Shooting the trouble down to the Wire...Shark Lua Plugin

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Objectives

- Network analysis
  - Client-Server
  - Server-Server
- Production support
- Report generation
- Anomaly detection
- Protocol Development

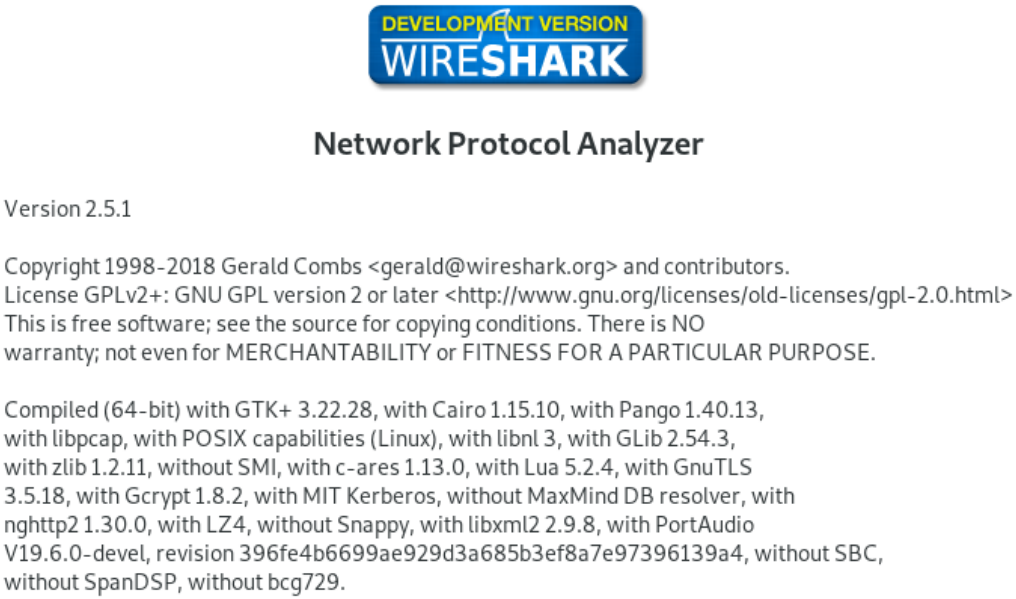
Why Lua?

- Light-weight
- Dynamic
- Prototyping dissectors
- Ease of deployment
- Scripting
- Portability
- C interface

Wireshark Lua

- Dissectors
  Decode packet data.
- Chained Dissectors
  Access to one dissector's data.
- Post-dissectors
  Called after every other dissector has been called.
- Listeners
  Called for every packet that matches a filter or tap.

Usage




```
$ wireshark -X lua_script:aerospike.lua capture.pcapng
```

```
$ tshark -X lua_script:aerospike.lua capture.pcapng
```

You can also place plugins in ~/.wireshark/plugins folder.

Tap Listener

```
-- simple_http.lua
-- implements a very simple tap in Lua

-- this is going to be our counter
http_packets = 0

-- this is going to be our tap
tap_http = nil

-- first we declare the tap called "http tap" with the filter it is going to use
tap_http = Listener.new(nil,"http")

-- this function will get called at the end(3) of the capture to print the summary
function tap_http.draw()
    debug("http packets:" .. http_packets)
end

-- this function is going to be called once each time the filter of the tap matches
function tap_http.packet()
    http_packets = http_packets + 1
end

-- this function will be called at the end of the capture run
function tap_http.reset()
    http_packets = 0
end
```

Debugging

- critical(text)
- warn(text)
- info(text)
- debug(text)
- print(text)

```
local d = require 'debug'

print(d.traceback())

d.debug()
```

https://wiki.wireshark.org/Development/Tips

Luacheck

- accessing undefined variable
- line contains only whitespace
- setting non-standard global variable
- line is too long
- trailing whitespace in a comment

```
$ luarocks install luacheck

$ luacheck lua/aerospike.lua

Total: 0 warnings / 0 errors in 1 file
```

Markdown Structure

```
# Configuration
# Statistics
# Helper Functions
# Protocols
## Common
## Info
## Message
### Aerospike Message: Header Section
### Aerospike Message: Fields
### Aerospike Message: Operations
### Functions
## Heartbeat
# The Main
```

lit2lua

```
## Heartbeat

Heartbeat protocol

>   +----------------------+--------------------------+
>   |   Message Header     |     Message Fields       |
>   +----------------------+--------------------------+

Message Header

>   +-------------+------+
>   |    size     | type |
>   +-------------+------+
>   0             4      6

Constants

    local HB_HEADER_SZ_START    = 0
    local HB_HEADER_SZ_LENGTH   = 4
    local HB_HEADER_TYPE_START  = 4
    local HB_HEADER_TYPE_LENGTH = 2
```

lit2lua ...

Op

Value	Name	Description
1	AS_MSG_OP_READ	Read the value
2	AS_MSG_OP_WRITE	Write the value
3	AS_MSG_OP_CDT_READ	Prospective CDT top-level ops
4	AS_MSG_OP_CDT_MODIFY	Prospective CDT top-level ops
5	AS_MSG_OP_INCR	Add a value to an existing value (only on integers)
6	Unused	Reserved
7	Unused	Reserved
8	Unused	Reserved
9	AS_MSG_OP_APPEND	Append a value to an existing value (on strings and blobs)
10	AS_MSG_OP_PREPEND	Prepend a value to an existing value (on strings a blobs)
11	AS_MSG_OP_TOUCH	Touch a value (will only increment the generation)
129	AS_MSG_OP_MC_INCR	Memcache-compatible version of the increment command
130	AS_MSG_OP_MC_APPEND	Append value to existing value (only on strings)
131	AS_MSG_OP_MC_PREPEND	Prepend a value to an existing value (only on strings)
132	AS_MSG_OP_MC_TOUCH	Memcache-compatible touch (does not change generation)

Source: https://github.com/citrusleaf/aerospike-server/blob/master/as/include/base/proto.h#L239

```
$ less -f "docs/aerospike.lua.md" | lit2lua > lua/aerospike.lua
```

lit2lua ...

```
local TYPES_OPS = {
      [1] = "AS_MSG_OP_READ",
      [2] = "AS_MSG_OP_WRITE",
      [3] = "AS_MSG_OP_CDT_READ",
      [4] = "AS_MSG_OP_CDT_MODIFY",
      [5] = "AS_MSG_OP_INCR",
      [6] = "Unused",
      [7] = "Unused",
      [8] = "Unused",
      [9] = "AS_MSG_OP_APPEND",
     [10] = "AS_MSG_OP_PREPEND",
     [11] = "AS_MSG_OP_TOUCH",
    [129] = "AS_MSG_OP_MC_INCR",
    [130] = "AS_MSG_OP_MC_APPEND",
    [131] = "AS_MSG_OP_MC_PREPEND",
    [132] = "AS_MSG_OP_MC_TOUCH",
}
```

Protocol Dissection Pattern

Constants

```
local PROTO_VERSION_START  = 0
local PROTO_VERSION_LENGTH = 1

local PROTO_HEADER_START  = 1
local PROTO_HEADER_LENGTH = 1

local PROTO_TYPE_INFO = 1
local PROTO_TYPE_MSG  = 3

local INFO_SIZE_START  = 2
local INFO_SIZE_LENGTH = 6
local INFO_DATA_START  = 8
```

Protocol Dissection Pattern ...

Proto Objects, Header Fields

```
Create Proto objects

    local aerospike_attribute       = Proto("AerospikeAttribute",      "Aerospike Attributes")
    local aerospike_attribute_value = Proto("AerospikeAttributeValue", "Aerospike Attribute Value pairs")

Proto header fields

    local header_attributes = {
       attribute = ProtoField.string("header.attribute", "Attribute"),
    }

    local header_attribute_values = {
       attribute = ProtoField.string("header_attribute_values.attribute",   "Attribute "),
       value     = ProtoField.string("header_attribute_values.value",       "Value"),
    }

Register the protocol fields

    aerospike_attribute.fields       = header_attributes
    aerospike_attribute_value.fields = header_attribute_values
```

Protocol Dissection Pattern ...

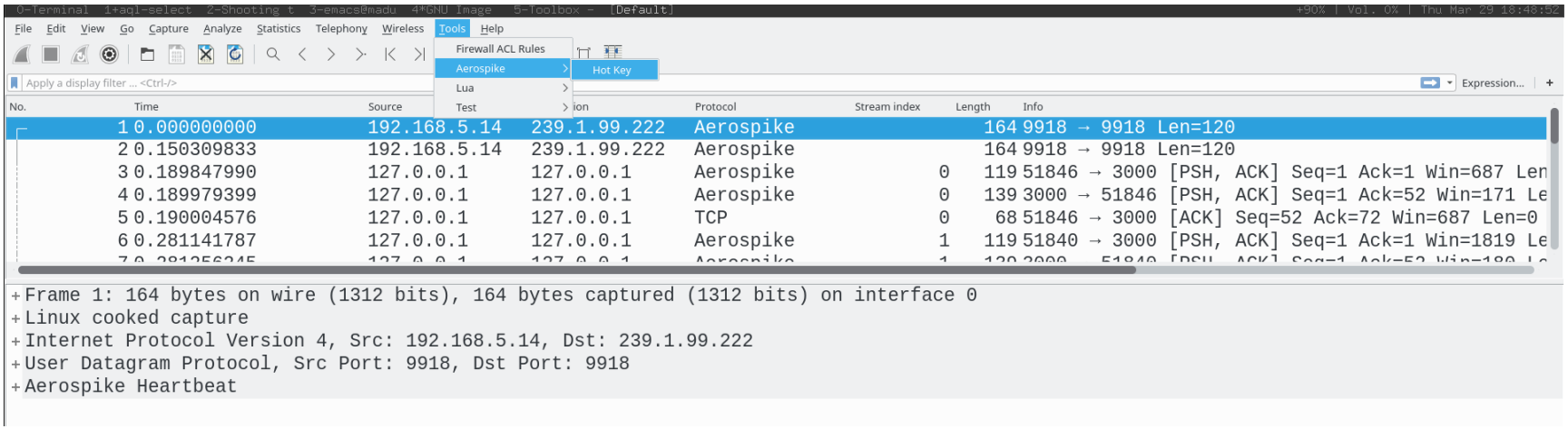
Functions

```
local function dissect_aerospike_info (tvbuf, tree, size)
   -- Separate the data by newline
   local data_tvbr = tvbuf:range(INFO_DATA_START, tonumber(size))
   local data_string = data_tvbr:string()

   local subtree = tree:add(aerospike_attribute, data_tvbr)
   local data_start = INFO_DATA_START
   for line in string.gmatch(data_string, "[^\n]+") do
      local d = tvbuf:range(data_start, string.len(line))
      local d_string = d:string()

      -- if contains attribute-values
      if string.find(d_string, "") then
         local parts = split_tab(d_string)
         ...
         ...
         ...
      end
      data_start = data_start + string.len(line) + 1 -- for \n
  end
end
```

Dissector Table

```
local default_settings =
   aerospike_port            = 3000,
   heartbeat_multicast_port = 9918,
   heartbeat_mesh_port       = 3002,


DissectorTable.get("tcp.port"):add(
   default_settings.heartbeat_mesh_port,      heartbeat_proto)
DissectorTable.get("udp.port"):add(
   default_settings.heartbeat_multicast_port, heartbeat_proto)
```

User Interface



Info protocol

```
- Aerospike Protocol
    Version: 2
    Type: Info (1)
    Size: 43
  - Aerospike Attributes
      Attribute: node
      Attribute: peers-generation
      Attribute: partition-generation
```

```
0000  00 00 03 04 00 06 00 00  00 00 00 00 00 00 08 00   ........ ........
0010  45 00 00 67 cb bf 40 00  40 06 70 cf 7f 00 00 01   E..g..@. @.p.....
0020  7f 00 00 01 ca 86 0b b8  8d ba 71 bb 7f c1 70 7f   ........ ..q...p.
0030  80 18 02 af fe 5b 00 00  01 01 08 0a 00 3b ab 16   .....[.. .....;..
0040  00 3b aa 1c 02 01 00 00  00 00 00 2b 6e 6f 64 65   .;...... ...+node
0050  0a 70 65 65 72 73 2d 67  65 6e 65 72 61 74 69 6f   .peers-g eneratio
0060  6e 0a 70 61 72 74 69 74  69 6f 6e 2d 67 65 6e 65   n.partit ion-gene
0070  72 61 74 69 6f 6e 0a                              ration.
```

Message protocol

```
- Aerospike Message Header
    Header Size: 22
  + Info1 : 0
  - Info2 : 1
      0... .... = AS_MSG_INFO2_RESPOND_ALL_OPS: 0
      .0.. .... = Unused: 0
      ..0. .... = AS_MSG_INFO2_CREATE_ONLY: 0
      ...0 .... = AS_MSG_INFO2_DURABLE_DELETE: 0
      .... 0... = AS_MSG_INFO2_GENERATION_GT: 0
      .... .0.. = AS_MSG_INFO2_GENERATION: 0
      .... ..0. = AS_MSG_INFO2_DELETE: 0
      .... ...1 = AS_MSG_INFO2_WRITE: 1
  + Info3 : 0
    Unused: 0
    Result code: 0
    Generation: 0
    Record TTL: 0
    Transaction TTL: 1000
    Number of fields: 3
    Number of operations: 2
+ Aerospike Fields
+ Aerospike Operations
```

New List Operations

```
▼ Aerospike Operations
    Size: 10
    Op: AS_MSG_OP_CDT_MODIFY (4)
    Bin data type: AS_PARTICLE_TYPE_BLOB (4)
    Bin version: 0
    Bin name length: 1
    Bin name: l
    Data bytes: 000c920006
```

```
0000  08 00 27 21 3c 79 0a 00  27 00 00 02 08 00 45 02   ..'!<y.. '.....E.
0010  00 8b 00 00 40 00 40 06  77 0f c0 a8 21 01 c0 a8   ....@.@. w...!...
0020  21 0a e1 b0 0b b8 9b 07  65 aa 0c da 18 75 80 18   !....... e....u..
0030  10 13 db 94 00 00 01 01  08 0a 1e 86 ac 8d 00 ff   ........ ........
0040  5a 09 02 03 00 00 00 00  00 4f 16 00 01 00 00 00   Z....... .O......
0050  00 00 00 00 00 00 00 00  00 00 03 e8 00 03 00 01   ........ ........
0060  00 00 00 05 00 74 65 73  74 00 00 00 05 01 74 65   .....tes t.....te
0070  73 74 00 00 00 15 04 11  e4 58 59 5e e4 01 0a 6a   st...... .XY^...j
0080  c7 a3 38 41 27 22 cc 8a  8e 76 50 00 00 00 0a 04   ..8A'".. .vP.....
0090  04 00 01 6c 00 0c 92 00  06                        ...l.... .
```

Heartbeat protocol

```
+User Datagram Protocol, Src Port: 9918, Dst Port: 9918
-Aerospike Heartbeat
   Size: 114
   Field Type: M_TYPE_HEARTBEAT (5)
   ID: AS_HB_MSG_ID (0)
   Message Type: 1
   Data bytes: 00006864
   ID: AS_HB_MSG_TYPE (1)
   Message Type: 1
   Data bytes: 00000000
   ID: AS_HB_MSG_NODE (2)
   Message Type: 3
   Data bytes: 0bb9b11300000000
   ID: AS_HB_MSG_HLC_TIMESTAMP (4)
   Message Type: 3
   Data bytes: 01600c6828f50000
```

Demo

Source: `https://xkcd.com/1323/`

Future

- Migration
- Clustering
- Proxy
- RW (Replication)
- Fabric
- System Meta Data
- Cross Data Centre Replication (XDR)
- Security

References

- Lua: `https://www.lua.org/`
- Wireshark Lua API: `https://wiki.wireshark.org/LuaAPI`
- Dissectors: `https://wiki.wireshark.org/Lua/Dissectors`
- Lua Examples: `https://wiki.wireshark.org/Lua/Examples`
- Lua scripting in Wireshark:
  `https://sharkfest.wireshark.org/sharkfest.09/DT06_Bjorlykke_Lua%20Scripting%20in%20Wireshark.pdf`
- Lua style guide: `http://lua-users.org/wiki/LuaStyleGuide`
- “Changing Wireshark with Lua: Writing a Lua Plug-in to Create a Custom Decoder” (˜ 1h 20m)
  `https://www.youtube.com/watch?v=HTtVHxIh6ww`