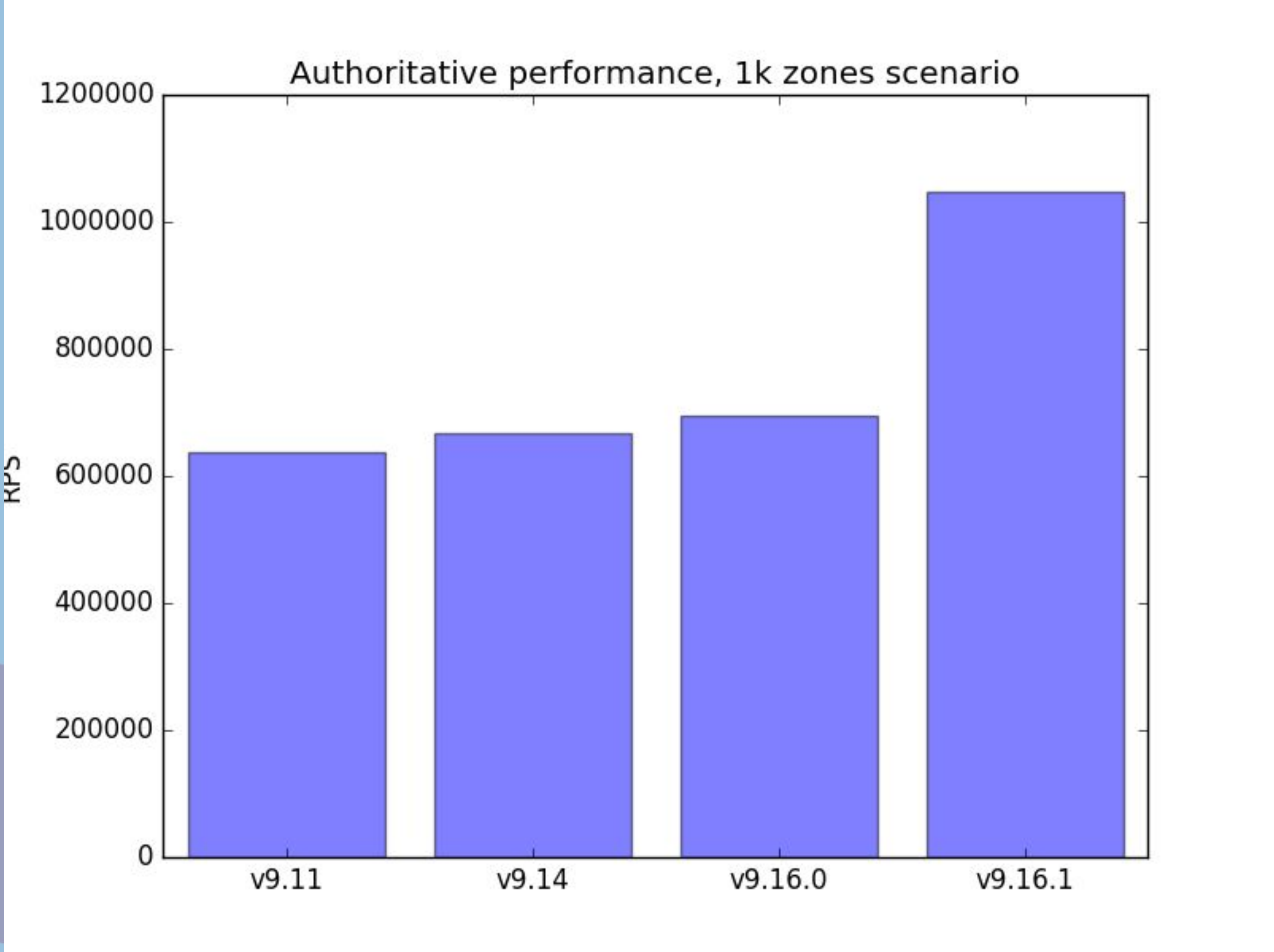
Performance in 9.16.0



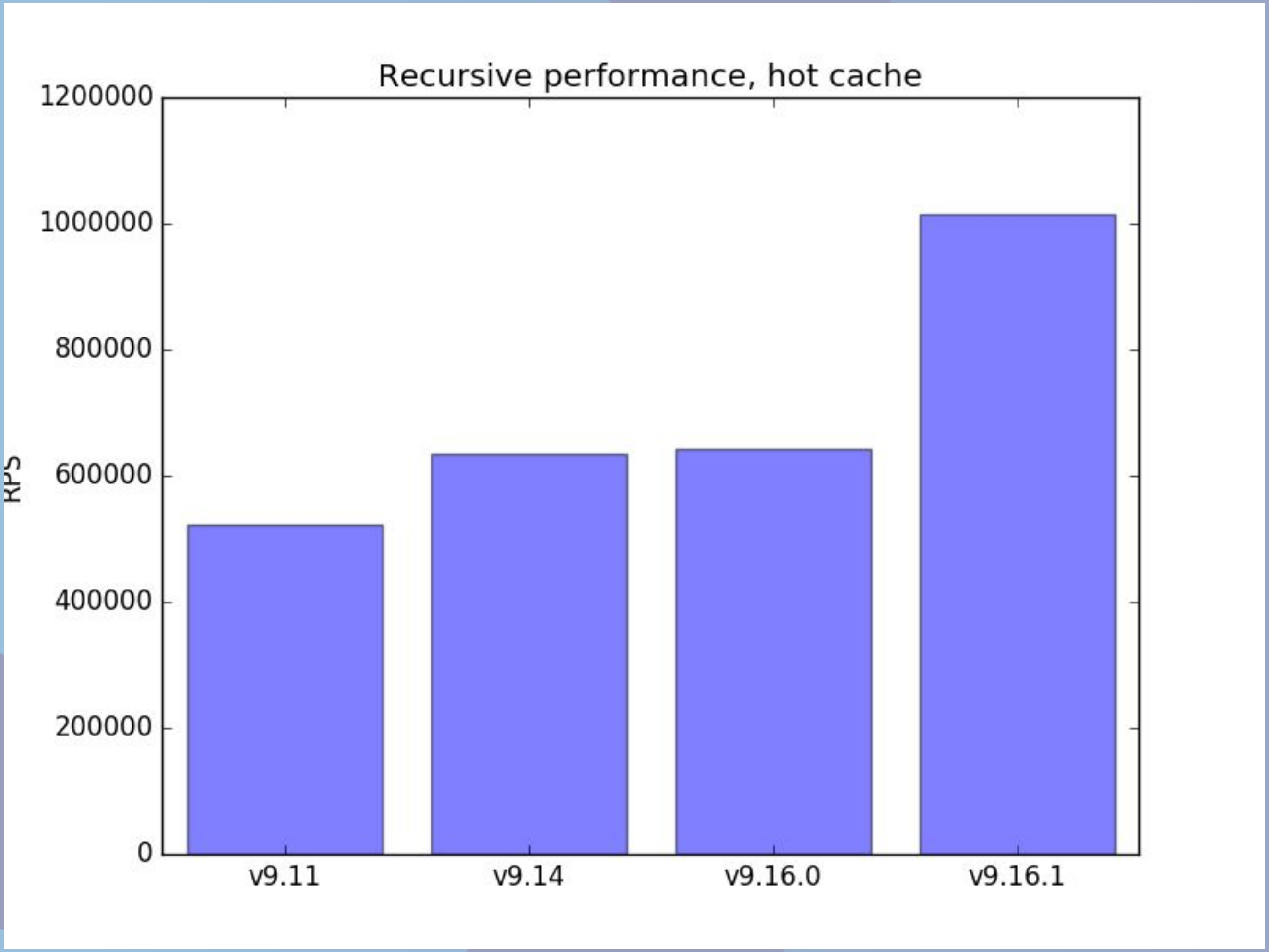
Performance in 9.16.0



Performance in 9.16.1 (under development)



Performance in 9.16.1 (under development)

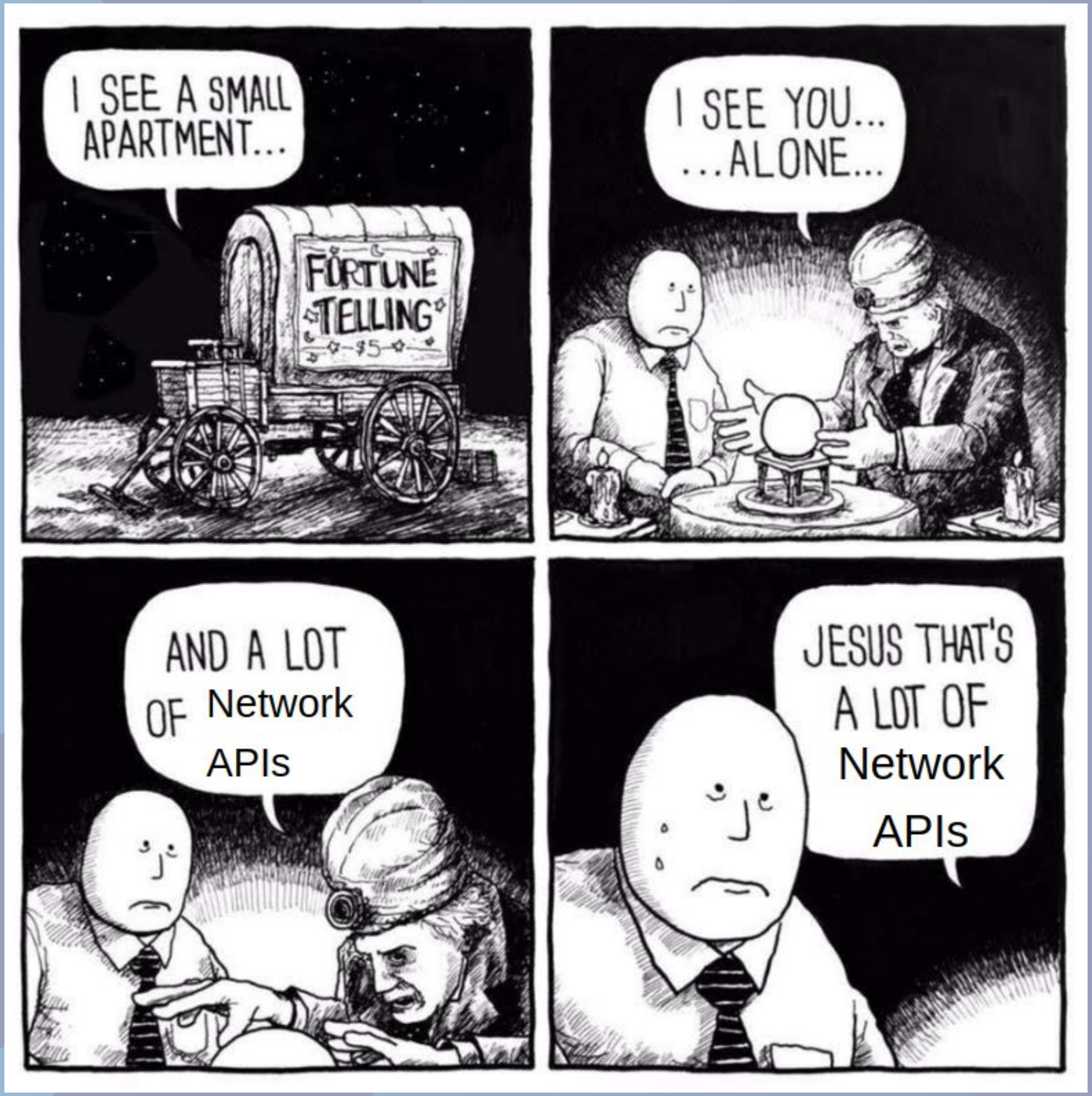


Not yet complete...

The network manager is currently only used for processing client requests.

The original BIND isc_socket API is still in use for:

- Upstream queries
- RNDC
- Statistics
- ...everything else



Coming in 9.17/9.18 (2021)

- Finish conversion to network manager
- DNS over TLS
- DNS over HTTPS
- More dnssec-policy features
- ...

Thank you! Questions?

- Main website: https://www.isc.org
- Software downloads: https://www.isc.org/download or https://downloads.isc.org
- Presentations: https://www.isc.org/presentations
- Main GitLab: https://gitlab.isc.org