Packet in Packet - Cisco HDLC

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Packet in Packet

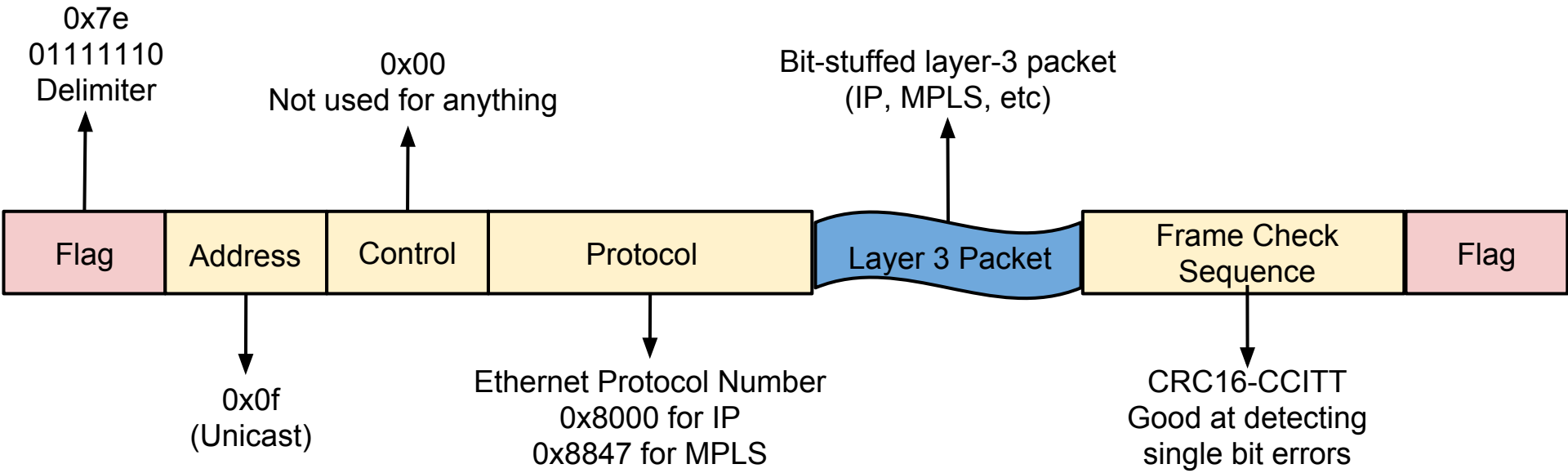
Like SQL Injection, but with packets

Travis Goodspeed did an excellent talk at Ruxcon on sending packets for one wireless protocol inside packets for another.

This is a variation of his technique, but on a wire protocol that some telcos and service providers use.

Practicality warning: this attack is a really long shot, especially on slow links

Cisco HDLC



- Flag always sent before and after a packet
- Flag is continuously sent on idle synchronous link
- Address can be 0x8f for broadcast
- Both Address and Control are basically pointless

Bit Stuffing

If 5 simultaneous 1 bits are sent on the link, a 0 bit is sent, which is ignored by the remote end.

```
01111110
```

becomes

```
011111010
```

Same concept as URL encoding

This prevents people like me from putting flags inside packets, unless...

Bit-errors Happen

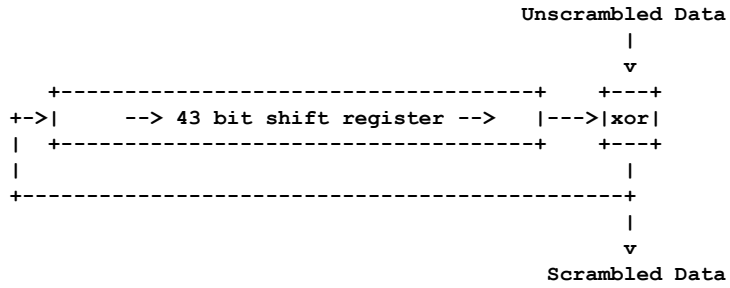
Bit errors are very rare on good clean optical links.

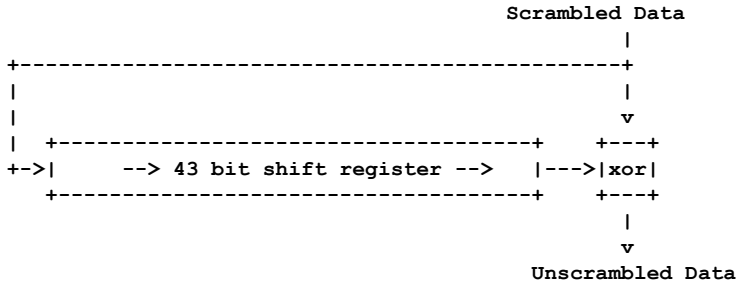
Many microwave links are using POS, which would usually use a HDLC-like encapsulation

If there's a Cisco router on each end they will probably be talking cHDLC (the default setting)

0x7e = 01111110
0x5e = 01011110
That's a bit-flip away from a flag

The ATM Self-Synchronous Scrambler





`draft-ferguson-pppsonet-selfsync-00.txt`

43 bits was chosen as the size because the ATM committee was batshit crazy

- Bit errors are repeated 43 bits later
- Burst errors (> 43 bits) randomize packet data
- Recovers after 43 bits of clean data

The most likely way you'll get a working exploit is for a burst error to scramble the first 3 bits of your faux-flag. If such a lucky coincidence occurred, there'd be a 12.5% chance of this exploit working.

A random bit-error 40 bits before our faux-flag would also work

Injection

Information you need to collect

- What you want your packet to look like
  - If the target is MPLS, you need to know label values for the BGP route for the target router on that link
  - If providers forget to enter 'no mpls ip propagate-ttl [forwarded]', this can be done with traceroute (on Cisco MPLS networks)
- What your packet does look like
  - TTL
  - MPLS label values (traceroute)
  - Random evil firewalls
  - ISP tampering

Collision!

One flag is hard, two flags are impossible

Most layer 2 protocols use a variation of CRC at the end of the packet

Cisco HDLC uses CRC16-CCITT

CRC16 can be reset to any value by manipulating 16 bits

You want it so that after your faux-flag, the CRC will be at 0xffff

Just brute force it (one less slide = 1 more beer)

The leaning tower of packet

```
[cHDLC header]
  [mpls transport tag]
  [mpls vpn tag]
    [ip]
      [tcp/udp/icmp]
        [2 bytes of crc collision]
        [faux flag byte]
        [cHDLC header]
          [evil mpls transport tag]
          [evil mpls vpn tag (optional!)]
            [ip]
              ....
[cHDLC FCS]
```

Stuff you need to know

Stuff you control

Other Layer-2 Protocols

- PPP
  - Address is 0xff
  - The *ACFC* option removes address and control
- Ethernet
  - Bit errors are very rare
  - Only -T is likely to be vulnerable at all
  - 10G-BaseW (aka WAN-PHY) is not vulnerable (but still insane)

Watch Travis Goodspeed's Ruxcon Talk:

`http://youtu.be/iQk0GHXs8NY`

Thanks!

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