Lua Scripting in Wireshark

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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
  - – Post-dissectors
- 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

- Dynamically 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.

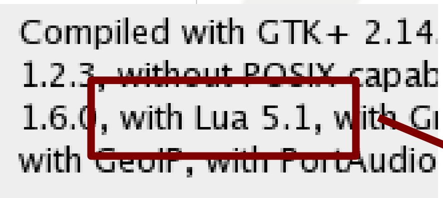
Lua in Wireshark

- Not fully implemented yet
  - Not built 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

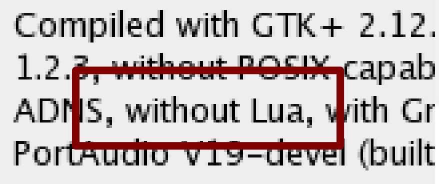
1. Check your version of Wireshark

Help -> About

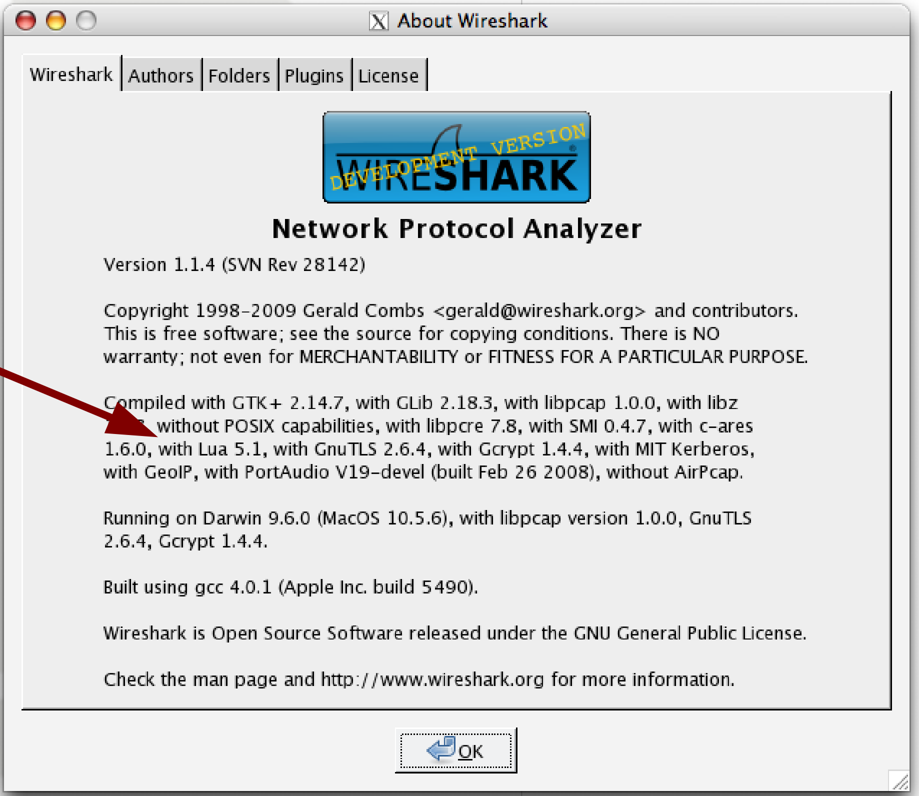


Compiled with GTK+ 2.14.
1.2.3, without POSIX capab
1.6.0, with Lua 5.1, with Gr
with GeoIP, with PortAudio

versus



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



Network Protocol Analyzer

Version 1.1.4 (SVN Rev 28142)

Copyright 1998-2009 Gerald Combs <gerald@wireshark.org> and contributors.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

Compiled with GTK+ 2.14.7, with GLib 2.18.3, with libpcap 1.0.0, with libz
1.2.3, without POSIX capabilities, with libpcre 7.8, with SMI 0.4.7, with c-ares
1.6.0, with Lua 5.1, with GnuTLS 2.6.4, with Gcrypt 1.4.4, with MIT Kerberos,
with GeoIP, with PortAudio V19-devel (built Feb 26 2008), without AirPcap.

Running on Darwin 9.6.0 (MacOS 10.5.6), with libpcap version 1.0.0, GnuTLS
2.6.4, Gcrypt 1.4.4.

Built using gcc 4.0.1 (Apple Inc. build 5490).

Wireshark is Open Source Software released under the GNU General Public License.

Check the man page and http://www.wireshark.org for more information.

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

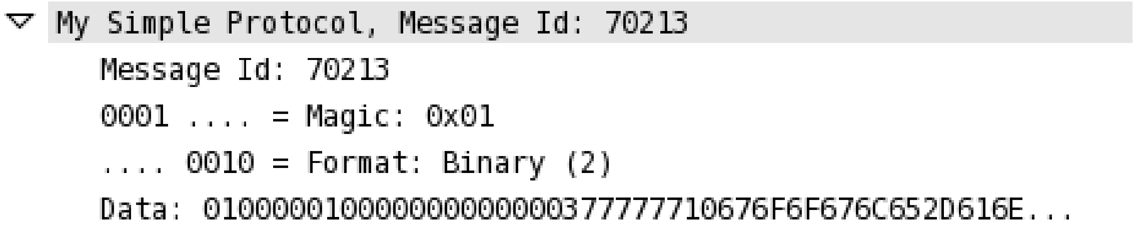
```lua
-- The dissector function

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
```



```
▽ My Simple Protocol, Message Id: 70213
    Message Id: 70213
    0001 .... = Magic: 0x01
    .... 0010 = Format: Binary (2)
    Data: 0100000100000000000000377777710676F6F676C652D616E...
```

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

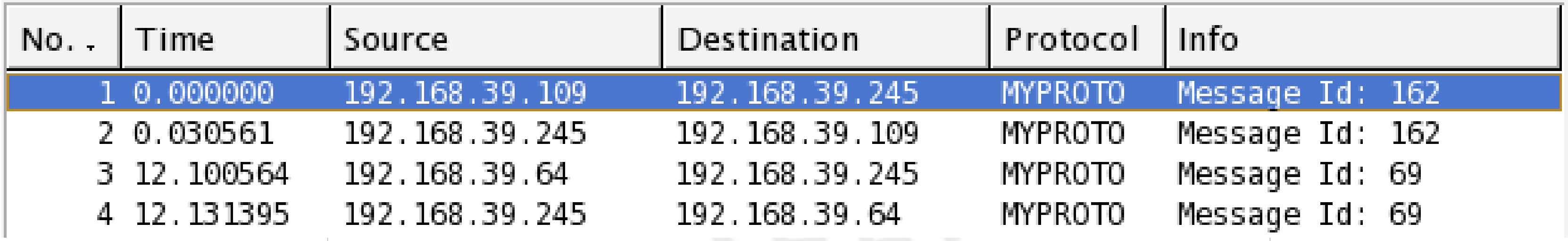
- Read write
  - – pinfo.cols: packet list columns
  - – pinfo.src
  - – pinfo.src_port
  - – pinfo.dst
  - – pinfo.dst_port
- Generated while dissecting

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

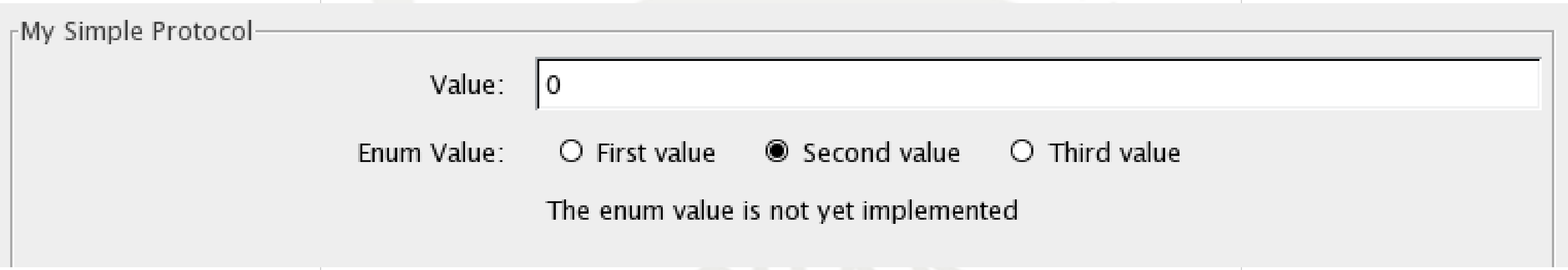
- Pref
  - – Creates a preference to be put in Proto.prefs
  - – Several types available
    - Pref.{bool,uint,string} (label, default, desc)
    - Pref.enum (label, default, desc, enum, radio)
    - Pref.range (label, default, desc, range, max)
    - Pref.statictext (label, desc)
  - – Can be used as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



My Simple Protocol

Value: 0

Enum Value: ○ First value ● Second value ○ Third value

The enum value is not yet implemented

Create a post-dissector

- A post-dissector 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

```lua
-- 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

```lua
-- 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 post-dissector

Q & A

Questions?