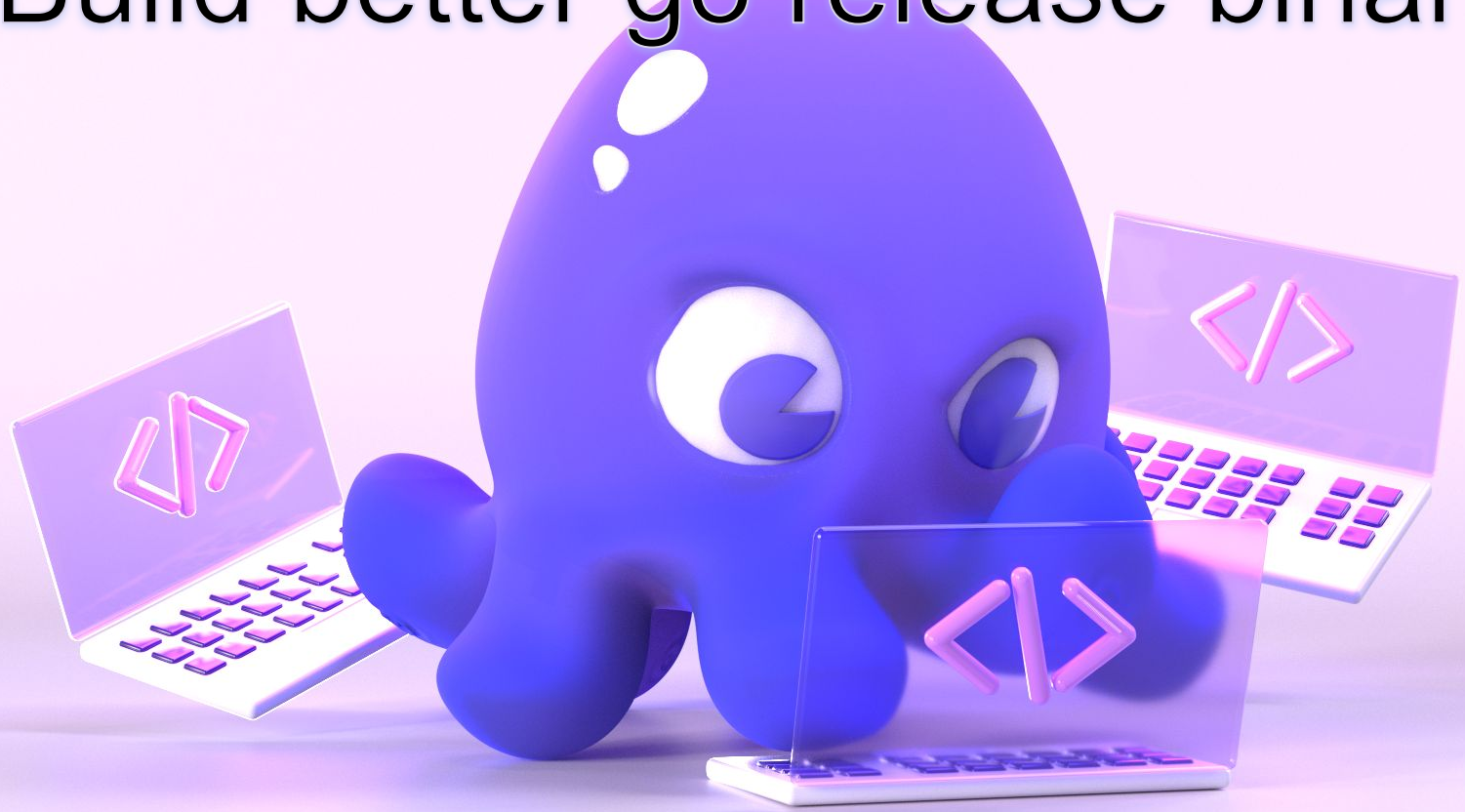
Build better go release binaries



About me

- Linux OS Distribution developer
- Debian, Ubuntu, Clear Linux, Wolfi
- SysV init, Upstart, Systemd, Grub, Linux, OpenSSL …
- Principle Engineer at Chainguard
- Focused on building production-grade container images

- Linux focused, broad application, tested at scale on x86_64 & arm64
- Production builds
- Transferable to other arches / OSes

go build -ldflags -w

- Debug information is on by default
- It can be quite large in size
- Often unused in production

Resolution:

- go build -ldflags -w

Alternative

- Strip & Store in debuginfod server: strip –strip-debug

go build -trimpath

- Full file paths leak into binary
- Takes up space & lead to non-reproducible builds

Resolution:

- go build -trimpath

Caveat:

- Removes -X importpath.name=value definitions from buildinfo
- Upstream bug report in progress to resolve this

go build -tags netgo,osusergo

- Default libc/NSS for DNS and username resolution
- Old hammer CGO_ENABLED=0
- Can elect golang implementation & maintain CGO access
- Helps with boringcrypto, go-openssl, go-msft-fips

Resolution:

- For containers / portable binaries: go build -tags netgo,osusergo
- For explicit Host os resolution: CGO_ENABLED=1 go build

GOAMD64=v2 GOARM64=v8.0

- Production hardware is not 20 years old
- Optimisations available that can be used by default
- Depending on your deployments can use v3, v4 too

Resolution:

- Environment variables: GOAMD64=v2 GOARM64=v8.0

Caveat:

- Check your production hardware SKUs, some have broken v3 support

go build -buildmode=pie

- Position Independent Code/ Executable can improve security
- Should use for dynamic binaries
- Security scanners / hardening-check report this

Resolution:

- go build -buildmode=pie

Alternative:

- Also available with external linker

go build -ldflags -X main.Version=$(git describe…)

- go build sets commit & date; and go install sets tag; but not both
- Do not use trimpath
- Check with go version -m & scanners look for it too

Solution:

$ go build -ldflags -X main.Version=$(git describe --tags --dirty --always --abbrev=12)

$ go version -m mybinary | grep -e main.Version

build -ldflags="-X main.Version=1.19.0”

CGO Hardening

- Accelerated code & C library access is convenient
- OpenSSF Compiler Options Hardening Guide for C and C++
- CFLAGS / CXXFLAGS ignored by go
- Distributions (rpmspec / dpkg-buildflags) typically do not set these

Resolution:

- Use CGO_CFLAGS CGO_CXXFLAGS etc
- Use wrapper for gcc -specs with file
- Use clang .cfg automatically loaded config files

Gcc spec file example

Gcc wrapper:

```
#!/bin/sh

exec /usr/bin/${0##*/} -specs "${GCC_SPEC_FILE:-openssf.spec}" "$@"
```

Reduced OpenSSF spec file for GCC-14:

```
*self_spec:

+ -O2 -fhardened -Wl,--as-needed,-O1,--sort-common,-z,noexecstack,
-z,relro,-z,now -fno-delete-null-pointer-checks -fno-strict-overflow
-fno-strict-aliasing -fno-omit-frame-pointer -mno-omit-leaf-frame-pointer
```

[security] Vulnerability in golang.org/x/net

Hello gophers,

We have tagged version v0.33.0 of golang.org/x/net in order to address a security issue.

x/net/html: non-linear parsing of case-insensitive content

Version v0.33.0 of golang.org/x/net fixes a vulnerability in the golang.org/x/net/html package which could cause a denial of service.

An attacker can craft an input to the Parse functions that would be processed non-linearly with respect to its length, resulting in extremely slow parsing.

Thanks to Guido Vranken for reporting this issue.

This is CVE-2024-45338 and Go issue https://go.dev/issue/70906.

Cheers,
Go Security team

Keep symbols tables!

- Govulncheck in -mode=binary reports **module** level CVEs
- If binary has symbols tables, it reports **symbol** level CVEs

Example from Wolfi

- Packages/Sub-packages found with x/net : 1065
- x/net/html Symbols found in binaries : 242
- Govulncheck : 13

This often removes need to upgrade, rebuild, re-release binaries

Example coredns v1.11.1

$ go install -ldflags -s github.com/coredns/coredns@v1.11.1

$ govulncheck -mode=binary coredns

Your code is affected by **15** vulnerabilities from **7** modules and the Go standard library.

This scan found no other vulnerabilities in packages you import or modules you require.

Example coredns v1.11.1

$ go install github.com/coredns/coredns@v1.11.1

$ govulncheck -mode=binary coredns

Your code is affected by **8** vulnerabilities from **4** modules and the Go standard library.

This scan **also found 2 vulnerabilities** in packages you import and **5**

vulnerabilities in modules you require, **but your code doesn't appear to call**

these vulnerabilities.

How to keep symbols tables?

- Do **not** use: go build -ldflags -s
- Do **not** use: strip --strip-all
- Verify with: go tool nm

Caveats:

- There is binary size penalty
- Worth it, if production binary is subject to security scans
- Check if your security scanners support this
- Reflection (urgh)

Rince & repeat - rebuild & re-release

- Go toolchains have bug fixes & CVE fixes
- Dependencies have bug fixes & CVE fixes
- Continuously release binaries, or tag micro-point releases
- Same code built with new go toolchain can be safer

Solution

- Bump “toolchain go1.21.3” in go.mod
- Go get dependencies in go.mod
- Tag a micro-point releases
- Automate low-key micro-point releases

Thank you!

Will try to contribute this to OpenSSF Working Group

I have Chainguard Linky stickers!

Questions?