Building and Deploying a new Nameserver

Manu Bretelle
Production Engineer
DNS@FB History
DNS@FB

History

• Using tinydns since 2012
• IPv6 support
• CIDR based location matching
• EDNS Client Subnet location matching
• Multiple Map support
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Feature Requirements

• Resolver-based “views”
• EDNS Client Subnet “views”
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Operational Requirements

- Simple to generate views
- Simple to configure
- Simple to deploy DB updates
- Query Logs
- Service Health Metrics
- Easy to integrate in our infrastructure.
What's great about tinydns?

- Simple
- Efficient
- Opinionated
- Line-based zone format
- Distributing data.cdb is simple
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Why moving off tinydns?

- Not easy to extend
- Simplicity comes with trade-offs
- Lack of tests and modern programming paradigms
- Lot of global/static variables
- Hard for engineers to ramp up
Searching alternatives
<table>
<thead>
<tr>
<th></th>
<th>Resolver View</th>
<th>ECS View</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIND</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Knot</td>
<td>No (until 2.7.0)</td>
<td>No (until 2.7.0)</td>
</tr>
<tr>
<td>NSD</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>PowerDNS</td>
<td>Yes (geoip backend)</td>
<td>Yes (geoip backend)</td>
</tr>
</tbody>
</table>

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Had they been available solutions, we would have needed to make sizeable changes to our existing pipeline.

Deploying a .cdb works well for us. We have plenty of tooling available that does sanity checking and operational work for us.
What then?
Plug your own logic in
aka building a module

- CoreDNS
- Knot DNS
- PowerDNS
Picking up a solution
Building a Proof of Concept

- How easy to get started with it?
- What is the learning curve?
- How easy to build/test?
- How familiar are engineers with the language/library?
- How easy would it be to integrate in-house?
Picking up a solution

CoreDNS

- Excellent plugin tutorial
- miekg/dns:
  - already used in our DNS pipeline
  - simple to use
- Go tooling makes building/running/testing easy
Development
From Proof of Concept To Prod

PoC
Get something working to demonstrate feasibility.

Production-ize
Logging, metrics, refactoring, performance.

Compatibility
Support feature parity. same input, same output

Integration
Make it work internally, remove unnecessary dependencies.
Proof of Concept
aka get some answers

- 3 weeks times
- Read from CDB
  - Map/Query matching
  - Location for Resolver/ECS
  - Unpack RDATA from CDB
- unittests, unittests, unittests, unittests
- dirty^Wquick hacks
This is still a POC, but it does support (as in answer somehow correctly) some of the basic A/AAAA queries. Quick benchmark shows it is 3x slower than TinyDNS on a single core,
Compatibility
aka “actually works correctly”

• 2 weeks time
• Feature parity with tinydns
• Validate replaying queries against tinydns and fbdns
• Find bugs, fix them, unit test them, rinse and repeat
• Would work if taking prod traffic
Integration
aka “use internal toolchain”

• 2 weeks time
• Get rid of CoreDNS dependencies
• Build standalone UDP/TCP listening layer
• Reuse CoreDNS’s ServeDNS entrypoint and helpers
Production-ize
aka “prime time”

• 1 month time
• Query Logging
• Metrics
• refactoring
• profile, find hotspots, optimize
• rinse/repeat
Deployment
Deployment Strategy

- Focus on `b` nameservers
- Leave `a` alone
- Start small
- Push early in the week
- Build confidence
- Deploy to more POPs
Test the water

Slow Start

- Couple of hosts in a cluster
- Eventually a full cluster
- Let it bake 1 week
- Look for traffic change
- Check performance
How does it compare?
Ramp it up

- 7 days later
- 1 more cluster
- Let it bake
- Look for traffic change
It’s working great!
gogogogogogogo

- 2 days later
- Deploy to more clusters at 12pm
- Later that day, employees started reporting issues
- Revert to tinydns
- Everyone is happy
- Troubleshoot, unit tests, fix
Didn’t you have validating tests?
Yes…. but

• Source IP is hard to spoof if you want to receive the answer.
• Tests validated answers using ECS
What Happened?

[fbdns] properly handle IPv6 resolver ip in FindLocation

Author: chantra · Created Apr 19, 2018 · Last Updated Apr 20, 2018 1:43 PM

Summary

In the case of ResolverLocation lookup, the logic constructing the net.IPNet was buggy and only affected IPv6. Unittest did cover the IPv6 resolver lookup in DB but were bypassing the part that built that net.IPNet. This diffs added test cases that confirmed failure, added unitests that excercise the net.IPNet logic and fixes the issue. Unitests are covering resolver location lookup as well as full DNS resolution.
Next Monday!
Just keep rolling!

• Quickly back to where we were
• Over 2 weeks, rolled to 100% of `b` nameservers
• `a` nameservers
  • stayed on tinydns 5 more months
  • migrated to fbdns over 2 weeks
1 year later....

Pay the tech debt

- 2018-03-02 copy coredns/coredns:request/request.go
- 2018-03-21 coredns report “High CPU Load” GH#1625
- 2018-03-22 coredns fix in GH#1629
- 2019-04-30
- 2019-05-01 Production SEVs ► some fbdns tasks busy-spinning 1 core
Fixing this

Clean the tech debt

• get rid of copy/paste:
  • use proper dependency management
  • avoid forks, work with upstream
• Keep third-party up-to-date
• Invest in regression detection
• Invest in continuous (staged) rollout
• Invest in Fuzzing
Thank You

- miekg/dns and CoreDNS
- BIND, Knot, NSD and PowerDNS
- gitlab.isc.org/isc-projects/DNS-Compliance-Testing
- github.com/DNS-OARC/dnsperf