Lecture 5: Passive Testing & Network Trace Analysis

Passive Testing Techniques for Communication Protocols

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OUTLINE

INTRODUCTION & ENVIRONMENT DESCRIPTION

DEEP PACKET INSPECTION

PASSIVE TESTING WITH NETWORK TRACES

Regarding "non-intrusive" testing methods

By now you **should** know:

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- We know what we want to test interacts over the network, perhaps we can take a look at the exchanged protocol messages?

Network trace analysis

Environment description

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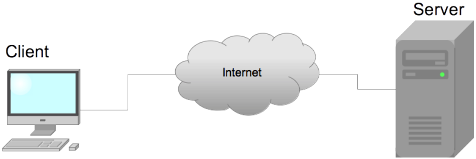

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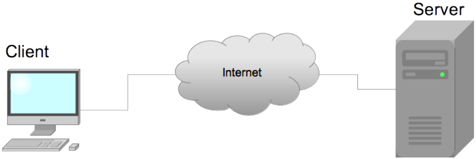

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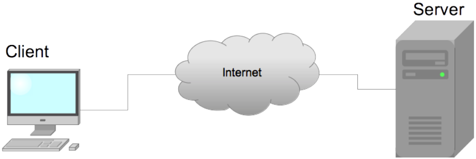

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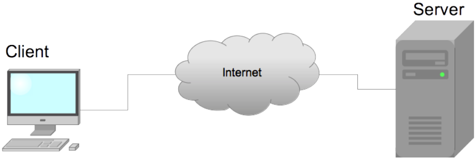

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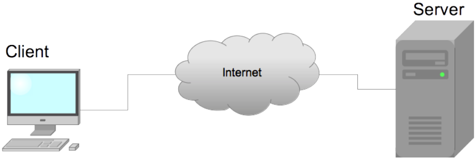

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  - Or what would change?

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  - Mostly, the sense of "direction". The VSNP server responses: outgoing from local IP if P.O. @ server; incoming from a remote IP if P.O. @ client

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  - Small tool/protocol developed in academia packet capture over IP, filter, and send(optionally using SSL/TLS) to a remote host; "somebody" planned to post this on-line as open source tool...

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An image, 10^3 words…

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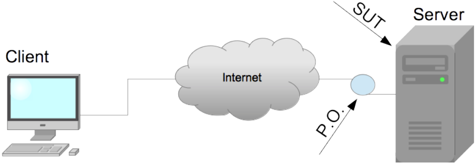

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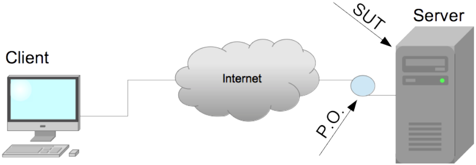

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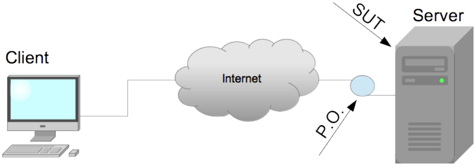

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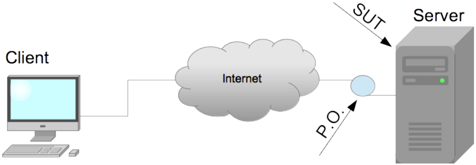

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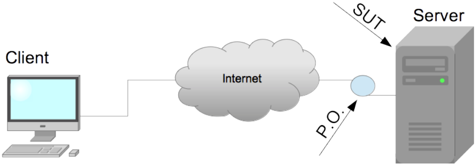

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We know about the environment and how to obtain the data, how do we test this?

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- Report the finding. Usually searching has the sense of searching for prohibited elements

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- Many existing approaches (Cisco, Snort, etc.) , nonetheless, they tend to have common points. . .

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- Good for security, bad for DPI!

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- The fast: expect the network trace decrypted by any external entity

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- Look for FTP data channel commands, when detected, associate to FTP session the data channel, they are related

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PASSIVE TESTING USING NETWORK TRACES 101

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  - Oxford — a test is: "A procedure intended to establish the quality, performance, or reliability of something, especially before it is taken into widespread use"

PASSIVE TESTING USING NETWORK TRACES 102

Call it how you feel it is correct…

Passive Testing using Network Traces 102

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Nonetheless, we want to guarantee that:

PASSIVE TESTING USING NETWORK TRACES 102

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PASSIVE TESTING USING NETWORK TRACES 102

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Assume the VSNP protocol and its even/odd, odd/even property

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- Let's take a look at a potential network trace to list some properties

UNDERSTANDING CORRELATED NETWORK INTERACTIONS

Assume the following trace

Understanding correlated network interactions

Assume the following trace

ID:2	**ID:3**	**ID:4**	**ID:2**	**ID:4**	**ID:21**	**ID:21**
N:	N:	N:	N: 77	N: 89	N:	N: 101

UNDERSTANDING CORRELATED NETWORK INTERACTIONS

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ID:2	**ID:3**	**ID:4**	**ID:2**	**ID:4**	**ID:21**	**ID:21**
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Questions

Understanding correlated network interactions

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Questions

- How can two requests / responses be together?

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- What do we do with a non-replied request?
  - It depends on one characteristic, more on this later, keep it in mind…

UNDERSTANDING CORRELATED NETWORK INTERACTIONS (CONT.)

How the trace happened / How the tester should treat it

Understanding correlated network interactions (cont.)

How the trace happened / How the tester should treat it

ID:2

N:

UNDERSTANDING CORRELATED NETWORK INTERACTIONS (CONT.)

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Understanding correlated network interactions (cont.)

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UNDERSTANDING CORRELATED NETWORK INTERACTIONS (CONT.)

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- Given the nature of properties, matching packets cannot be expressed by a regular language (I hope you know why now)

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UNDERSTANDING CORRELATED NETWORK INTERACTIONS (CONT.)

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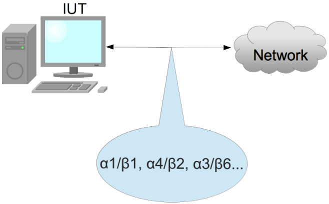
  - How to avoid resource consumption?

UNDERSTANDING CORRELATED NETWORK INTERACTIONS (CONT. 2)

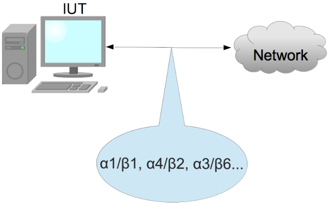
Interaction



Invariants or properties

Understanding correlated network interactions (cont. 2)

Interaction



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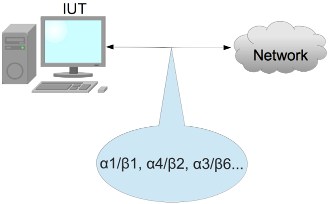

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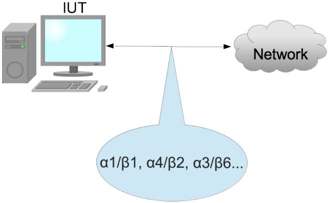

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  - Let's take a look at those concepts. . .

Passive Testing with Network Traces

Concepts

Based on the network traces and the desired properties that **must hold** (invariants)

PASSIVE TESTING WITH NETWORK TRACES

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  - That is, to describe how packet A relates to packet B (request port is equal to response port, etc.)

Passive Testing with Network Traces
Concepts (cont.)

How are the characterization of packets and relationships made?

Passive Testing with Network Traces

Concepts (cont.)

How are the characterization of packets and relationships made?

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PASSIVE TESTING WITH NETWORK TRACES

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PASSIVE TESTING WITH NETWORK TRACES CONCEPTS (CONT.)

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- The SYN flag, of the TCP header, of *i*-th the packet
- Hierarchical as you can see…

Passive Testing with Network Traces

Concepts (cont. cont.)

Granular data access

Passive Testing with Network Traces Concepts (cont. cont.)

Granular data access

- Simple access based byte offset (TCP SYN flag is on byte offset 21 of packet, for example) is not feasible

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- A mapping function is needed between the raw data bytes and the structure

Passive Testing with Network Traces Concepts (cont. cont. cont.)

P packet

```
...

(TCP Header)
eb5d01bbd3e75a55cfa6
e7c0801810001cd50000

...
```

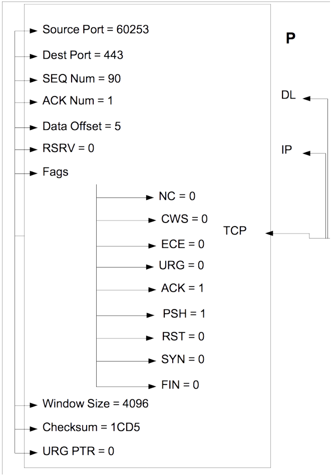
Passive Testing with Network Traces Concepts (cont. cont. cont.)

P packet

...

```
(TCP Header)
eb5d01bbd3e75a55cfa6
e7c080181000 1cd50000
```

...



Passive Testing with Network Traces
Concepts (cont. cont. cont.)

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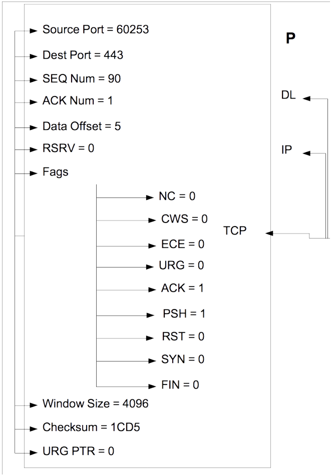
eb5d01bbd3e75a55cfa6
e7c080181001cd50000
```

...

ACK flag of TCP header of packet addressing



PASSIVE TESTING WITH NETWORK TRACES CONCEPTS (CONT. CONT. CONT.)

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```
(TCP Header)
eb5d01bbd3e75a55cfa6
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```

...

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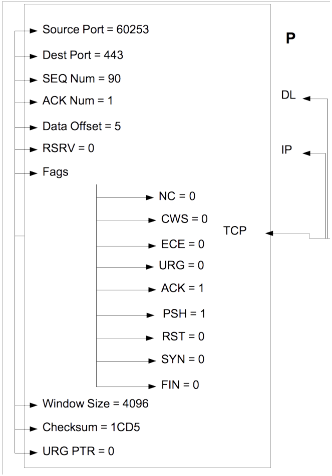
- Many notations, assume packet is P, then value is 1 for

```
P->TCP->fags->ACK
```



P

DL

IP

TCP

Source Port = 60253

Dest Port = 443

SEQ Num = 90

ACK Num = 1

Data Offset = 5

RSRV = 0

Fags

NC = 0

CWS = 0

ECE = 0

URG = 0

ACK = 1

PSH = 1

RST = 0

SYN = 0

FIN = 0

Window Size = 4096

Checksum = 1CD5

URG PTR = 0

EXPRESSING INVARIANTS

Without a "formal" language

Expressing invariants

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Expressing invariants

Without a “formal” language

- For each response with an even number a “corresponding” request with an odd ID should have been received
- For instance:

```
if RES
(
   RES->TCP->srcP = 1010 &
   RES->VSNP->Num % 2 = 0 &
   RES->IP->srcIP = REQ->IP->dstIP &
   REQ->VSNP->ID = RES->VSNP->ID &
   REQ->VSNP->ID %2 != 0
) then REQ<RES
(
   REQ->VSNP->Num = NULL
)
```

YOU ARE HERE ↓

You should know

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- Open areas for research