I12: Capturing a packet - from Ether and Wire to Wireshark

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Onlineversion of Sharkfest talk

Introduction

Jörg Mayer

1st sniffer: Etherfind on SunOS (1992)

Ethereal user since 1998

1st patch submitted 1998

Core Developer

Dayjob:

Network Consultant (Design, Implementing, Troubleshooting)

Content

- Part 1

  Capturing data on the wire

  Passing the OS

  dumpcap and wireshark

- Part 2

  What's diferent with wireless

  OS

  Capture

Part I

From wire to Wireshark

Data Capture

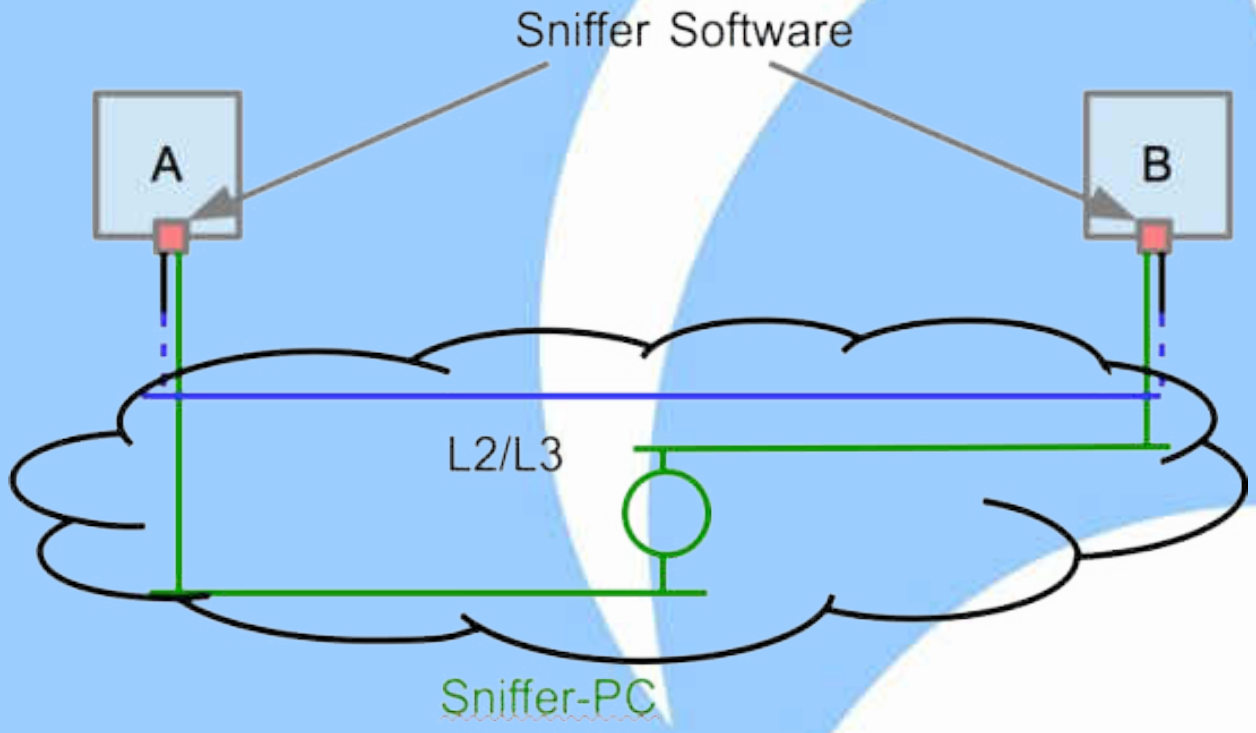
3 Scenarios how data is captured

(ultra short version, there are whole talks just about this)

- Shared media
- Mirror ports
- Taps

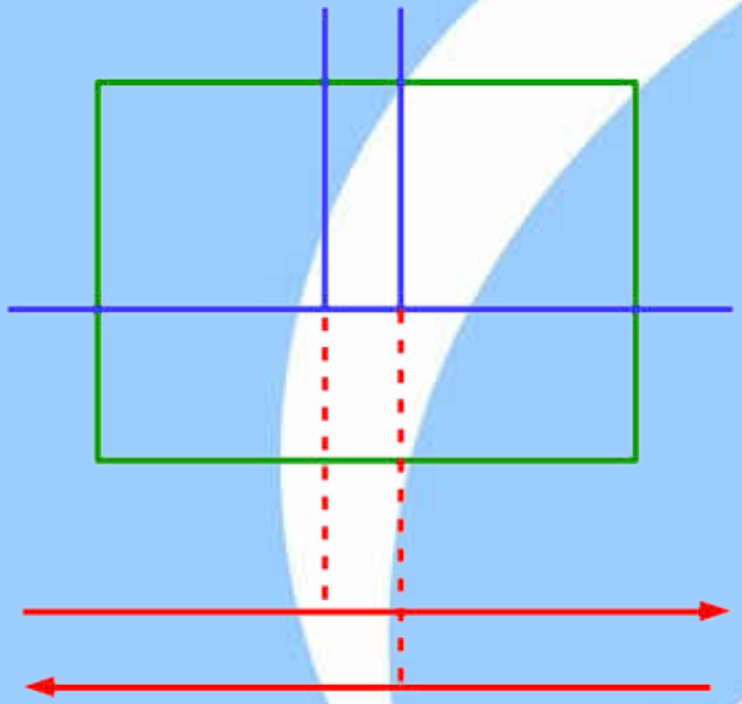
Data Capture

- Shared/BUS
  - All network participants may see each other's traffic



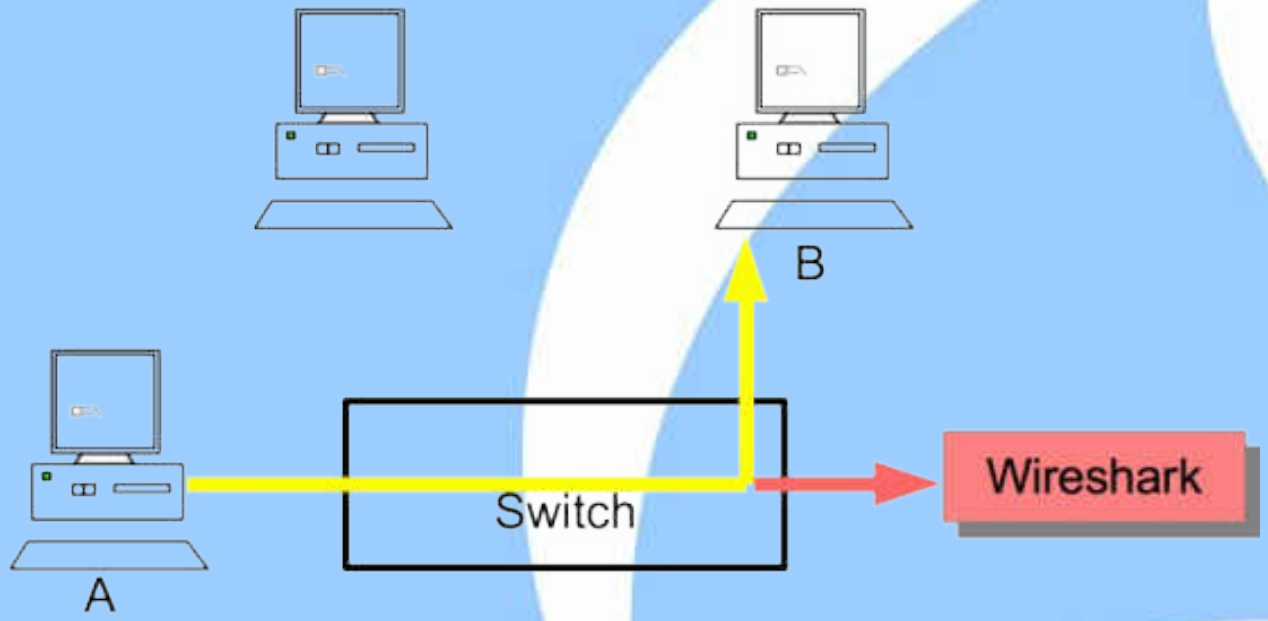
Data Capture

- Tap

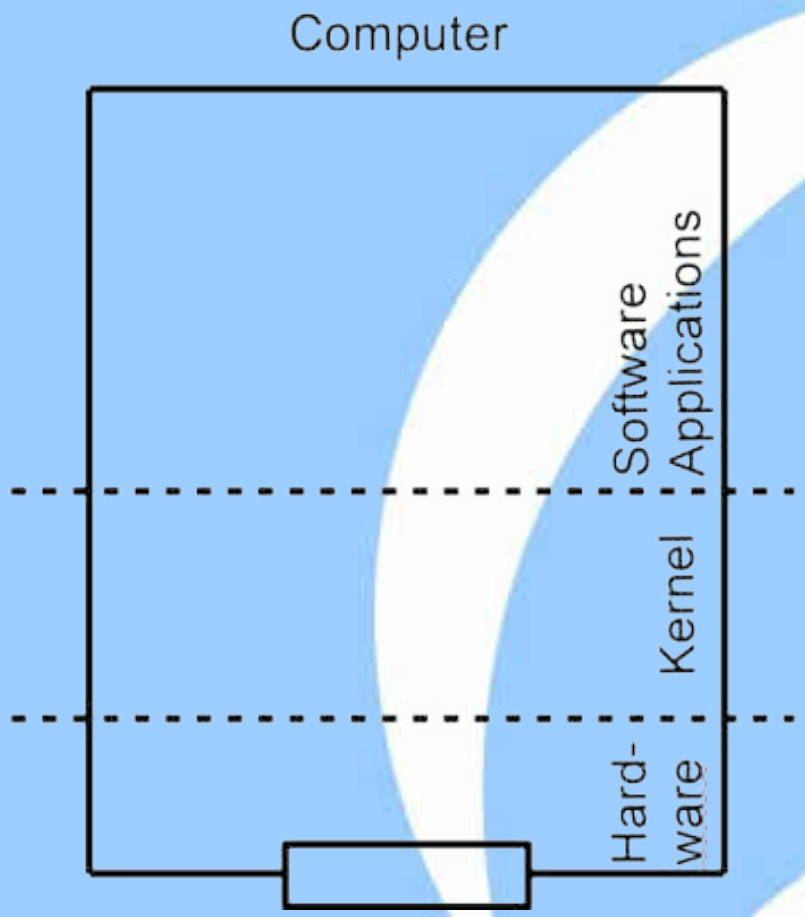


Data Capture

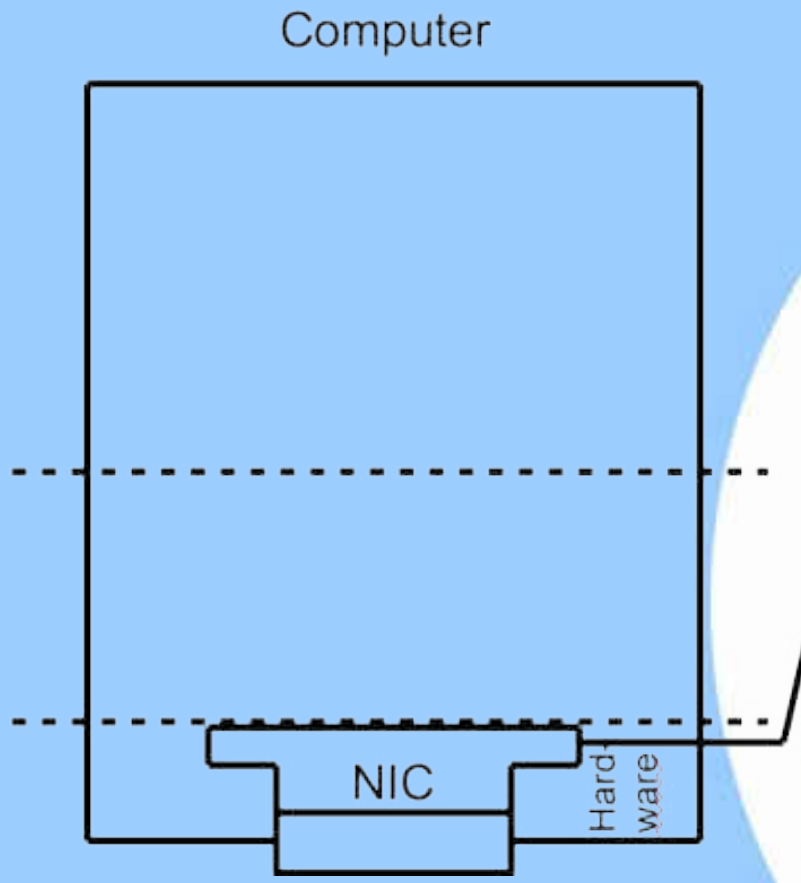
- Mirror port



Data Flow



Data Flow



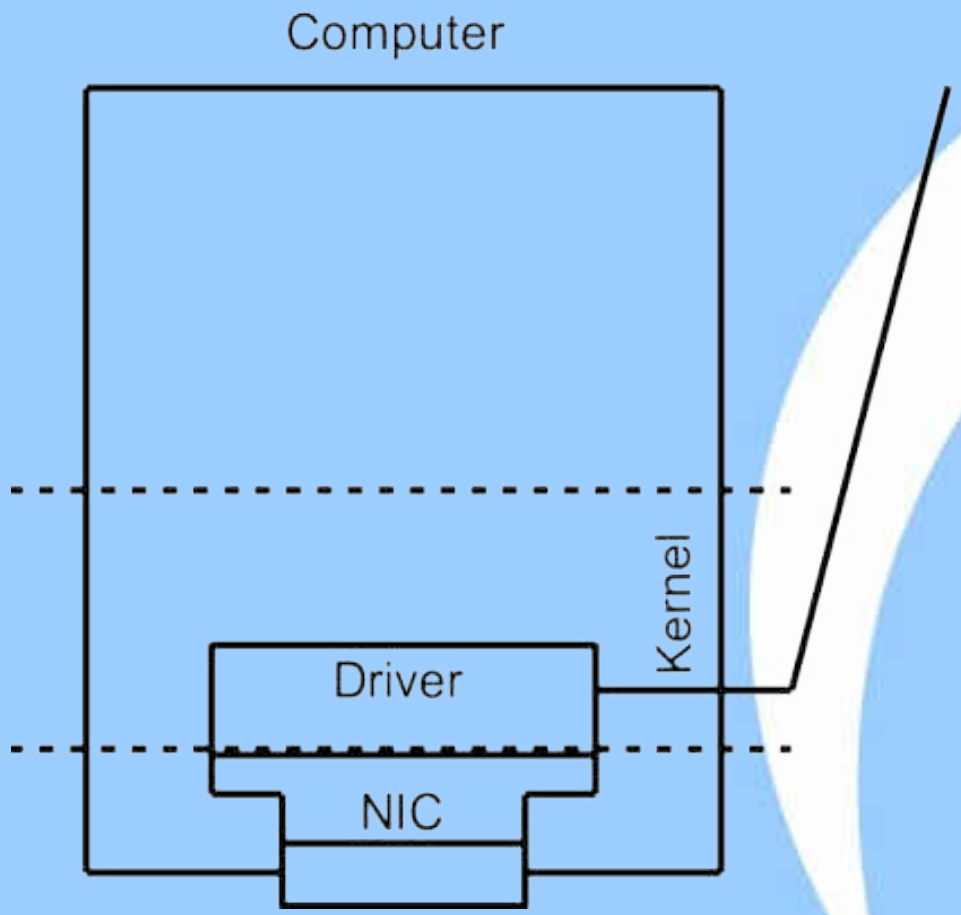
Destination MAC Filter

- In Hardware
- Filters Unicast and Multicast
- Disable by activating „promiscuous mode“

Ethernet chip „surprises“

- always filters errored frames
- fcs often missing
- mac filtering (turn off via „promiscous mode“)
- vlan tagging offloading
- ip/udp/tcp checksum offloading
- generic/udp/tcp segmentation offloading
- link-pulse, autonegotiation invisible

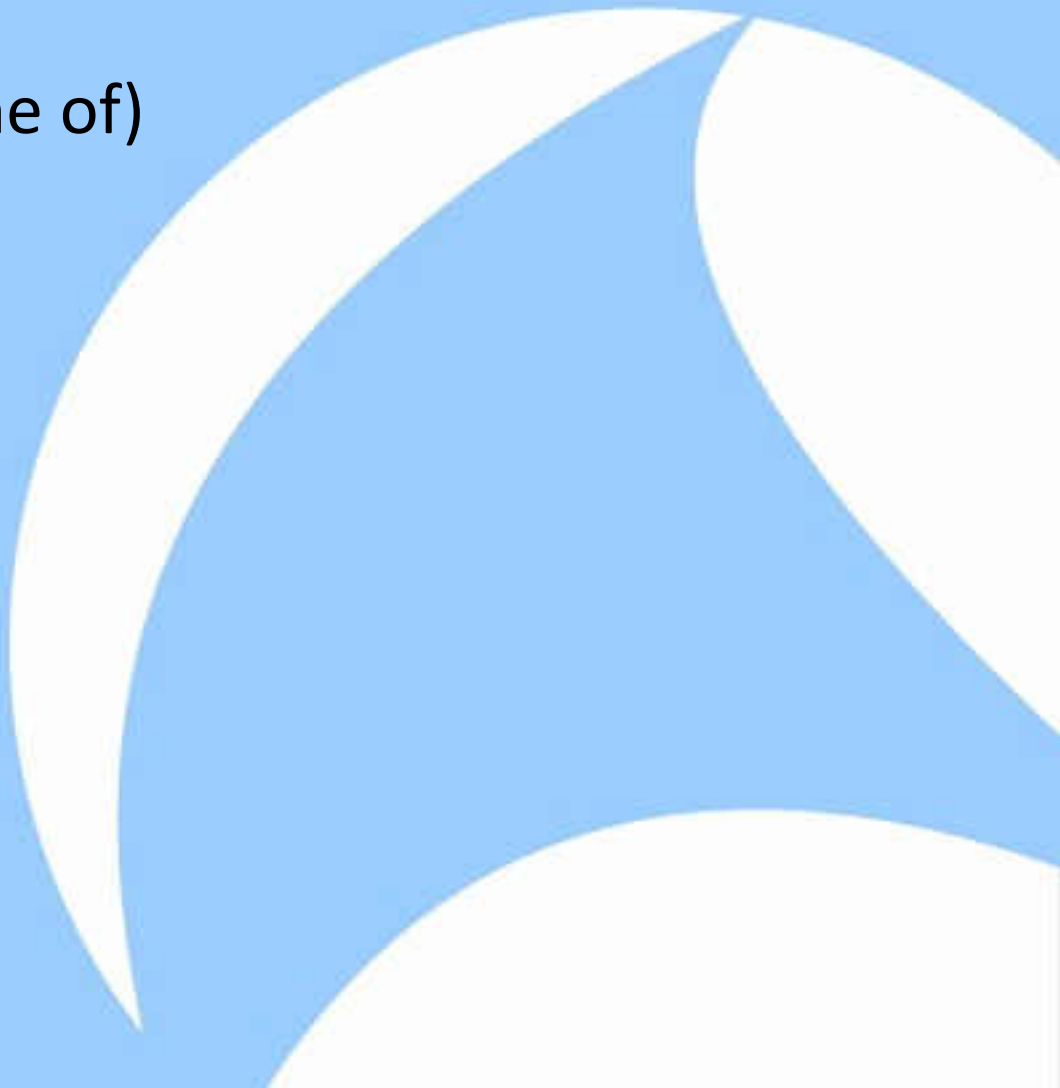
Data Flow



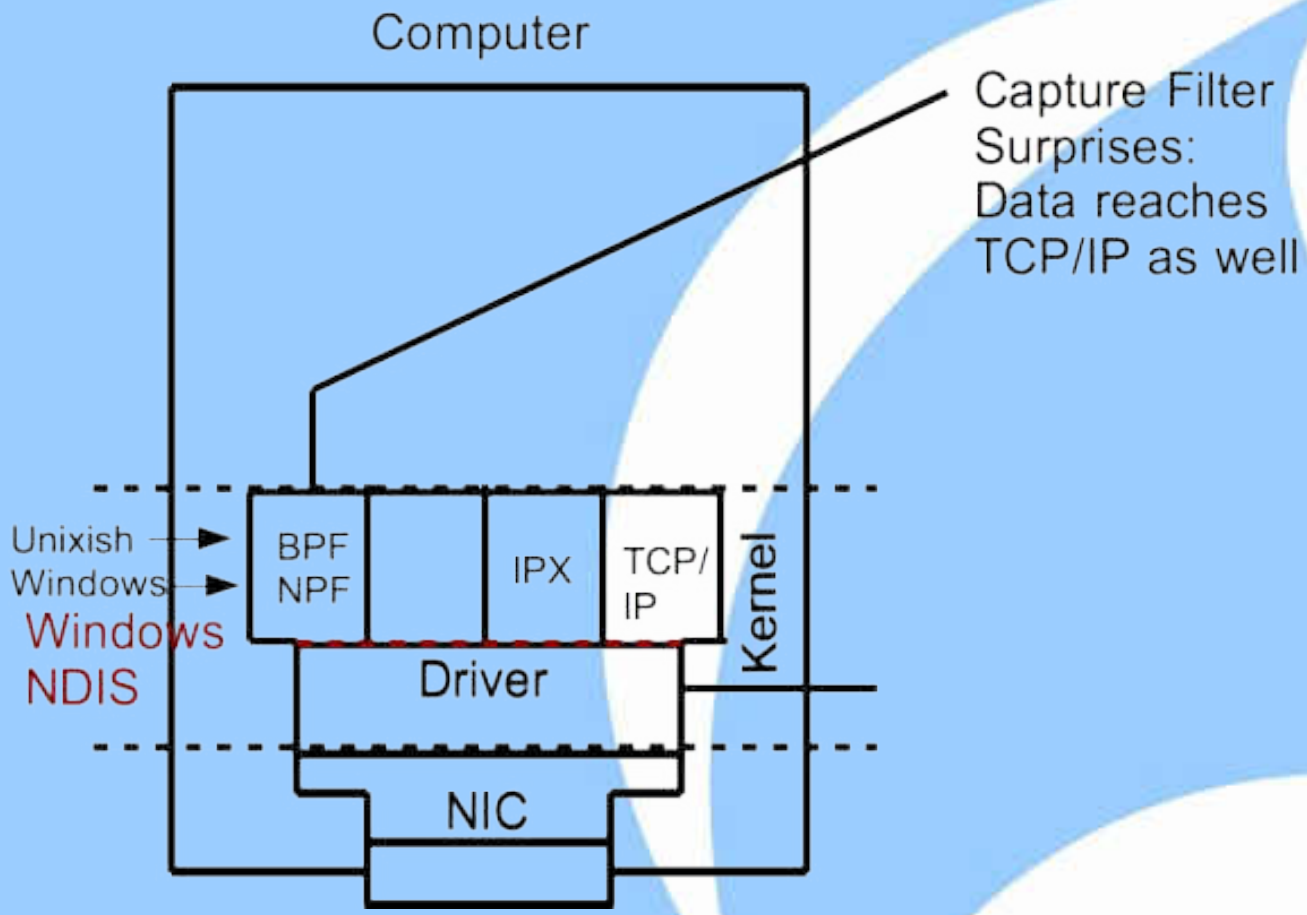
- Sometimes disable additional hardware Feature VLAN offloading
- Additional surprises: IP/UDP/TCP checksum offloading and TCP segmentation

Driver (not Windows)

- adds metadata (some of)
- timestamp
- direction
- packet size
- capture size
- encapsulation type



Data Flow


Computer
Capture Filter
Surprises:
Data reaches
TCP/IP as well
Unixish
Windows
Windows
NDIS
BPF
NPF
IPX
TCP/
IP
Kernel
Driver
NIC

Sidetrack: NDIS

Windows „driver framework“

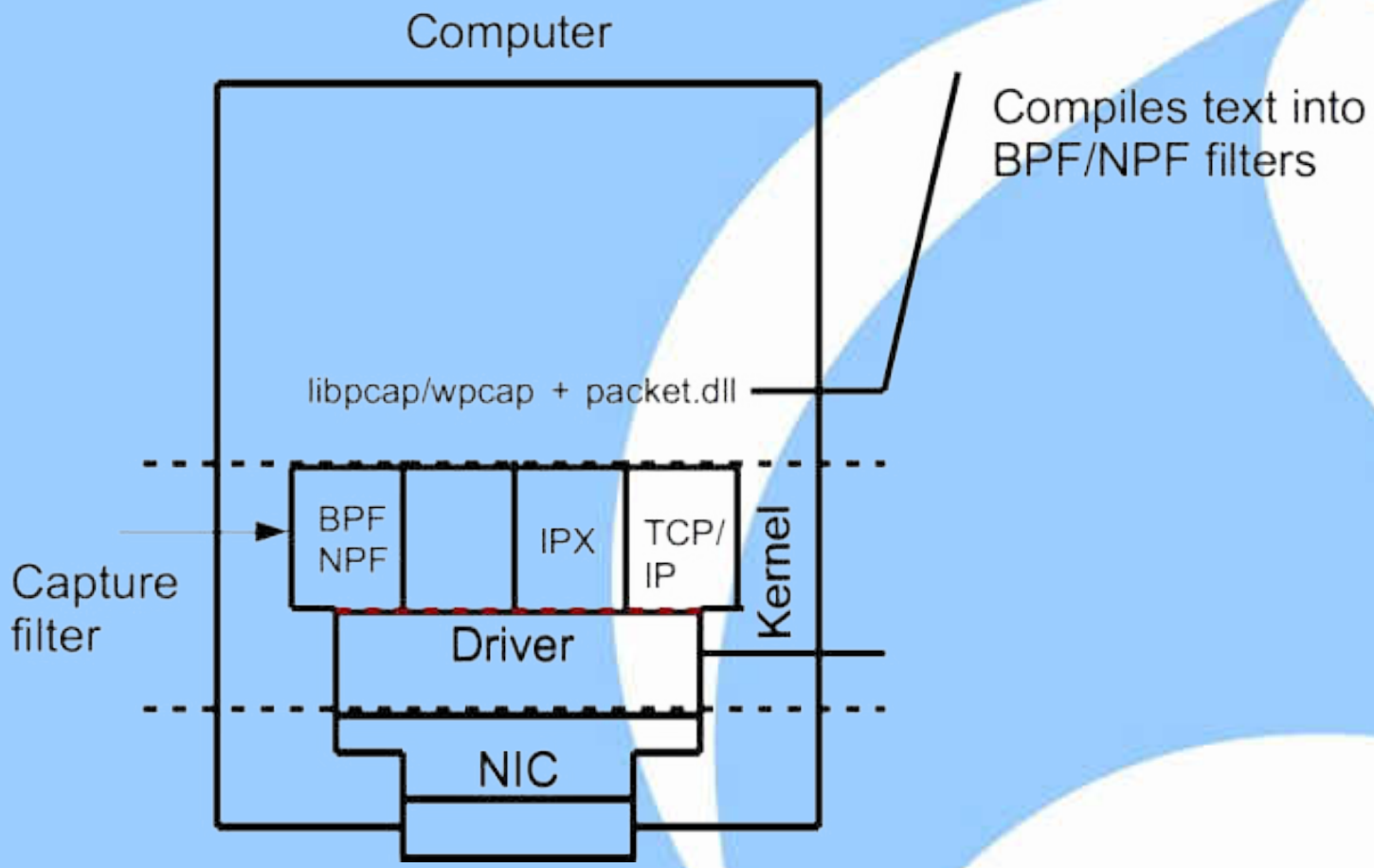
(ultra short version)

- Drivers and IP-Stack hook into it
- WinPcap uses NDIS version 5
- Responsible for many „features“ of windowscapture

Sidetrack: NDIS „surprises“

- No capture on Loopback, ppp, vpn interfaces
- „random“ placement in the chain of other clients
- Firewalls
- Virus checkers
- VPN

Data Flow


Computer
Compiles text into
BPF/NPF filters
libpcap/wpcap + packet.dll
BPF
NPF
IPX
TCP/
IP
Kernel
Capture
filter
Driver
NIC

More on packet.dll (Windows only)

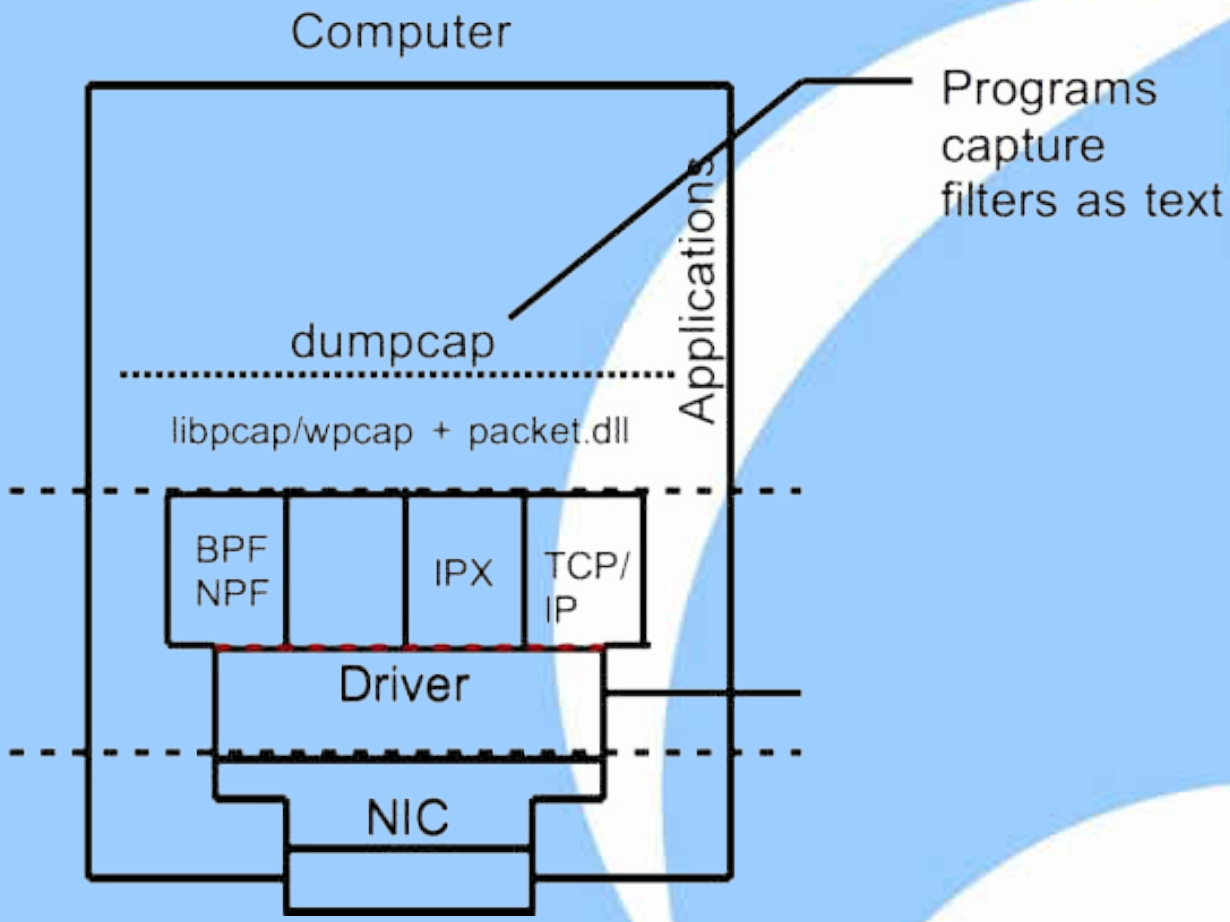
Compensates for missing stuff in kernel/drivers

(ultra short version)

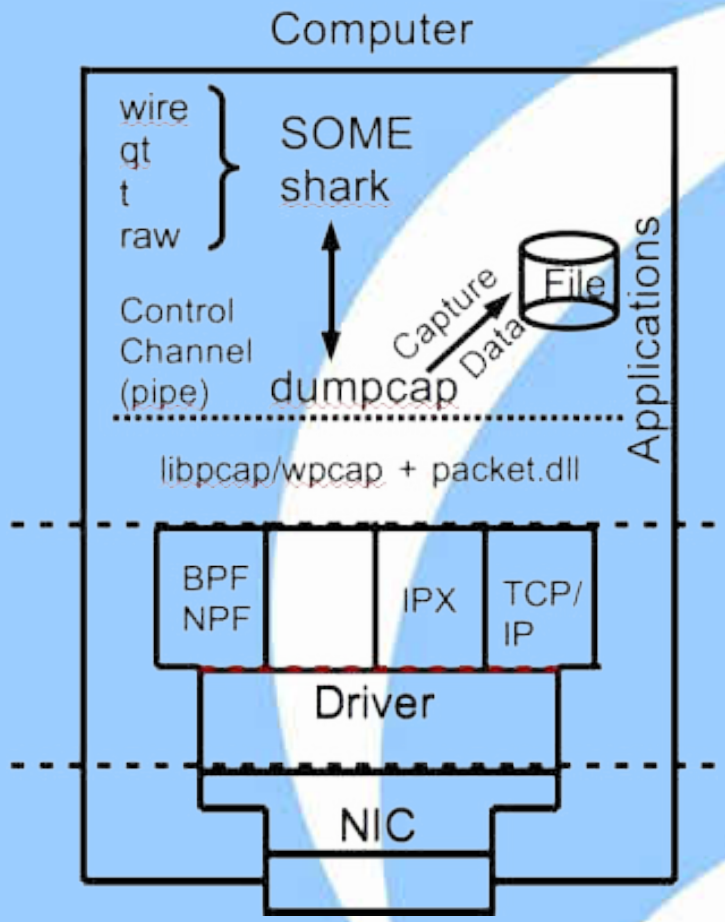
- Provides NPF
- Provides timestamps (and other metainfo)

Timestamps on Windows are way more inaccurate than on Unix'ish systems

Data Flow


Computer
Programs
capture
filters as text
Applications
dumpcap
libpcap/wpcap + packet.dll
BPF
NPF
IPX
TCP/
IP
Driver
NIC

Data Flow

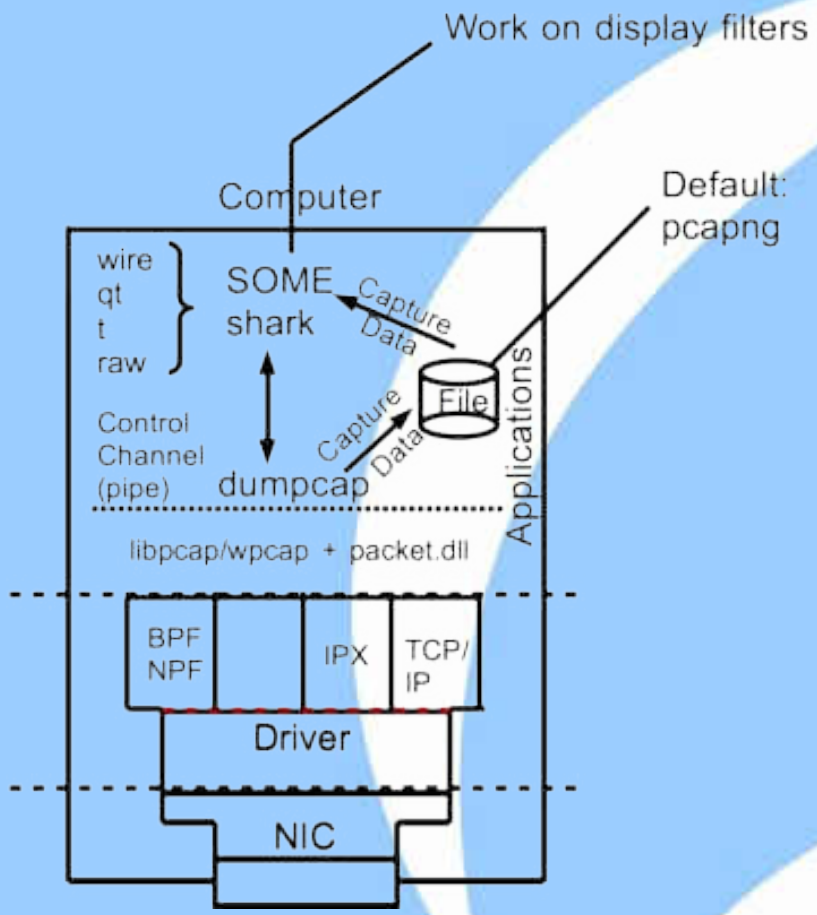

Computer
wire
qt
t
raw
SOME
shark
Control
Channel
(pipe)
dumpcap
Capture
Data
File
Applications
libpcap/wpcap + packet.dll
BPF
NPF
IPX
TCP/
IP
Driver
NIC

dumpcap

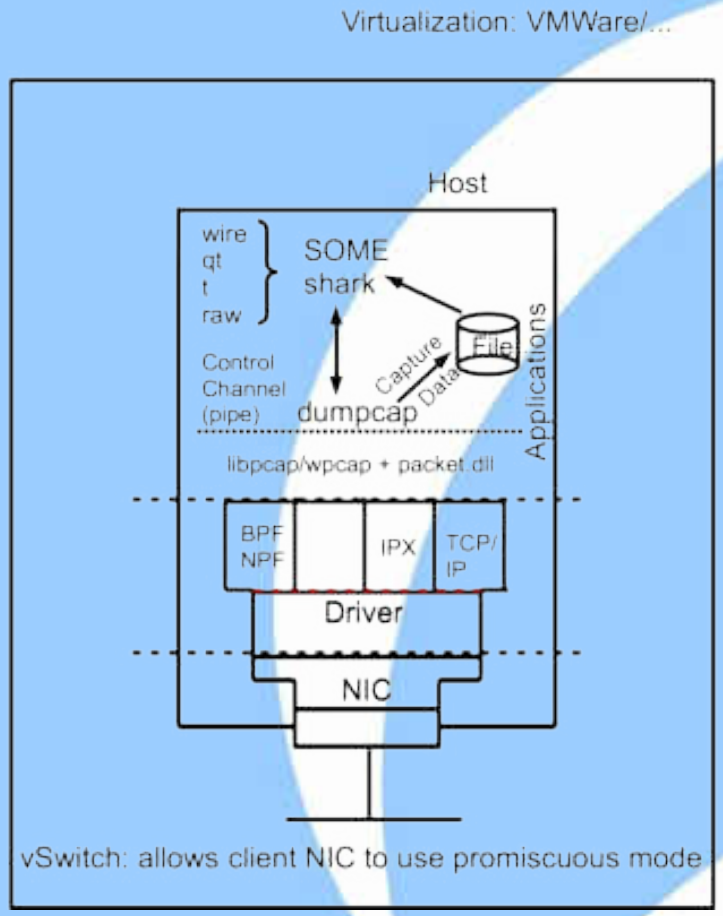
The program that does (almost) nothing

- Asks the kernel to capture (often requires special privileges)
- Adds pcapng header to packet and writes to file
- Signals Wireshark that new data is available

Data Flow


Work on display filters
Computer
Default:
pcapng
wire
qt
t
raw
SOME
shark
Capture
Data
File
Control
Channel
(pipe)
Capture
Data
dumpcap
Applications
libpcap/wpcap + packet.dll
BPF
NPF
IPX
TCP/
IP
Driver
NIC

Data Flow


Virtualization: VMWare/...
Host
wire
qt
t
raw
SOME
shark
File
Capture
Data
Control
Channel
(pipe)
dumpcap
Applications
libpcap/wpcap + packet.dll
BPF
NPF
IPX
TCP/
IP
Driver
NIC
vSwitch: allows client NIC to use promiscuous mode

Inside Wireshark

Read filters

The packets Wireshark **knows** about

Command line syntax: -R <read filter>

Same syntax as display filters

Display filters

The packets Wireshark **shows**

Command line syntax: -Y

Inside Wireshark

Filtering is expensive (CPU, memory)

Read filters easily filter too much:

- IP fragments relevant to your protocol
- TCP packets without payload relevant to your protocol
- There are talks about what can go wrong here

Part II

Wireless

Wireless works the same

if we only

- do cooked capture

  (frames look like Ethernet frames)

- don't turn on promiscous on Windows

  (some Windows drivers do „interesting“ things)

… well - almost the same

cooked capture means

- replace IEEE802.11 header by Ethernet_V2 header
- we only see traffic as we would do on a switch

  Broadcasts, Multicasts, Unicasts to/from us
- data frames only

  no wireless control, management or eapol frames (4-way-handshake)
- already decrypted

Surprises with WLAN captures

- No packets captured at all
- Are you on Windows?
- Have you promiscous mode turned on?
- I only see my own traffic
- Maybe you are actually looking at cooked traffic?
- What is the L2-Header: 802.11 or Ethernet?

Surprises with WLAN captures

- No machines visible or only traffic in one direction
- Are you on the same channel/band that they are on?
- Is the „invisible“ machine a „hidden station“ (AP can see station but we can't)?
- Special case of hidden station: Incompatible antenna (polarization)
- I see traffic from machines not on my channel
- A channel is 5 MHz wide, a signal is 22(b), 20 (a/g), 20/40 (n), 20/40/80/160(ac) MHz wide. So we see neighboring traffic as well.

Surprises with WLAN captures

- Some packets are missing
- Channel hopping sniffing software (e.g. kismet)
- Rarely: AP changing channel (DFS: regulator, ACS: optimize)
- Some of ACK, RTS, CTS frames are missing
- Some (mostly older chips) process these frames and can't forward them to the driver (redued raw capture)

Surprises with WLAN captures

- No data frames or multicast/broadcast frames only
- The capture hardware is too old (b < g < n2, a < n5 < ac)
- The capture hardware supports not enough streams (n, ac)
- Lots of corrupted but ACK'ed frames
- Sniffer close to interference source

Surprises with WLAN captures

- Decryption of WPA/WPA2 doesn't work
- raw capture required AND 4-way-handshake capture required AND no 802.1X
- Wireshark: pwd vs. psk
- Network not visible but active clients
- Hidden SSID
- deactivated beacons

Thanks to....

- Gerald Combs for providing me with a hobby that has lasted for close to 16 years
- Janice and all the other helpers: It has been a great time
- Riverbed for sponsoring
- The Wireshark community

THANKS for listening!

Questions?