

Debug golang program with Delve

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COSCUP 2020

About Me

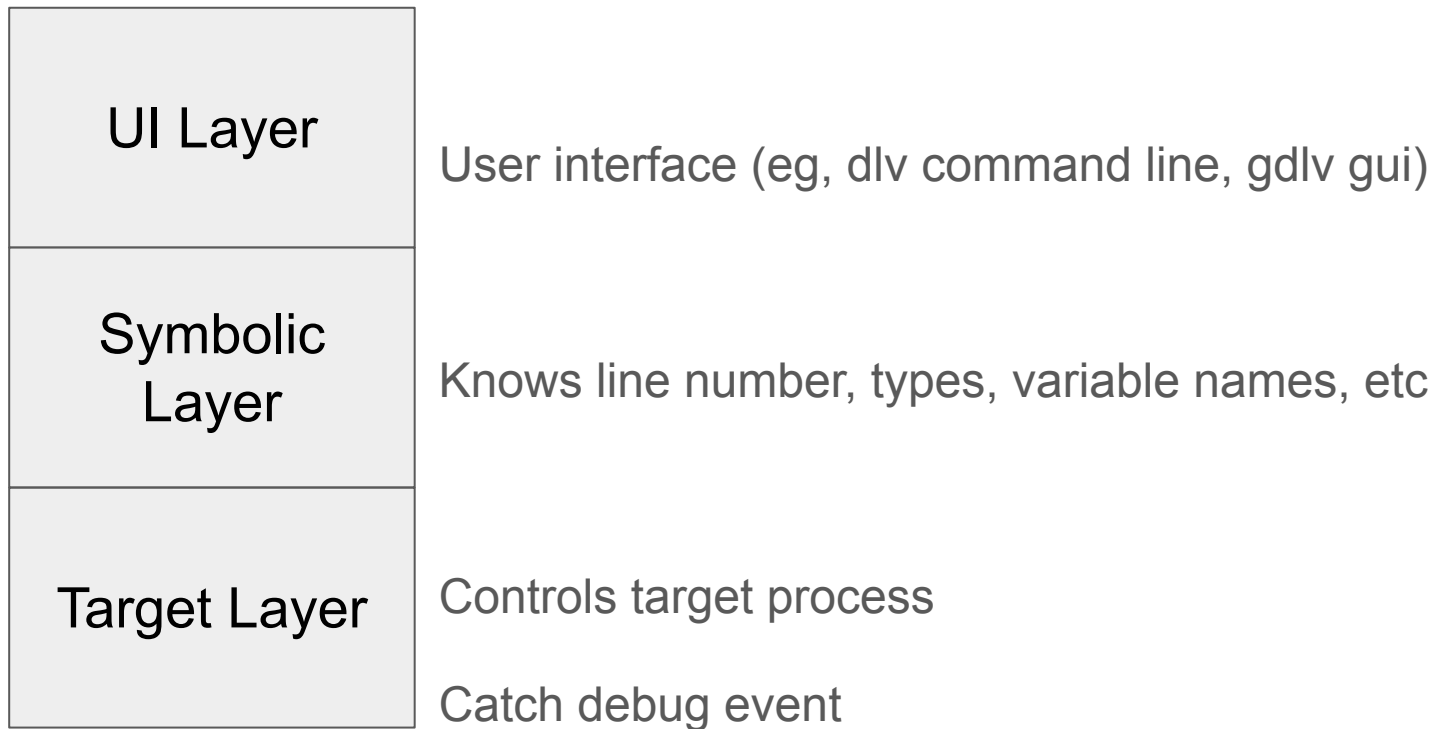
- Blockchain Engineer at Diode (<https://diode.io/>)
- Editor of Taipei Ethereum Meetup
- Open source contributor
- Love to learn new technology
- Programming languages: JS, GO, PHP, C, PYTHON
- Twitter: @alk03073135 | Github: @sc0vu



Outline

- How delve works
- Debug with delve
- Debug with GDB

How delve works



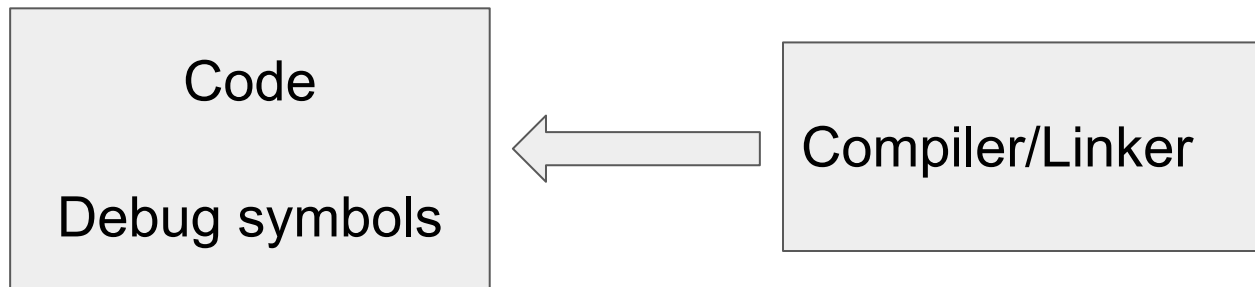
Target layer

- native
 - windows
 - linux
 - macos
 - won't work properly
- freebsd/amd64, linux/386 and linux/arm64

Target layer

- core
 - linux_amd64
- gdbserial
 - debugserver on macos
 - tcp/ip service
 - won't need to sign the binary
 - lldb server
 - mozilla rr

Symbolic layer



- Opening executable file and reading the debug symbols.
- The format of debug symbols is DWARFv4, which they implement in /pkg/dwarf

Symbolic layer

- dwarfdump ./thttp
 - debug_info
 - debug_frame
 - debug_line

```
0x0009c689: DW_TAG_variable
    DW_AT_name      ("&tunnel")
    DW_AT_decl_line  (15)
    DW_AT_type       (0x00000000000421b7 "*github.com/sc0vu/simttunnel.Tunnel")
    DW_AT_location   (DW_OP_fbreg -312)

0x0009c69b: DW_TAG_variable
    DW_AT_name      ("sig")
    DW_AT_decl_line  (24)
    DW_AT_type       (0x00000000000421eb "os.Signal")
    DW_AT_location   (DW_OP_fbreg -304)

0x0009c6a9: DW_TAG_variable
    DW_AT_name      ("err")
    DW_AT_decl_line  (16)
    DW_AT_type       (0x000000000003895c "error")
    DW_AT_location   (DW_OP_fbreg -288)

0x0009c6b7: NULL

0x0009c6b8: DW_TAG_variable
    DW_AT_name      ("main..inittask")
    DW_AT_location   (DW_OP_addr 0x125d2a0)
    DW_AT_type       (0x0000000000038fb1 "runtime.initTask")
    DW_AT_external   (0x01)

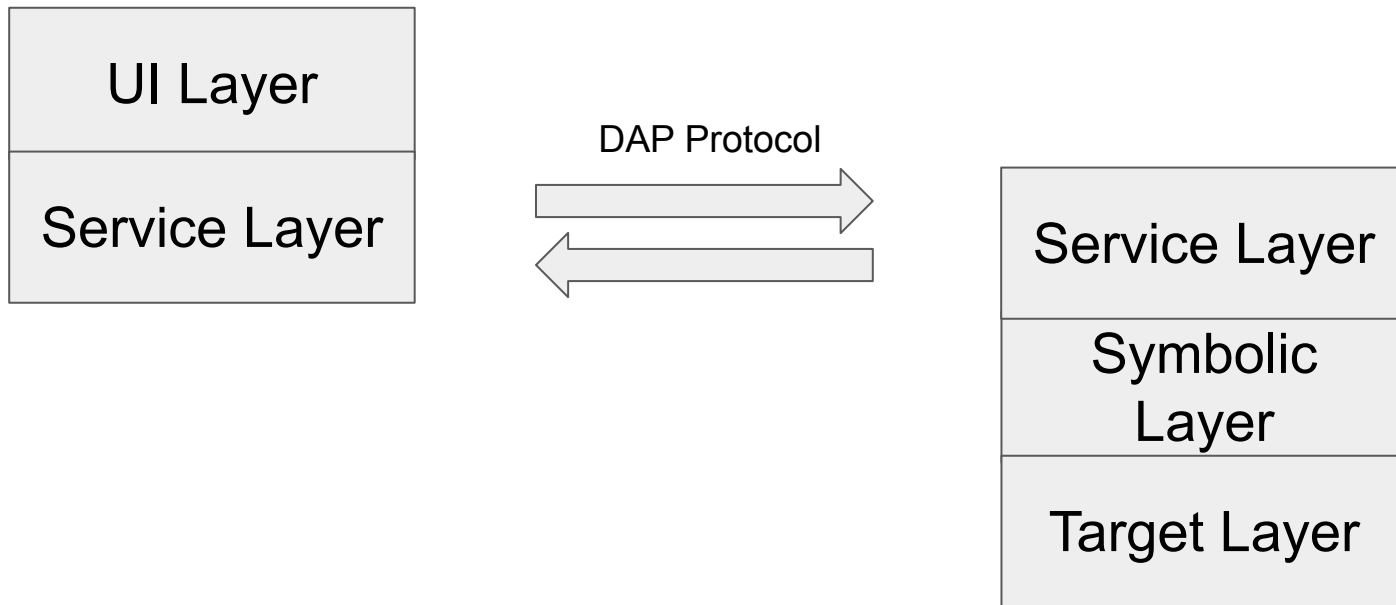
0x0009c6d7: DW_TAG_variable
    DW_AT_name      ("runtime.modinfo")
    DW_AT_location   (DW_OP_addr 0x126b400)
    DW_AT_type       (0x0000000000031b7b "string")
    DW_AT_external   (0x01)

0x0009c6f7: NULL
0x0009c6f8: Compile Unit: length = 0x0000007f version = 0x0004 abbr_offset = 0x0000 addr_size = 0x08 (next unit at 0x0009c77b)

0x0009c703: DW_TAG_compile_unit
    DW_AT_name      ("internal/syscall/execenv")
    DW_AT_language   (DW_LANG_Go)
    DW_AT_comp_dir    (".")
    DW_AT_producer    ("Go cmd/compile go1.14.3; -N -l")
    DW_AT_unknown_2905 ("execenv")

0x0009c747: DW_TAG_variable
    DW_AT_name      ("internal/syscall/execenv..inittask")
    DW_AT_location   (DW_OP_addr 0x125c0c0)
    DW_AT_type       (0x0000000000031343 "<unspecified>")
    DW_AT_external   (0x01)
```


How delve works



- Debug adapter protocol
- <https://microsoft.github.io/debug-adapter-protocol>

Debug with delve

Examples to debug with this:

<https://github.com/sc0vu/simtunnel>

```
1 package main
2
3 import (
4     "log"
5     "os"
6     "os/signal"
7     "syscall"
8
9     "github.com/sc0vu/simtunnel"
10 )
11
12 func main() {
13     localPort := 9999
14     forwardPort := 8080
15     tunnel := simtunnel.NewTunnel(localPort, "localhost", forwardPort)
16     err := tunnel.ListenAndServe()
17     if err != nil {
18         log.Printf("Failed to listen and serve the tunnel: %s\n", err.Error())
19     }
20     log.Printf("Listen and serve on port: %d\n", localPort)
21     log.Printf("Forward to: localhost:%d\n", forwardPort)
22     sigChan := make(chan os.Signal, 1)
23     signal.Notify(sigChan, syscall.SIGINT)
24     sig := <-sigChan
25     switch sig {
26     case syscall.SIGINT:
27         break
28     }
29     tunnel.Close()
30     log.Printf("Close tunnel")
31     return
32 }
33
```

Debug with delve

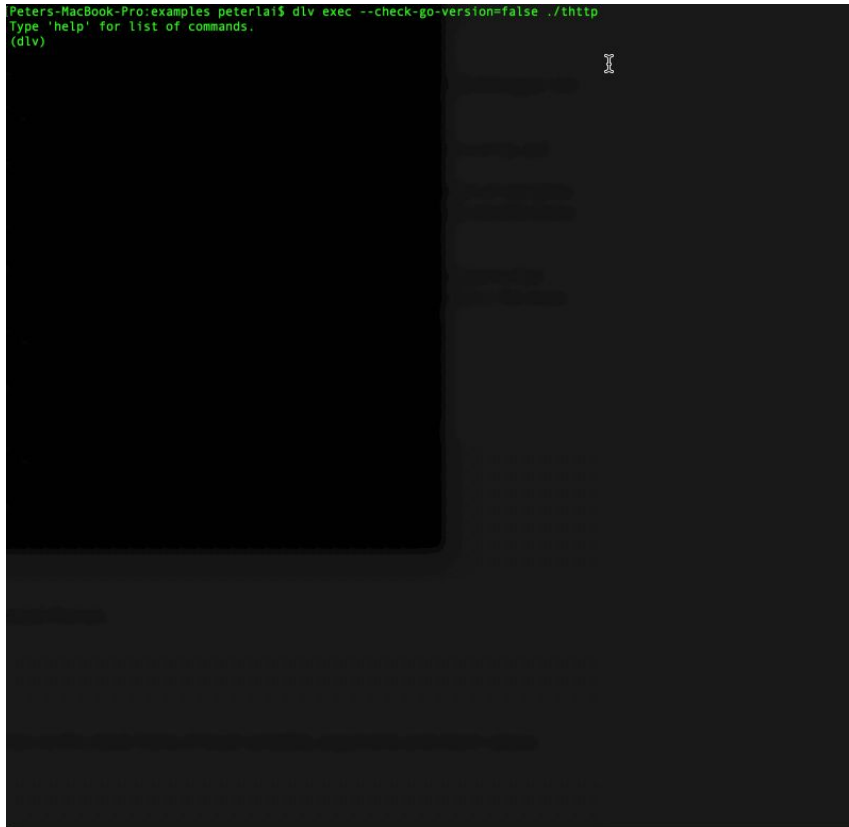
- debug with go files:
 - `$ dlv debug *.go -- [parameters]`
- debug with build go binary:
 - `$ go build -gcflags="all=-N -l" *.go`
 - `$ dlv exec [filename] -- [parameters]`
 - `$ dlv attach [pid]`

Debug with delve

- debug with remote dlv server:
 - `$ dlv debug --listen [127.0.0.1:8888] --headless *.go -- [parameters]`
 - `$ dlv connect [127.0.0.1:8888]`

Debug with delve

- find the function
 - funcs netCopy
- set the breakpoints
 - b netCopy
- continue till next breakpoint
 - c
- next step
 - n [1]



```
Peters-MacBook-Pro:examples peterlai$ dlv exec --check-go-version=false ./http
Type 'help' for list of commands.
(dlv)
```

Debug with delve

- set breakpoint
 - b tunnel.go:41
- stop when srcPort is 9999
 - cond 1 srcPort==9999

```
Peters-MacBook-Pro:examples peteria$ dlv exec --check-go-version=false ./http
Type 'help' for list of commands.
(dlv) i
```

Debug with delve

- set breakpoint
 - b netCopy
- step into io.Copy
 - step

```
Peters-MacBook-Pro:examples peterlai$ delve exec --check-go-version=false ./http
Type 'help' for list of commands.
(dlv) b netCopy
Breakpoint 1 set at 0x1137fa8 for github.com/sc0vu/simtunnel.(*Tunnel).netCopy() /Users/peterlai/simtunnel/tunnel.go:19
(dlv) █
```

Debug with GDB

- Build `-gcflags="all=-N -l"`
- Build `-ldflags=-compressdwarf=false`
- Load GO runtime-gdb.py support (`src/runtime/runtime-gdb.py`)
 - `$len, $cap, $dtype`
 - `GoroutinesCmd(), GoroutineCmd(), GofaceCmd()`

Debug with GDB

```
Peters-MacBook-Pro:examples peterlai$ gdb ./http
GNU gdb (GDB) 9.2
Copyright (C) 2020 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-apple-darwin18.7.0".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.

For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from ./http...
Loading Go Runtime support.
(gdb) b tunnel_http.go:15
Breakpoint 1 at 0x1138e34: file /Users/peterlai/simtunnel/examples/tunnel_http.go, line 15.
(gdb) run
Starting program: /Users/peterlai/simtunnel/examples/http
[New Thread 0x1803 of process 5020]
[New Thread 0x2503 of process 5020]
```

stuck sometimes.

```
http://www.gnu.org/software/gdb/documentation/...
For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from ./http...
Loading Go Runtime support.
(gdb) b tunnel_http.go:15
Breakpoint 1 at 0x1138e34: file /Users/peterlai/simtunnel/examples/tunnel_http.go, line 15.
(gdb) b tunnel_http.go:16
Breakpoint 2 at 0x1138eae: file /Users/peterlai/simtunnel/examples/tunnel_http.go, line 16.
(gdb) b tunnel_http.go:17
Breakpoint 3 at 0x1138ee1: file /Users/peterlai/simtunnel/examples/tunnel_http.go, line 17.
(gdb) b tunnel_http.go:18
Breakpoint 4 at 0x1138eeb: file /Users/peterlai/simtunnel/examples/tunnel_http.go, line 18.
(gdb) run
Starting program: /Users/peterlai/simtunnel/examples/http
[New Thread 0x2703 of process 21967]
[New Thread 0x2603 of process 21967]
[New Thread 0x1b03 of process 21967]
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/bsd.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/darwin_vers.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/dirstat.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/dirstat_collection.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/err.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/exception.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/init.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/mach.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/stdio.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/stdlib.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/string.o': can't open to read symbols: No such file or directory.
warning: '/BuildRoot/Library/Caches/com.apple.xbs/Binaries/Libc_darwin/install/TempContent/Objects/Libc_build/libsystem_darwin.dylib.build/Objects-normal/x86_64/variant.o': can't open to read symbols: No such file or directory.
[New Thread 0x2717 of process 21967]
[New Thread 0x1c03 of process 21967]
[New Thread 0x1d03 of process 21967]
[New Thread 0x1e03 of process 21967]
[New Thread 0x2617 of process 21967]
```

it works

Debug with GDB

```
Thread 3 hit Breakpoint 1, main.main ()
    at /Users/peterlai/simtunnel/examples/tunnel_http.go:15
15      tunnel := simtunnel.NewTunnel(localPort, "localhost", forwardPort)
(gdb) step
runtime.newobject (typ=0x116e240 <type.*+216832>, ~r1=<optimized out>)
    at /usr/local/Cellar/go/1.14.3/libexec/src/runtime/malloc.go:1164
1164     func newobject(typ *_type) unsafe.Pointer {
```

- Stop in tunnel_http.go:15
- Step into NewTunnel
- Didn't set breakpoint in NewTunnel

Debug with GDB

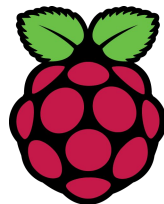
```
Thread 3 hit Breakpoint 2, main.main () at /Users/peterlai/simtunnel/examples/tunnel_http.go:16
16      err := tunnel.ListenAndServe()
(gdb) p err
$4 = {tab = 0x11, data = 0xc00011cf70}
```

- Stop in tunnel_http.go:16
- Didn't know much about struct data

```
(gdb) p $dtype(err.data)
$10 = (void *) 0xc00011cf70
```

Pi Givaway

- Pi zero with camera module
 - Download and publish the local resource to diode network (<https://diode.io/download>)
 - Register BNS in diode network (<https://diode.io/prenet/#/dns>)
 - Connect to your local resource from your BNS



Q & A

References

- GDB (<https://www.gnu.org/software/gdb/>)
- Debugging Go Code with GDB (<https://golang.org/doc/gdb>)
- [Codesign the gdb on macos](#)
- Alessandro Arzilli talks:
 - Internal Architecture of Delve, a Debugger For Go (<https://www.youtube.com/watch?v=IKnTr7Zms1k>)
- Delve github (<https://github.com/go-delve/delve>)
- Mozilla RR (<https://github.com/mozilla/rr>)
- Diode (<https://diode.io>)
- Diode Go Client (https://github.com/diodechain/diode_go_client)