OSY.SSI[2015][5]

Internet part I

Question.

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High-level experience :

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Fact: Internet is *not a place*.

An intermediary-level view

Internet is

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Internet is a stack of spaghetti protocols:

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How can it even work at all?

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A nice approach by nice 1970's guys:

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ISO/IEC 7498-1 (1974–1984, 1994) – "Open Systems Interconnection" (OSI)

Then someone invented TCP/IP and all of it was forgotten.

An intermediary-level view

"Internet protocol suite"

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Example: HTTP/TCP/IP/Ethernet.

Note: Application-to-Application communication.

But there's only one cable! How works!?

A low-level view

Wow. Such networks. Much protocol.

Protocols are *encapsulated*:

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Can we see that in action?

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Can we see that in action?Yes!

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Can we see that in action?Yes!

Demo:

A low-level view

Can we see that in action?Yes!

Demo: `tcpdump`, `wireshark`, or Network Lab (next time)!

That's not enough...

For our purpose, we actually need a few more things on:

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Spoiler:

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For our purpose, we actually need a few more things on:

- Addressing (link, IP and domain name)
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Spoiler: all of this was devised against $\perp$.

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Note: caffe-latte attack.

Internet addressing

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Solution: hierarchical addresses + routing

Internet addressing

Hierarchical addressing

32 bit addresses = Four 8-bit bytes (little endian):

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IP address ranges : `xxx.xxx.xxx.0` to `xxx.xxx.xxx.255`

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IP address ranges : `xxx.xxx.xxx.0` to `xxx.xxx.xxx.255`

`138.195.42.0/24`

(“fixed 24 first bits”)

Internet addressing

Hierarchical addressing

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Workarounds:

Internet addressing

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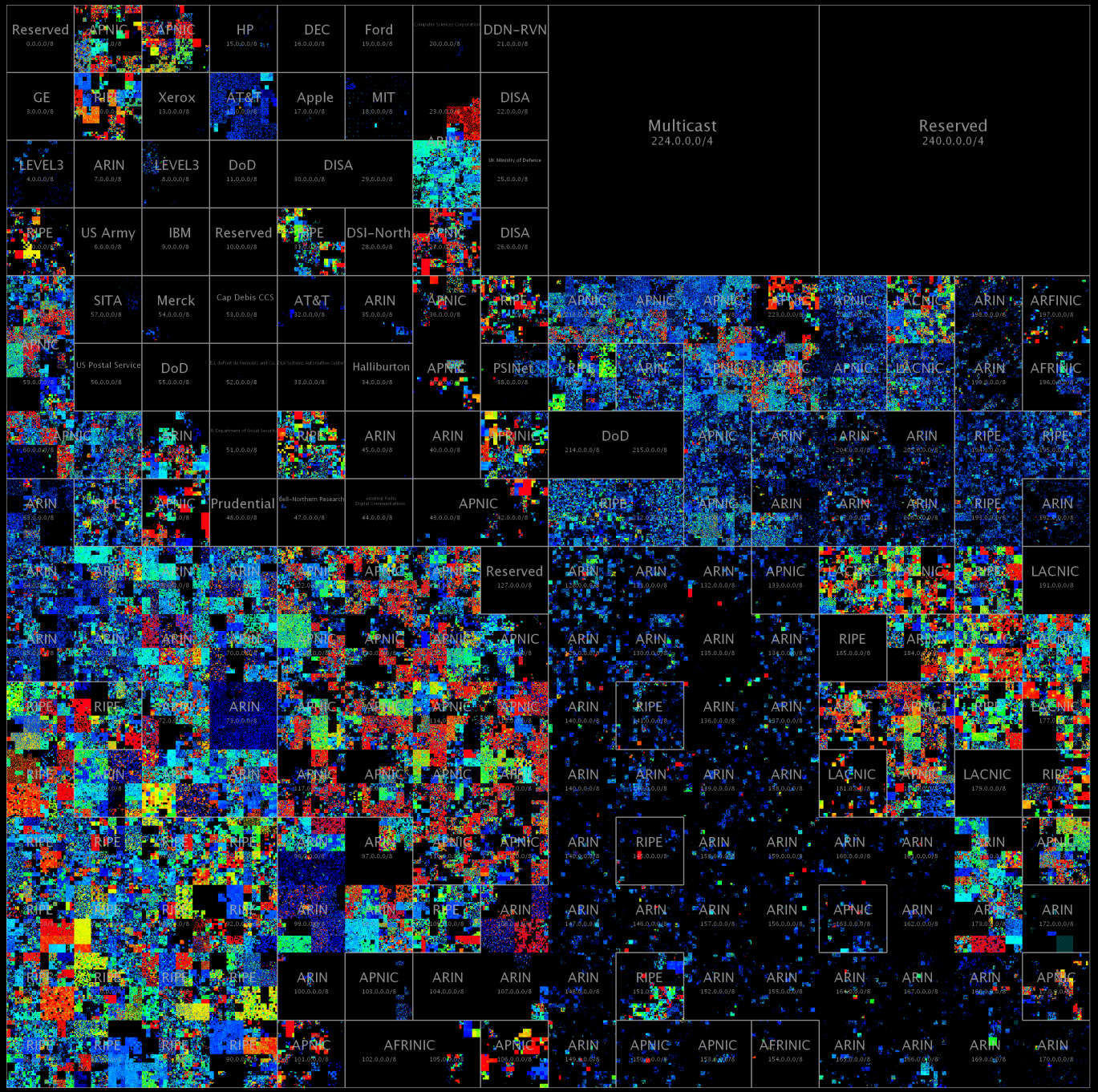
Workarounds: NAT, encapsulation, IPv6...



IPv4 Census Map

June – October 2012

Utilization

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

Prefix Sizes

= /8

= /12

= /16

= /20

= /24

420 Million hosts that responded to ICMP Ping at least 2 times between June and October 2012
Source: Carna Botnet

Internet addressing

Routing

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Demo: `route -nev`

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The missing links

I'm Bob. I want to send Alice a message.

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- Figure out Alice's IP address `1.2.3.4` (**How???**)

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The missing links are *name resolution* and *address resolution*.

Name resolution

I give you “Alice”, give me `1.2.3.4`

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Demo: `dig`, `host`, `dig -x`

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Question: hypotheses, weaknesses, vulnerabilities?

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Fact:

Name resolution

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Fact: DNS is *critical*,

Name resolution

I give you “Alice”, give me `1.2.3.4`

Fact: DNS is *critical*, *slow*

Name resolution

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Fact: DNS is *critical*, *slow* and *not heavily protected*.

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Question: How do I know I’m talking to Alice... ?

Address resolution

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Demo: `arp -nav`

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IP addresses: one last thing

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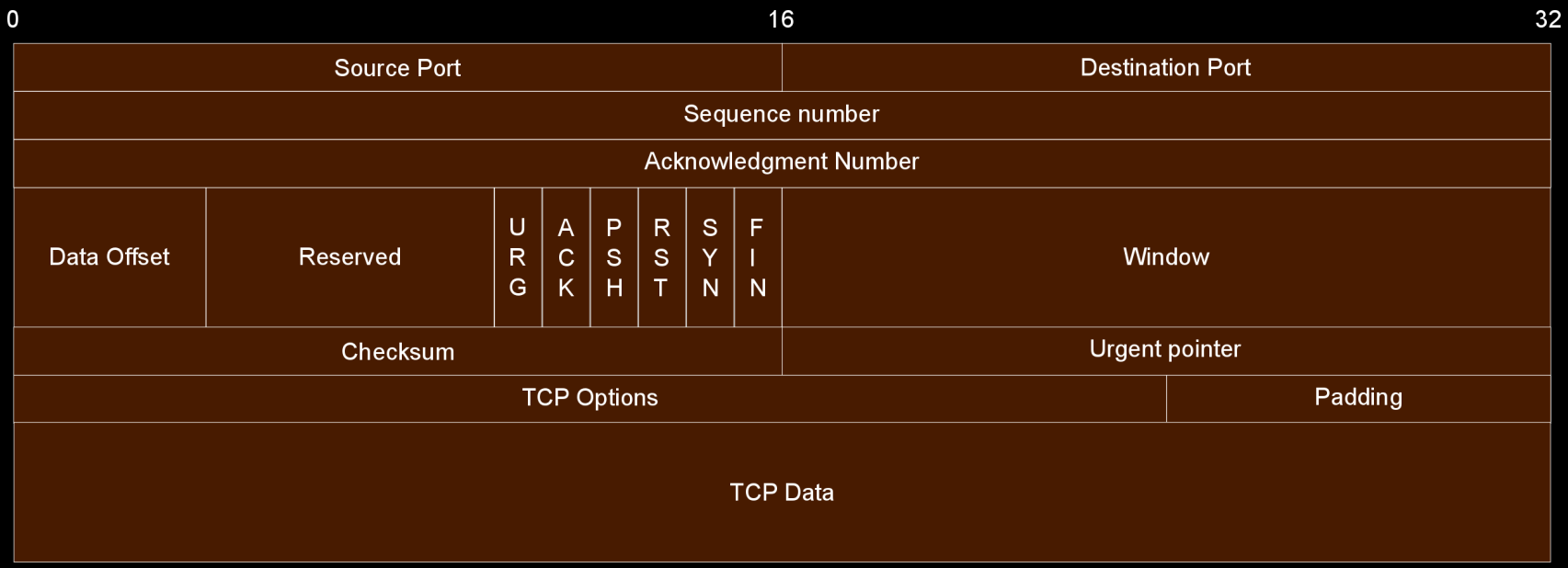
(sorry Hadopi...)

TCP: a few more notions

TCP packets



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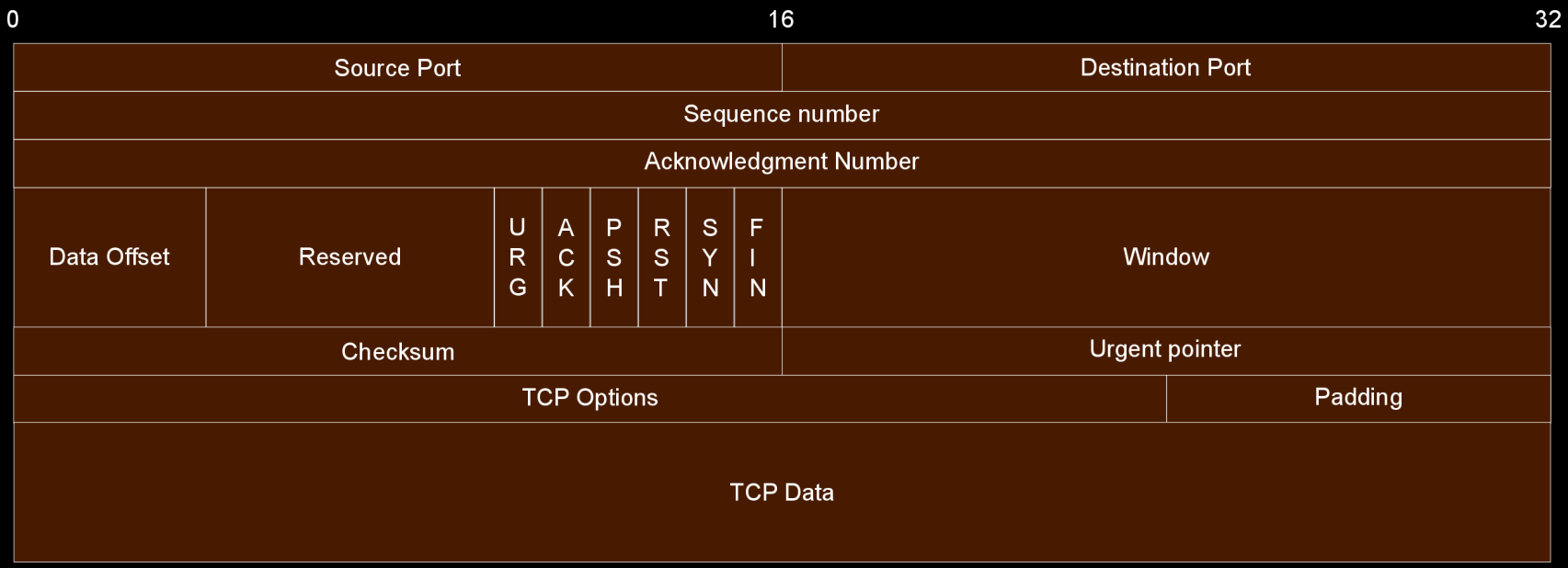

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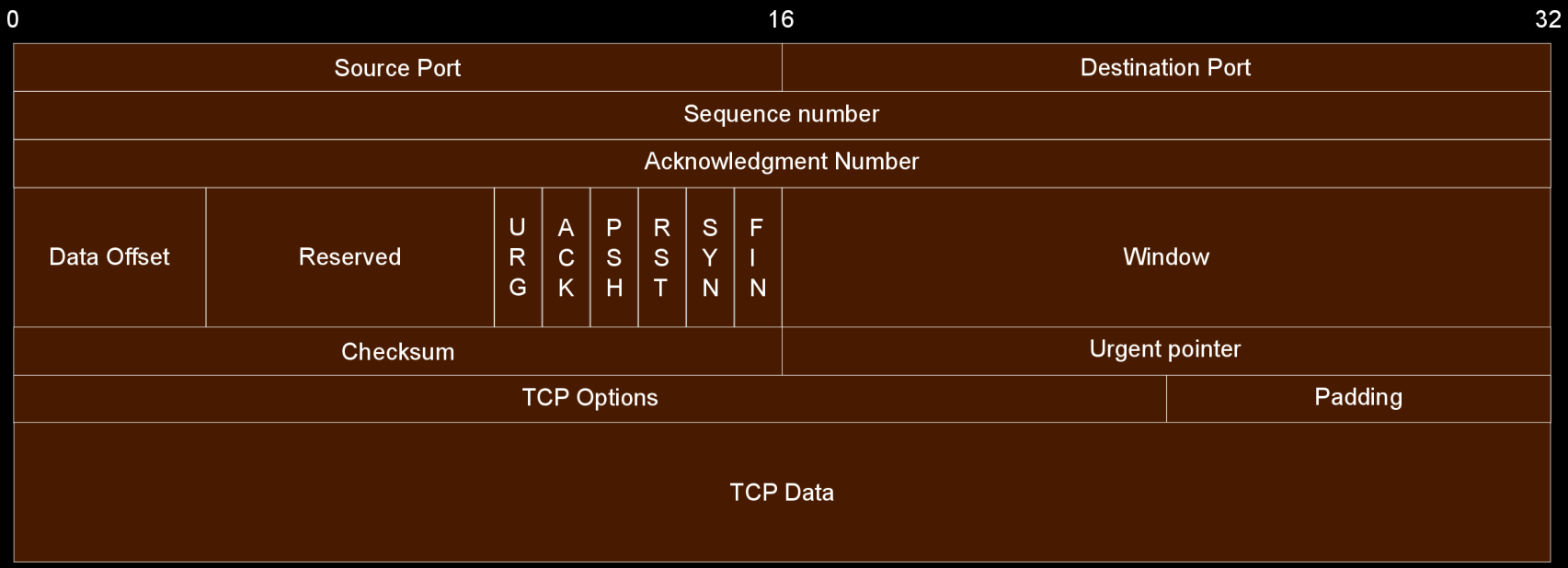

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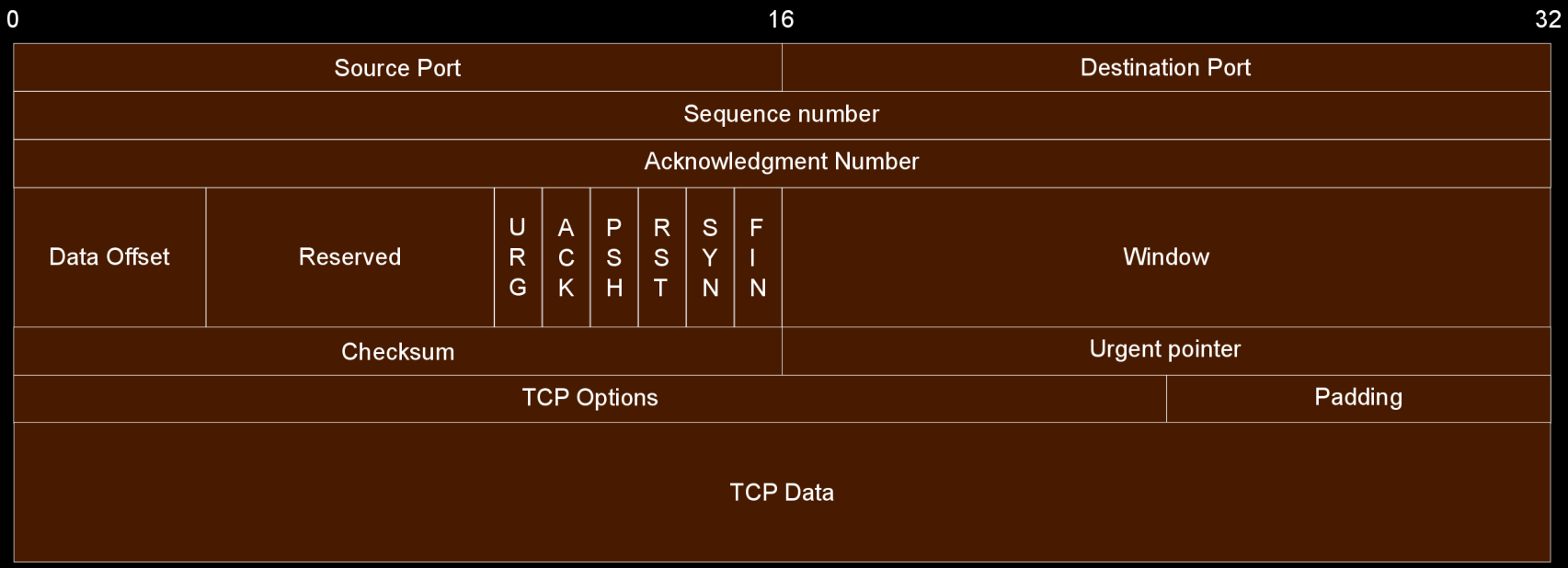

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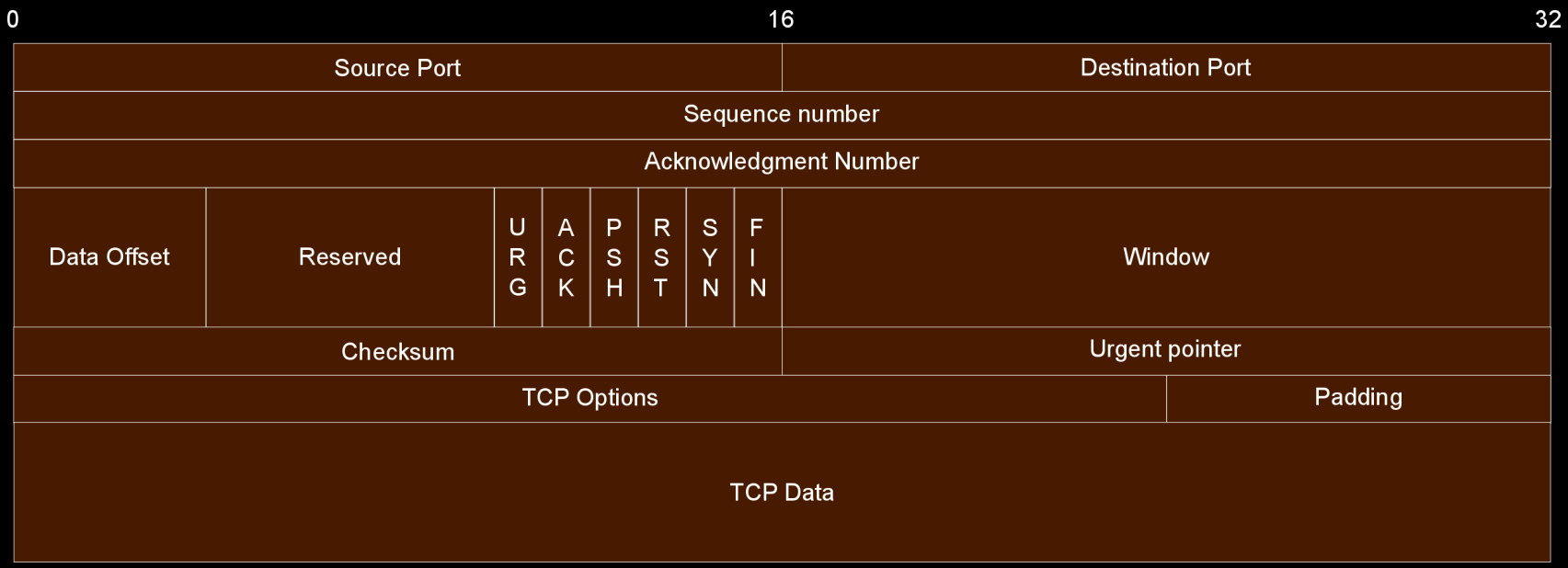

Interesting:

- Sequence and acknowledgement numbers
- Bit flags (URG, ACK, etc.)
- No authentication either, just a checksum

TCP: a few more notions

The TCP handshake

TCP is connection-based .

TCP: a few more notions

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TCP: a few more notions

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Question: what happens if the connection terminates early?

TCP: a few more notions

The TCP handshake – interrupted

At step 2, the Server has sent an `ACK` and opened a socket.

TCP: a few more notions

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More generally, fingerprinting by sending silly packets. Why? (see next slide)

TCP: a few more notions

TCP sequence

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TCP: a few more notions

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Fact2: many embedded systems have early implementations.

TCP: a few more notions

More details on the handshake

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TCP: a few more notions

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- A machine that accepts sends `ACK`, otherwise `RST`

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Zombie scanning

Hacker fridges!

Assume there is an idle device F

Zombie scanning

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Demo: `nmap -sI`.
Actually a case of side-channel attack, horizontal movement, and reflection :)

Reflection attack

Key idea:

Reflection attack

Key idea: some people are talkative.

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Demo:

- `dig DNSKEY isc.org @8.8.8.8`

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Same idea applies to *e.g.* NTP

NTP reflection attack

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No network infrastructure today can handle 400 Gb/s.

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`http://jumpespjump.blogspot.fr/2015/09/how-i-hacked-my-ip-camera-and-found.html`

A few more questions

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If you're interested, research it (or request a lecture)