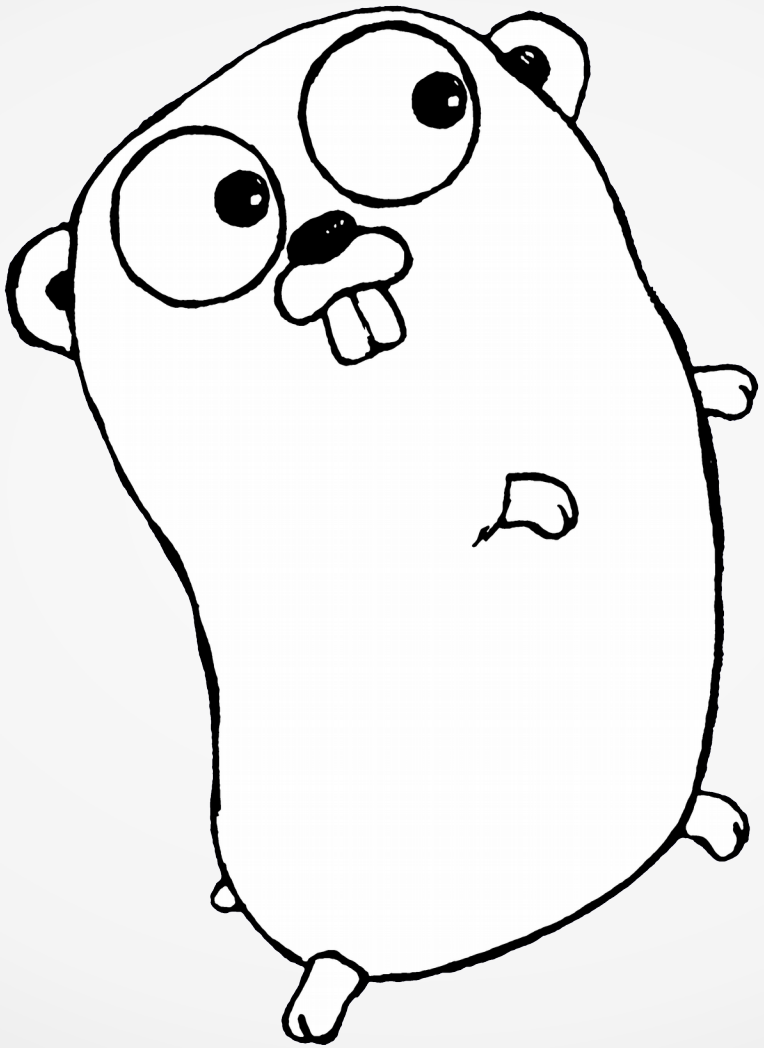
Packet Capturing with Go



What is Packet Capturing

- Wired vs wireless
- Promiscuous mode
- Hubs vs Switches
- Does not block or man-in-the-middle traffic

How Can it be Used?

- App development: app testing, validating encryption
- Reverse engineering an API
- Seeing what traffic goes on in background
- Stealing credentials
- Network administration
- Looking for malicious traffic on network
- Forensics for crime investigations
- Defcon Wall of Sheep

My Motivations

- Hacker by nature
- Want to see what happens under the hood
- Validating authentication mechanisms are encrypted
- Make sure no malicious traffic on my servers
- Understanding how secure traffic is on open wi-fi
- Stealing credentials (legally, of course)
  - Facebook did not use SSL for a long time
  - Neither did OKCupid
  - https://httpshaming.tumblr.com

Overview

- Getting a list of network devices
- Capturing packets from a network device
- Saving packets to a file
- Reading packets from a file
- Analyzing packet layers
- Creating custom layers
- Using Berkeley Packet Filters
- Injecting packets
- Following streams

Common Tools

- Wireshark/tshark
- Tcpdump
- Driftnet
- Firesheep

Prerequisites

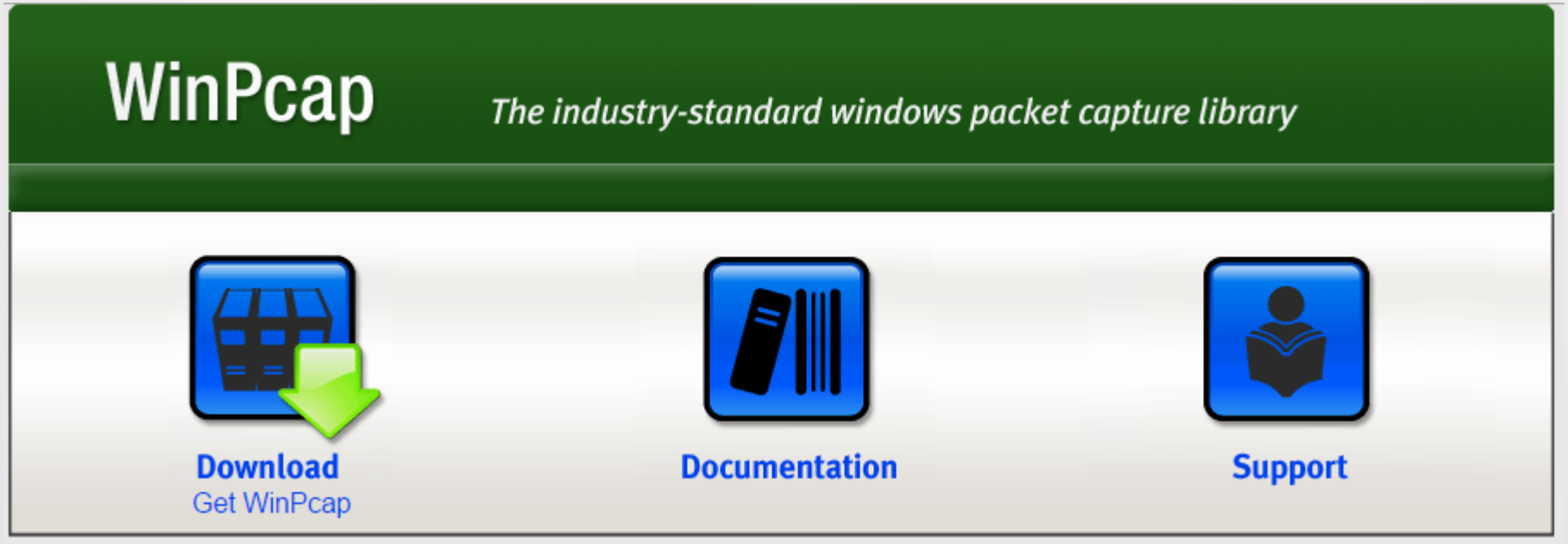
- libpcap or WinPcap
- Go

libpcap

- C library
- http://www.tcpdump.org/
- http://www.devdungeon.com/content/using-libpcap-c

WinPcap

- Windows compatible version of libpcap
- https://www.winpcap.org/



gopacket

- Utilizes libpcap, but also supports pfring and afpacket
- https://github.com/google/gopacket
- http://www.devdungeon.com/content/packet-capture-injection-and-analysis-gopacket

gopacket Sub-packages

- github.com/google/gopacket
- github.com/google/gopacket/pcap
- github.com/google/gopacket/layers
- github.com/google/gopacket/pcapgo

gopacket Overview

- https://godoc.org/github.com/google/gopacket
- Notable types
  - Decoder
  - Flow
  - Layer
  - Packet
  - PacketSource
  - Payload

Get pcap Version

```
import (
  "fmt"
  "github.com/google/gopacket/pcap"
)

func main() {
  version := pcap.Version()
  fmt.Println(version)
}
```

Find Network Device

```
var devices []pcap.Interface
devices, _ := pcap.FindAllDevs()
```

Network Adapter Struct

```
type Interface struct {
  Name         string
  Description string
  Addresses    []InterfaceAddress
}
```

Address Struct

```
type InterfaceAddress struct {
  IP      net.IP
  Netmask net.IPMask
}
```

Opening Live Device

```
handle, _ := pcap.OpenLive(
  “eth0”,         // device
  int32(65535), // snapshot length
  false,          // promiscuous mode?
  time.Duration = -1*time.Second, //timeout
)
defer handle.Close()
```

Opening pcap File

```
handle, _ = pcap.OpenOffline(“dump.pcap”)
defer handle.Close()
```

Creating a Packet Source

```
packetSource :=  gopacket.NewPacketSource(
   handle,
   handle.LinkType(),
)
```

Read One Packet

```
packet, _ := packetSource.NextPacket()
fmt.Println(packet)
```

Read All Packets

```
for packet := range packetSource.Packets() {
  fmt.Println(packet)
}
```

Capturing with Filter

```
handle.SetBPFFilter("tcp and port 80")
```

Berkeley Packet Filter Examples

- `10.1.1.3  # IP to and from`
- `128.3/16`
- `port 53`
- `host 8.8.8.8 and udp port 53`
- `net 199.16.156.0/22 and port 80`
- `(port 80 or port 443) and not host 192.168.0.1`

Opening pcap file for Writing

```
dumpFile, _ := os.Create(“dump.pcap”)
defer dumpFile.Close()

packetWriter := pcapgo.NewWriter(dumpFile)
packetWriter.WriteFileHeader(
  65535, // Snapshot length
  layers.LinkTypeEthernet,
)
```

Writing Pcap File

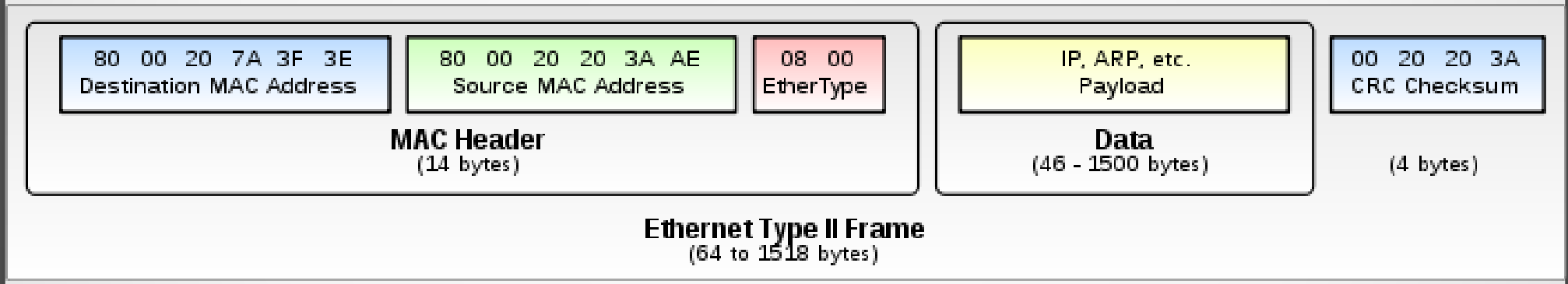
```
for packet := range packetSource.Packets() {

  packetWriter.WritePacket(
    packet.Metadata().CaptureInfo,
    packet.Data(),
  )

}
```

List Packet Layers

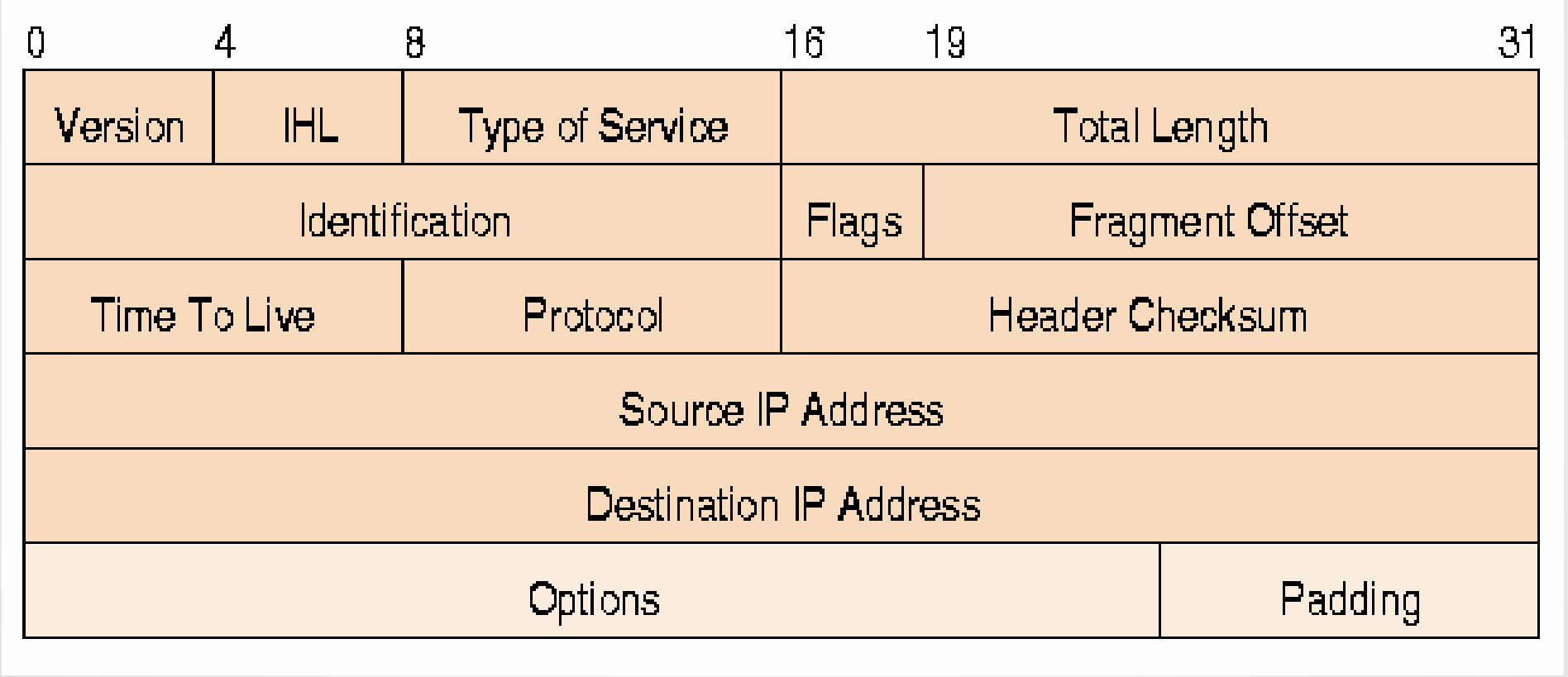
```
for _, layer := range packet.Layers() {
  fmt.Println(layer.LayerType())
}
```

Visualizing Packet Layers

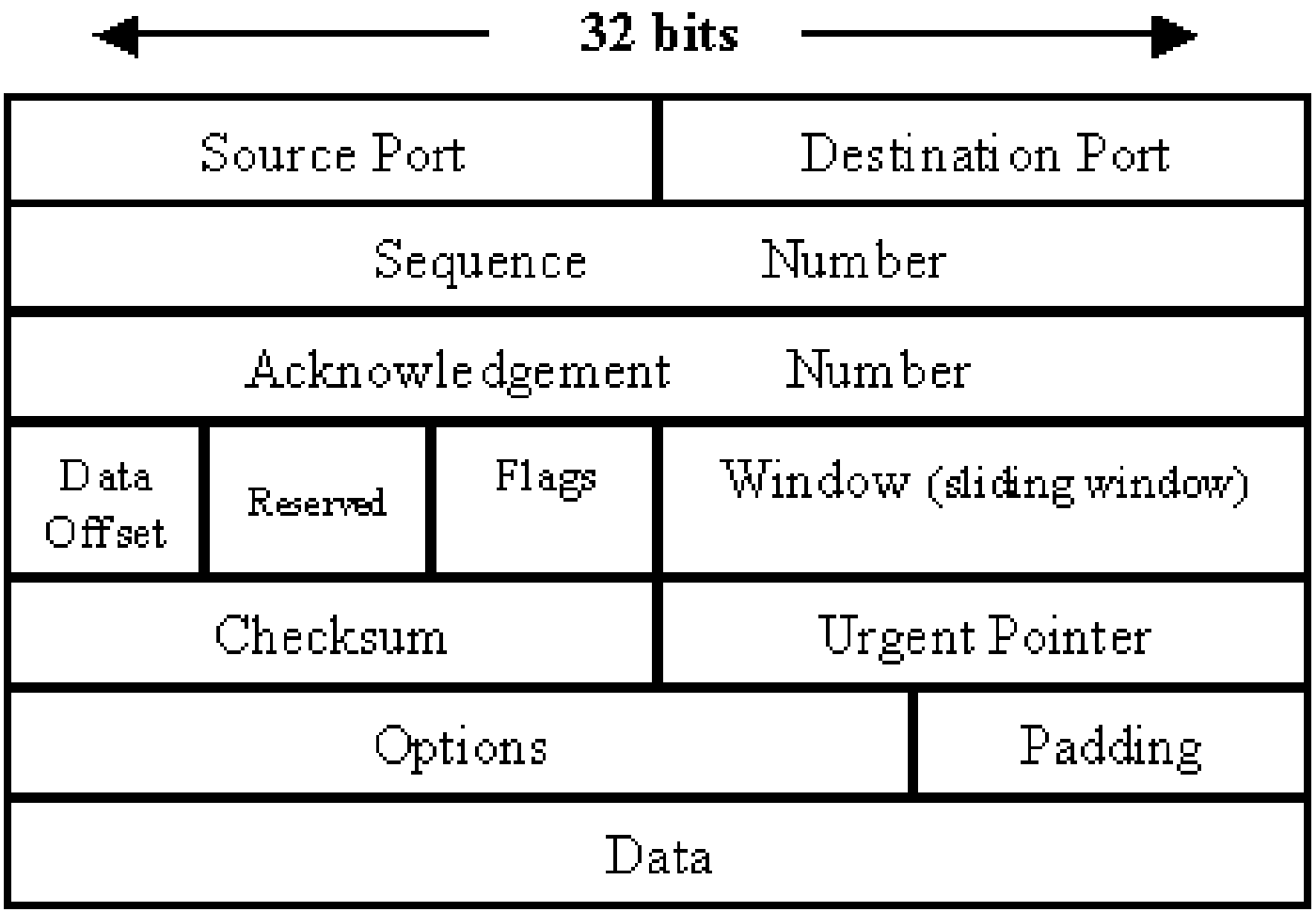
Ethernet Packet Structure



IP Packet Structure



TCP Packet Stucture



Analyze IPv4 Layer

```
ipLayer := packet.Layer(layers.LayerTypeIPv4)

if ipLayer != nil {
    ip, _ := ipLayer.(*layers.IPv4)
    fmt.Println(ip.SrcIP, ip.DstIP)
    fmt.Println(ip.Protocol)  // TCP
}
```

Analyze TCP Layer

```
tcpLayer := packet.Layer(layers.LayerTypeTCP)

if tcpLayer != nil {
  tcp, _ := tcpLayer.(*layers.TCP)
  fmt.Println(tcp.SrcPort)
  fmt.Println(tcp.DstPort)
}
```

Decoding Packet Layers

```
ethernetPacket := gopacket.NewPacket(
  packet, layers.LayerTypeEthernet, gopacket.Default)

ipPacket := gopacket.NewPacket(
  packet, layers.LayerTypeIPv6, gopacket.NoCopy)

tcpPacket := gopacket.NewPacket(
  packet, layers.LayerTypeTCP, gopacket.Lazy)
```

Faster Decoding (1/2)

```
// Create everything we'll be using
var eth layers.Ethernet
var ip4 layers.IPv4
var tcp layers.TCP
parser := gopacket.NewDecodingLayerParser(
  layers.LayerTypeEthernet, &eth, &ip4, &tcp)
decodedLayers := []gopacket.LayerType{}
```

Faster Decoding (2/2)

```
for packet := range packetSource.Packets() {

    parser.DecodeLayers(packet, &decodedLayers)
    for _, layerType := range decodedLayers {
      fmt.Println(layerType)
    }

}
```

Other Supported Layers

- ARP
- CiscoDiscovery
- DHCP
- DNS
- Dot11
- ICMP
- PPPoE
- USB
- 118 registered layers in package

Common Packet Layers

```
                                  // Example
packet.LinkLayer()                // Ethernet
packet.NetworkLayer()             // Ipv4/6
packet.TransportLayer()           // TCP/UDP
packet.ApplicationLayer()         // HTTP
packet.ErrorLayer()
```

Custom Layers (1/5)

```
// Register custom layer
var MyLayerType = gopacket.RegisterLayerType(
    12345,                 // Unique ID
    "MyLayerType",         // Unique name
    gopacket.DecodeFunc(decodeMyLayer),
)
```

Custom Layers (2/5)

```
// Define the layer contents
type MyLayer struct {
  Header []byte
  payload []byte
}
```

Custom Layers (4/5)

```
// Define the decode function
func decodeMyLayer(
  data []byte,
  p gopacket.PacketBuilder) error
{
  p.AddLayer(&MyLayer{data[:4], data[4:]})
  return p.NextDecoder(layers.LayerTypeEthernet)
}
```

Custom Layers (3/5)

```
// Satisfy the function requirements
func (m MyLayer) LayerType() LayerType {
  return MyLayerType
}
func (m MyLayer) LayerContents() []byte {
  return m.Header
}
func (m MyLayer) LayerPayload() []byte {
  return m.payload
}
```

Custom Layers (5/5)

```
// Decode like any other layer
decodedPacket := gopacket.NewPacket(
    data,
    MyLayerType,
    gopacket.Default,
)
```

Creating Packets

```
buffer = gopacket.NewSerializeBuffer()
options := gopacket.SerializeOptions{}
gopacket.SerializeLayers(buffer, options,
  &layers.Ethernet{},
  &layers.IPv4{},
  &layers.TCP{},
  gopacket.Payload([]byte{65, 66, 67}),
)
```

Sending Packet

```
handle.WritePacketData(buffer.Bytes())
```

Flow and Endpoint

```
someFlow := gopacket.NewFlow(
  layers.NewUDPPortEndpoint(1000),
  layers.NewUDPPortEndpoint(500))

t := packet.NetworkLayer() // Check nil
if t.TransportFlow() == someFlow {
  fmt.Println("UDP 1000->500 found.")
}
```

Project Ideas

- Detect blacklisted Ips
- Fuzz network services
- Monitor network traffic flow
- Port scanner
- Firewall
- IDS
- Reverse Engineering Mobile App APIs

Demos

- Questions before demos?