Lua Scripting in Wireshark

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THALES

Introduction

- About me
  - I'm working as a senior system developer for Thales Norway, a company focusing on defence, aerospace and security markets worldwide
  - Wireshark user since 2003
  - Wireshark core member since 2007
  - I enjoy parachuting and scuba diving

Agenda

- Introduction to Lua
  - Getting started using Lua in Wireshark
- Functions to write a dissector
  - Obtaining dissection data
  - Presenting information
  - Preferences
  - Postdissectors
- Functions to create a Listener

Introduction to Lua

- Lua is a powerful, fast, lightweight, embeddable scripting language designed for extending applications.

Introduction to Lua

- Script language
  - Good support for object-oriented programming
- Can be precompiled for
  - Faster loading (not faster *execution*)
  - Off-line syntax error detection
  - Protecting source code from user changes
- Lua's official web site

  http://www.lua.org/

Lua variables

- Dynamicaly typed language
- All values are *first-class values*
- Eight basic types
  - nil, boolean, number, string, function, userdata, thread and table
- All variables are global unless using the *local* keyword

Lua in Wireshark

- Usage in Wireshark
  - Dissectors
    - Used to decode packet data
  - Post-dissectors
    - Called after every other dissector has run
  - Listeners
    - Used to collect information after the packet has been dissected

Lua in Wireshark

- Advantages
  - Easy prototyping, implementing and testing
  - Small amount of code needed
  - No memory management
  - Easy to share with others
  - Perfect for reverse engineering

Lua in Wireshark

- Disadvantages
  - Several times slower than writing in C
  - Only a subset of dissector functions
  - Code is not distributed with Wireshark
  - Not widely used yet

Lua in Wireshark

- How Lua fits into Wireshark
  - A file called `init.lua` will be called first
    - First from the global configuration directory
    - Second from the personal configuration directory
  - Scripts passed with the `-X lua_script:file.lua` will be called after `init.lua`
  - All scripts will be run **`before`** packets are read, at the end of the dissector registration process.

Lua in Wireshark

- Not fully implemented yet
  - Not build by default on all platforms
  - Disabled in the init scripts
  - Still missing some functionality
  - Documentation is incomplete
  - Few working examples available
  - Probably still some bugs

Getting started

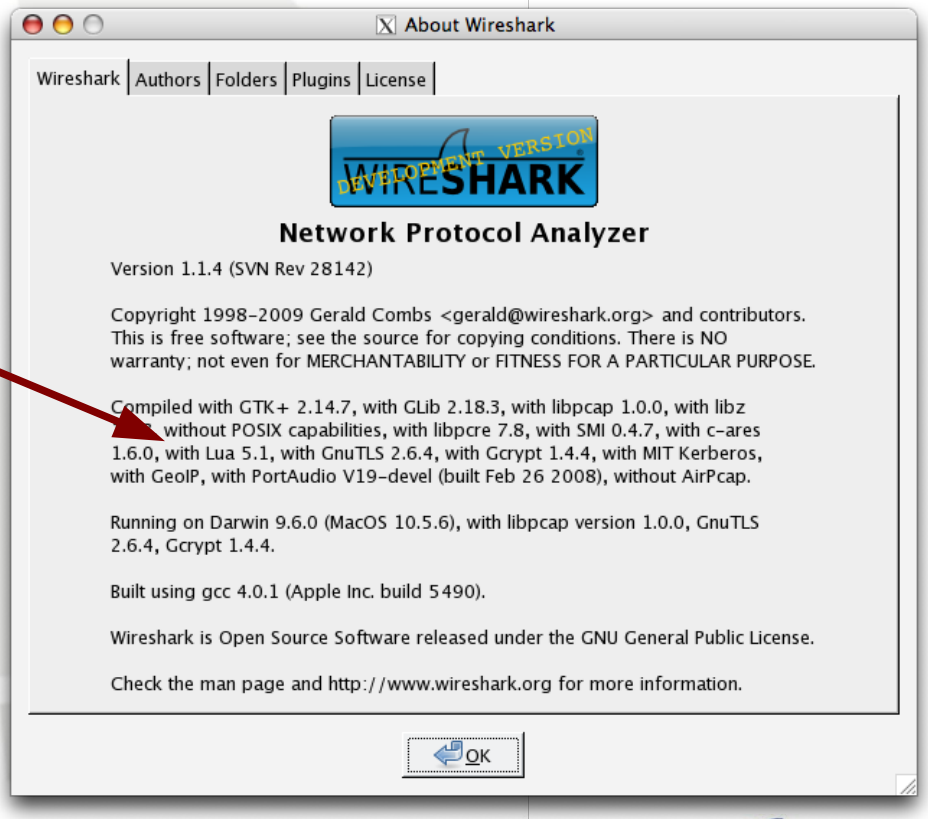
1. Check your version of Wireshark

Help -> About

Compiled with GTK+ 2.14.
1.2.3, without POSIX capab
1.6.0, with Lua 5.1, with Gr
with GeoIP, with PortAudio

versus

Compiled with GTK+ 2.12.
1.2.3, without POSIX capab
ADNS, without Lua, with Gr
PortAudio V19-devel (built



Getting started

2. Enable LUA in the global configuration file

Remove the disable_lua line from init.lua

File can be found from:

Help -> About -> Files -> Global configuration

```
-- Lua is disabled by default, comment out the following line
-- to enable Lua support.
disable_lua = true; do return end;

-- If set and we are running with special privileges this setting
-- tells whether scripts other than this one are to be run.
run_user_scripts_when_superuser = false
```

Getting started

3. Create a test script to check if it works

```
-- hello.lua
-- Lua's implementation of D. Ritchie's hello world program.
print ("Hello world!")
```

Getting started

4. Test the hello.lua script

This can be done with `tshark`

```
$ tshark -X lua_script:hello.lua

Hello world!
Capturing on AirPort
1   0.000000 192.168.1.55 -> 192.156.1.255 NBNS Name query NB XXX.COM<00>
```

Create a simple dissector

- Example: My Simple Protocol
  - Protocol specifications
    - Message Id (4 bytes)
    - Magic Value (4 bits)
    - Message Format (4 bits: 1=Text 2=Binary)
    - Data (variable length)
  - Runs on UDP port 1000

Create a new protocol

- Proto
  - Creates a new protocol in Wireshark
    - proto.dissector: a function you define
    - proto.fields: a list of fields
    - proto.init: the initialization routine
    - proto.prefs: the preferences
    - proto.name: the name given

Create a new protocol

```
-- Create a new dissector

MYPROTO = Proto ("myproto", "My Simple Protocol")
```

Add a protocol dissector

- Proto.dissector
  - This is the function doing the dissecting
  - Takes three arguments: buffer, pinfo and tree

```
-- The dissector function
function MYPROTO.dissector (buffer, pinfo, tree)
  <do something>
end
```

Create protocol fields

- ProtoField
  - To be used when adding items to the tree
  - Integer types:
    - ProtoField.{type} (abbr, [name], [desc], [base], [valuestring], [mask])

      uint8, uint16, uint24, uint32, uint64, framenum
  - Other types
    - ProtoField.{type} (abbr, [name], [desc])

      float, double, string, stringz, bytes, bool, ipv4, ipv6, ether, oid, guid

Create protocol fields

- Proto.fields
  - Contains a list of all ProtoFields defined

```
-- Create the protocol fields

local f = MYPROTO.fields

local formats = { "Text", "Binary", [10] = "Special"}

f.msgid  = ProtoField.uint32 ("myproto.msgid",  "Message Id")
f.magic  = ProtoField.uint8  ("myproto.magic",  "Magic", base.HEX, nil, 0xF0)
f.format = ProtoField.uint8  ("myproto.format", "Format", nil, formats, 0x0F)
f.mydata = ProtoField.bytes  ("myproto.mydata", "Data")
```

The protocol initialization

- Proto.init
  - Called before we make a pass through a capture file and dissect all its packets
    - E.g. when we read in a new capture file, or run a «filter packets» or «colorize packets»

```
-- A initialization routine
local packet_counter
function MYPROTO.init ()
  packet_counter = 0
end
```

Fetch data from the packet

- Tvb / TvbRange
  - The buffer passed to the dissector is represented by a tvb (Testy Virtual Buffer)
  - Data is fetched by creating a TvbRange
    - Tvb ([offset], [length])
  - The tvbrange can be converted to correct datatypes with this functions
    - uint, le_uint, float, le_float, ipv4, le_ipv4, ether, string, bytes

Fetch data from the packet

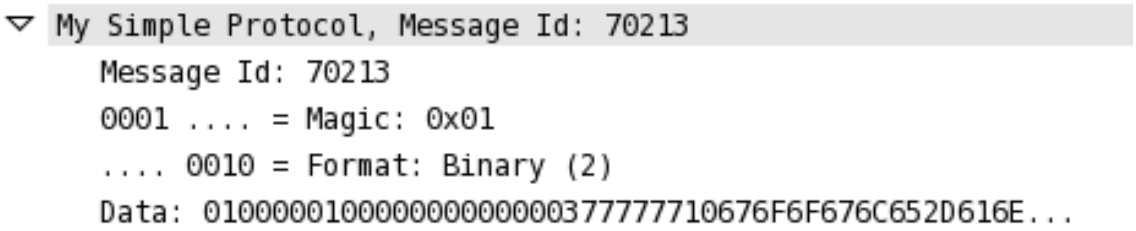
```
-- The dissector function

function MYPROTO.dissector (buffer, pinfo, tree)

  -- Fetch data from the packet
  local msgid_range = buffer(0,4)
  local msgid = msgid_range:uint()

  -- This is not supported in Wireshark, yet
  local format = buffer(4,1):bitfield(4,4)

  local mydata = buffer(5):bytes()

end
```

Adding fields to the tree

- TreeItem
  - Used to add a new entry to the packet details, both protocol and field entry
  - Adding a new element returning a child
    - treeitem:add ([field | proto], [tvbrange], [label])
  - Modifying an element
    - treeitem:set_text (text)
    - treeitem:append_text (text)
    - treeitem:add_expert_info ([group], [severity], [text])
    - treeitem:set_generated ()

Adding fields to the tree

```
-- The dissector function

function MYPROTO.dissector (buffer, pinfo, tree)

  -- Adding fields to the tree

  local subtree = tree:add (MYPROTO, buffer())
  local offset = 0

  local msgid = buffer (offset, 4)
  subtree:add (f.msgid, msgid)
  subtree:append_text (", Message Id: " .. msgid:uint())
  offset = offset + 4

  subtree:add (f.magic, buffer(offset, 1))
  subtree:add (f.format, buffer(offset, 1))
  offset = offset + 1

  subtree:add (f.mydata, buffer(offset))

end
```



Register the protocol

- DissectorTable
  - This is a table of subdissectors of a particular protocol, used to handle the payload
    - DissectorTable.get (tablename)
  - The most common tablenames
    - TCP and UDP uses port numbers
      - «tcp.port» and «udp.port»
    - Ethernet uses an ether type
      - «ethertype»

Register the protocol

```
-- Register the dissector

udp_table = DissectorTable.get ("udp.port")
udp_table:add (1000, MYPROTO)
```

Packet information

- Read only
  - pinfo.number: packet number
  - pinfo.len: packet length
  - pinfo.rel_ts: time since capture start
  - pinfo.visited: true if package has been visited
- Generated during capture

Packet information

- Read write
  - pinfo.cols: packet list columns
  - pinfo.src
  - pinfo.src_port
  - pinfo.dst
  - pinfo.dst_port
- Generated while dissecting

Modifying columns

- All columns can be modified
  - Most common is protocol and info
    - pinfo.cols.protocol
    - pinfo.cols.info
  - Others can be the addresses
    - pinfo.cols.src
    - pinfo.cols.dst
    - pinfo.cols.src_port
    - pinfo.cols.dst_port

Modifying columns

```
-- The dissector function

function MYPROTO.dissector (buffer, pinfo, tree)

  local offset = 0
  local msgid = buffer(offset, 4)

  -- Modify columns

  pinfo.cols.protocol = MYPROTO.name
  pinfo.cols.info = "Message Id: "
  pinfo.cols.info:append (msgid:uint())

  <continue dissecting>

end
```

No.	Time	Source	Destination	Protocol	Info
1	0.000000	192.168.39.109	192.168.39.245	MYPROTO	Message Id: 162
2	0.030561	192.168.39.245	192.168.39.109	MYPROTO	Message Id: 162
3	12.100564	192.168.39.64	192.168.39.245	MYPROTO	Message Id: 69
4	12.131395	192.168.39.245	192.168.39.64	MYPROTO	Message Id: 69

Adding preferences

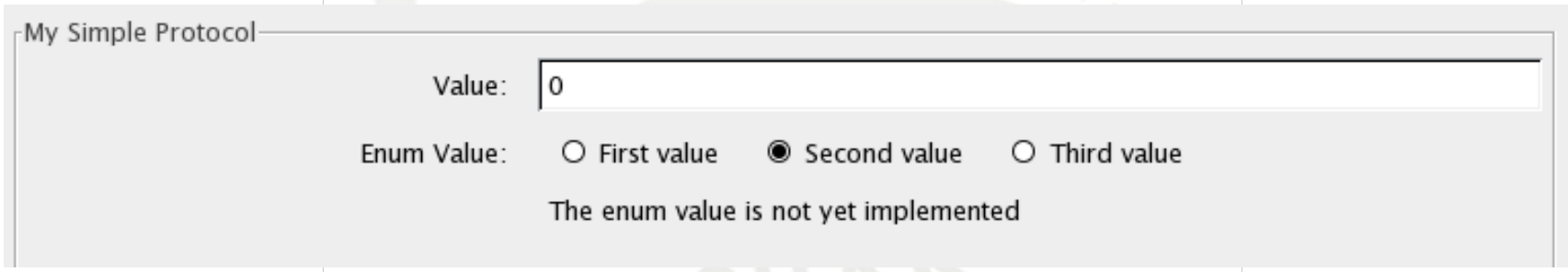
- Pref
  - Creates a preference to be put in Proto.prefs
  - Several types available
    - Pref.{bool,uint,string} (label, default, desc)
    - Pref.enum (label, default, desc, enum, radio)
    - Pref.range (label, default, desc, range, max)
    - Pref.statictext (label, desc)
  - Can be used as a regular variable

Adding preferences

```
-- Add a integer preference

local p = MYPROTO.prefs

p.value = Pref.uint ("Value", 0, "Start value for counting")




-- Use the preference

if not pinfo.visited and msgid:uint() >= p.value then
  packet_counter = packet_counter + 1
end
```

Adding preferences

```
-- Add a enum preference

local p = MYPROTO.prefs

local eval_enum = { { "First",  "First value",  0 },
                    { "Second", "Second value", 1 },
                    { "Third",  "Third value",  2 } }

p.value = Pref.uint ("Value", 0, "Start value for counting")
p.eval = Pref.enum ("Enum Value", 1, "Another value", eval_enum, true)
p.text = Pref.statictext ("The enum value is not yet implemented")
```



Create a postdissector

- A postdissector is just like a dissector
  - Register a protocol (with a dissector)
    - register_postdissector (Proto)
  - It will be called for every frame after dissection

```
-- Create a new postdissector
MYPOST = Proto ("mypost", "My Post Dissector")
function MYPOST.dissector (buffer, pinfo, tree)
  <do something>
end
register_postdissector (MYPOST)
```

Create a Listener

- A Tap is a listener which is called once for every packet that matches a certain filter or has a certain tap.
  - Register a new listener
    - Listener.new ([tap], [filter])
  - Must have this functions
    - listener.packet
    - listener.draw
    - listener.reset

Create a Listener

```
-- My Simple Listener

local function my_simple_listener ()
  local tw = TextWindow.new ("My Simple Listener")
  local tap = Listener.new (nil, "myproto")

  tw:set_atclose (function () tap:remove() end)

  function tap.packet (pinfo, buffer, userdata)
    -- called once for every matching packet
  end

  function tap.draw (userdata)
  -- called once every few seconds to redraw the gui
  end

  function tap.reset (userdata)
  -- called at the end of the capture run
  end

  retap_packets ()
end

register_menu ("My Simple Listener", my_simple_listener, MENU_TOOLS)
```

Obtain field values

- Field
  - Fields can be extracted from other dissectors
    - Field.new (filter)
- FieldInfo
  - An extracted Field used to retreived values
    - fieldinfo.value
    - fieldinfo.len
    - fieldinfo.offset

Obtain field values

```
-- Register a field value
udp_len_f = Field.new ("udp.length")


local function menuable_tap ()
  function tap.packet (pinfo, buffer, userdata)
    -- Fetch the UDP length
    local udp_len = udp_len_f()
    if udp_len and udp_len.value > 400 then
      -- Do something with big UDP packages
    end
  end
end
```

Calling other dissectors

- Dissector
  - A reference to a dissector, used to call a dissector against a packet or a part of it.

```
-- Send data to the UDP dissector

udp_dissector = Dissector.get ("udp")
udp_dissector:call (buffer, pinfo, tree)


-- Send data to the UDP dissector's port 53 (DNS) handler

udp_table = DissectorTable.get ("udp.port")
dnsdissector = udp_table:get_dissector (53)
dnsdissector:call (buffer, pinfo, tree)
```

Other Methods

- Dumper
  - Used to dump data to files
- TextWindow
  - Creates a new window
- ProgDlg
  - Creates a progress bar dialog
- Address
  - Represents an address

Wireshark User Guide

- More information is available in the WSUG
  - http://www.wireshark.org/docs/
  - 10.4. Wireshark's Lua API Reference Manual

Summary

- We have created a dissector using
  - Proto
  - ProtoField
  - Tvb / TvbRange
  - TreeItem
  - Pref
  - DissectorTable
- We also provide Listeners and ability to create a postdissector

Q & A

Questions?