


“Grasshopper always wrong in argument with Chicken.”
- *Book of Chan*


# Functional Fuzzing with Funk

and further explorations into the use of functional languages for network scripting

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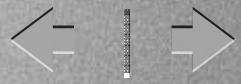
# Q:WTF? A:

Funk is a framework for the scripted generation of network traffic, written using the Chicken Scheme-to-C compiler.

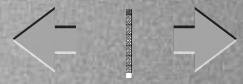
# Funk is...

- Simple
- Tiny
- Powerful
- Extensible
- Platform Independent and Protocol Agnostic
- Easily described by random adjectives


# Most Important Idea

Funk creates a generic interface to every network protocol!

This lets you keep your fuzzing logic separate from your protocol logic!

# Ok, but can it do?

- Fuzzing
- Flooding
- Spoofing
- Traffic Generation


# Long Term Goals

- Query-Response
- Arbitrary Network Scripting
- Rapid Prototyping
- Virtual Servers
- Firewall and IDS


# Previous Design

- XML-based scripts in flat file DB
- C/++ parser generator engine
- Domain-Specific Language, limited by regular grammars
- Imperfect, but still made some money


# Why That Sucked

Protocol logic and fuzzing logic were necessarily intertwined...

- Checksums
- Internet Header Length
- Type-Length Value Fields
- ICMP,  DHCP,  ASN.1

# Cue the music...


# Scheme FAQ

- What the hell is Scheme anyway?
- Seriously, what's up with all the parentheses?
- Why are LISP programmers so smug?
- Why can't you just use C like normal people?

Leave

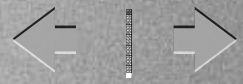
In

Stupid

Parentheses


# Why Scheme?

- Programming metaphor better suited to problem (lambda calc vs. Turing machine)
- Easily extensible
- Well established, widely used
- Portable
- No Bit Rot!

# Why Chicken?

- Actively developed
- Highly optimized (fast even in interpreter)
- Extends with Eggs or SWIG
- Compiles to straight C
- Functional language makes dealing with network protocols easy


# Chicken vs. Python

| | Chicken | Python |
|---|---|---|
| Interpreted? | Yes | Yes |
| Compiles? | to C | to Java |
| Lambdas? | Yes | Yes |
| Painfully Slow? | No | Yes |
| Stupid? | Parentheses | Whitespace |
| Tastes Like? | Chicken | Chicken |

# Implementation


# Packet Scripting

- Abstract Operations
- Flexibility
- Extensibility


# Protocols

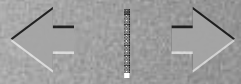
- Protocol Operations:
  - Generate
  - Serialize
  - Validate
  - Query


# Ethernet

```
(define (install-ethernet-protocol)

  ;; Fields ( list of lists with values: name, bitlength, validator, serializer )
  (define fields (list
        (list 'destmac  48 mac-validator mac-serializer)
        (list 'srcmac   48 mac-validator mac-serializer)
        (list 'pkt-type 16 (hex-validator 16) (hex-serializer 16))
                                                                    ))

  (define (generate packet aggregator) (default-generator packet fields aggregator))
  (define (validate packet) (default-validator packet fields))

  ;; Public Interface
  (put-op 'generate '(ethernet) generate)
  (put-op 'validate '(ethernet) validate)

  "ethernet done")
```


# IPv4

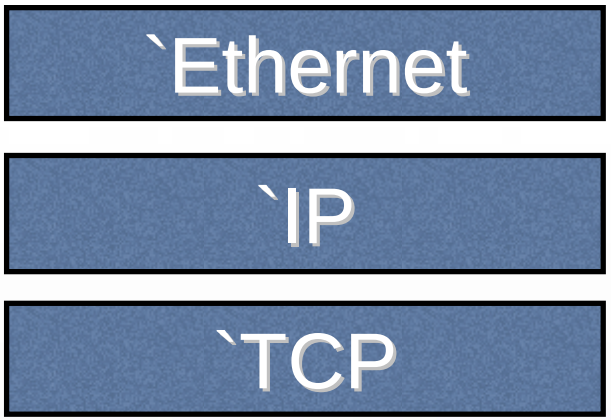
```
(define (install-ip4-protocol)

  ;; Fields ( list of lists with values: name, bitlength, validator, serializer )
  (define fields (list
                  (list 'version  4 (hex-validator 4) (hex-serializer 4))
                  (list 'internet-header-length 4 (hex-validator 4) (hex-serializer 4))
                  (list 'type-of-service 8 (hex-validator 8) (hex-serializer 8))
                  (list 'total-length 16 (hex-validator 16) (hex-serializer 16))
                  (list 'identification 16 (hex-validator 16) (hex-serializer 16))
                  (list 'CE 1 (hex-validator 1) (hex-serializer 1))
                  (list 'DF 1 (hex-validator 1) (hex-serializer 1))
                  (list 'MF 1 (hex-validator 1) (hex-serializer 1))
                  (list 'fragment-offset 13 (hex-validator 13) (hex-serializer 13))
                  (list 'time-to-live 8 (hex-validator 8) (hex-serializer 8))
                  (list 'protocol 8 (hex-validator 8) (hex-serializer 8))
                  (list 'header-checksum 16 (hex-validator 16) (hex-serializer 16))
                  (list 'source-ip 32 ip-validator ip-serializer)
                  (list 'dest-ip 32 ip-validator ip-serializer)
                  (list 'options 0 (hex-validator 32) (hex-serializer 32))
                                                                    ))
```

# Generate/Validate

```
;; Generate/Validate Operations on Packets and Protocols-------------------------
(define (generate-layer packet) ( (get-op 'generate (car packet)) (cdr packet) u8vector-cat) )
(define (validate-layer packet) ( (get-op 'validate (car packet)) (cdr packet)) )

(define (validate packet)
(cond ((null? packet) '())
      (else
      (cons (validate-layer (car packet))
      (validate (cdr packet))
      ))))

(define (generate packet)
 (cond ((null? packet) '())
      (else
      (u8vector-cat (generate-layer (car packet))
      (generate (cdr packet))
      ))))
```

# Generating a Packet



```
(define my-ip-packet (attach-tag '(ip4)
                     (list
                      "4" "5" "10" "0020"
                      "0030" "0" "1" "0"
                      "0755" "01" "04"
                      "A123" "192.168.1.1"
                      "192.168.1.2" ""
                                                  )))

(define my-eth-packet (attach-tag '(ethernet)
                     (list
                      "12:34:56:78:90:12"
                      "AA:BB:CC:DD:EE:FF"
                      "0800")))


(define my-packet (list my-eth-packet my-ip-packet ))

; send packet out
(require 'raw-sockets)
(raw-open "en0")
(define raw-packet (generate my-packet))
(raw-send raw-packet (u8vector-length raw-packet))
                                        (raw-close)
```


# Chicken Eggs

- bit-cat
- crc16
- raw-sockets


# Future Work

- Filter/Receive/Inject Support
- Binary and File Format Fuzzing
- Visual Script Design
- Support for Additional Protocols


# Funk Source Code

Current Funk Source is available at:

http://www.memescape.com/funk/funk_current.tgz


# Recommended Reading

- Structure and Interpretation of Computer Programs ("The Wizard Book")
  - Abelson & Sussman
  http://mitpress.mit.edu/sicp/
- The Scheme Programming Language
  - R. Kent Dybvig


# Q & A

Stump the chump!


# Extras

The following slides have all the information you need to set up a Funk/Chicken Scheme development environment on any platform.

Turn “Show Presenter Notes” on for more information.


# Funk Development

- Chicken Scheme - http://www.callcc.org
- Eclipse - http://www.eclipse.org
- SchemeScript plugin for Eclipse
- REPL
- Funk Source Code


# Install SchemeScript

- Install SchemeScript plugin
  - Help > Software Updates > Find & Install
  - Search for new features
  - New Update Site:

SchemeWay
http://schemeway.sourceforge.net/update-site/


# REPL

Compile with Chicken and put resulting binary in your project directory

```
; remote_chicken.scm
(use tcp)

(define (remote-repl #!optional (port 5156))
  (let*-values (((x) (tcp-listen port))
                ((i o) (tcp-accept x)))
    (current-input-port i)
    (current-output-port o)
    (current-error-port o)
    (repl)))

(remote-repl)
```

csc -o remote_chicken remote_chicken.scm


# Configuring Eclipse

- Add remote_chicken to External Tools
- Set SchemeScript to use Remote Interpreter
- Run remote_chicken from Run > External Tools
- Start Interpreter from Scheme > Start Interpreter


# SchemeScript Hotkeys

- Ctrl - Enter
  - Executes the preceding S-expression
- Ctrl - Shift - Enter
  - Executes the enclosing S-expression
- Ctrl - Shift - L
  - Loads current file in interpreter