Investigating the Security and Accessibility of Voyage Data Recorder Data using a USB attack

Authors:

Avanthika Vineetha Harish, Kimberly Tam, Kevin Jones

Presenter : Avanthika Vineetha Harish

University of Plymouth, United Kingdom

avanthika.vineethaharish@plymouth.ac.uk

Cyber-SHIP Lab

SECURING MARITIME

UNIVERSITY OF PLYMOUTH

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Avanthika Vineetha Harish

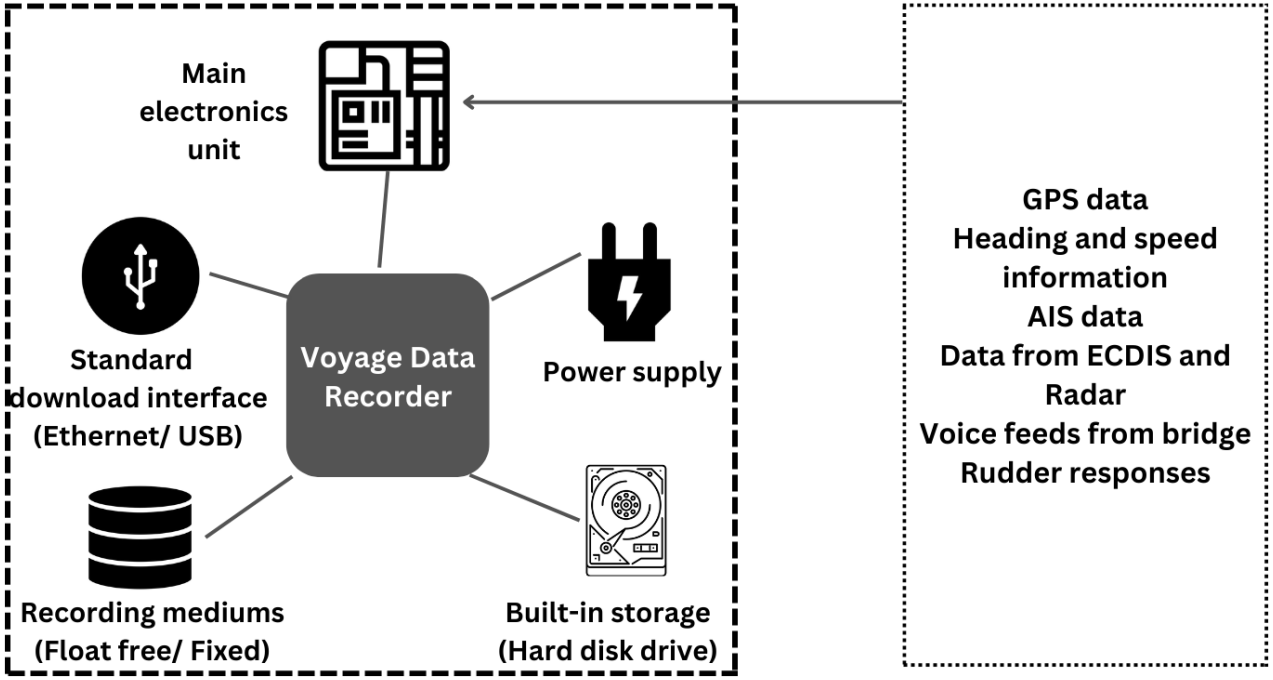
- Industrial Researcher at Cyber SHIP lab and a PhD candidate at the University of Plymouth, UK.
- Focused on vulnerability assessment and security testing for maritime systems.
- Masters in Cyber Security from Lancaster University, UK, with full scholarship from the British Council.
- Bachelor’s degree in Computer Science and Engineering from Mahatma Gandhi University, India.

Introduction

Voyage Data Recorder (VDR) - 'black box' for ships

- Critical role in accident investigations.
- Data need to be secure and tamper proof.
- Past cases where evidence data disappeared.

Image source: https://www.marineinsight.com/guidelines/voyage-data-recorder-on-a-ship-explained/



Background

- VDR components and features.
- International Maritime Organization regulations.
- Investigating authorities used VDRs extensively – popular cases like:
  - Sinking of El Faro [1]
  - Grounding of Costa Concordia [2]

*All icons from nounproject.com

Testing

Testing

- **Data tampering :** Manipulating accident investigation data can lead to loosen ends.
- **Testing on real hardware to see real effects.**
- **Automation of tests.**

Threat

- **Insider threat :** Critical evidence stored in VDRs are at sea for months and prone to insider access.
- According to a recent data breach report, there were 275 incidents related to data breach by privilege misuse from 2020 to 2021, and all these incidents were caused by insiders [4].

Attack Vector

- **USB :** Top cyber security attack vector, most VDRs use this port for updating, does not need much skill set.
- The number of USB threats rose to **52%** in 2022 from 37% in 2021 [3].

Aim:

- To investigate the possibility of VDR data manipulation by someone with limited technical skills and knowledge and to automate the attacks using USB device.

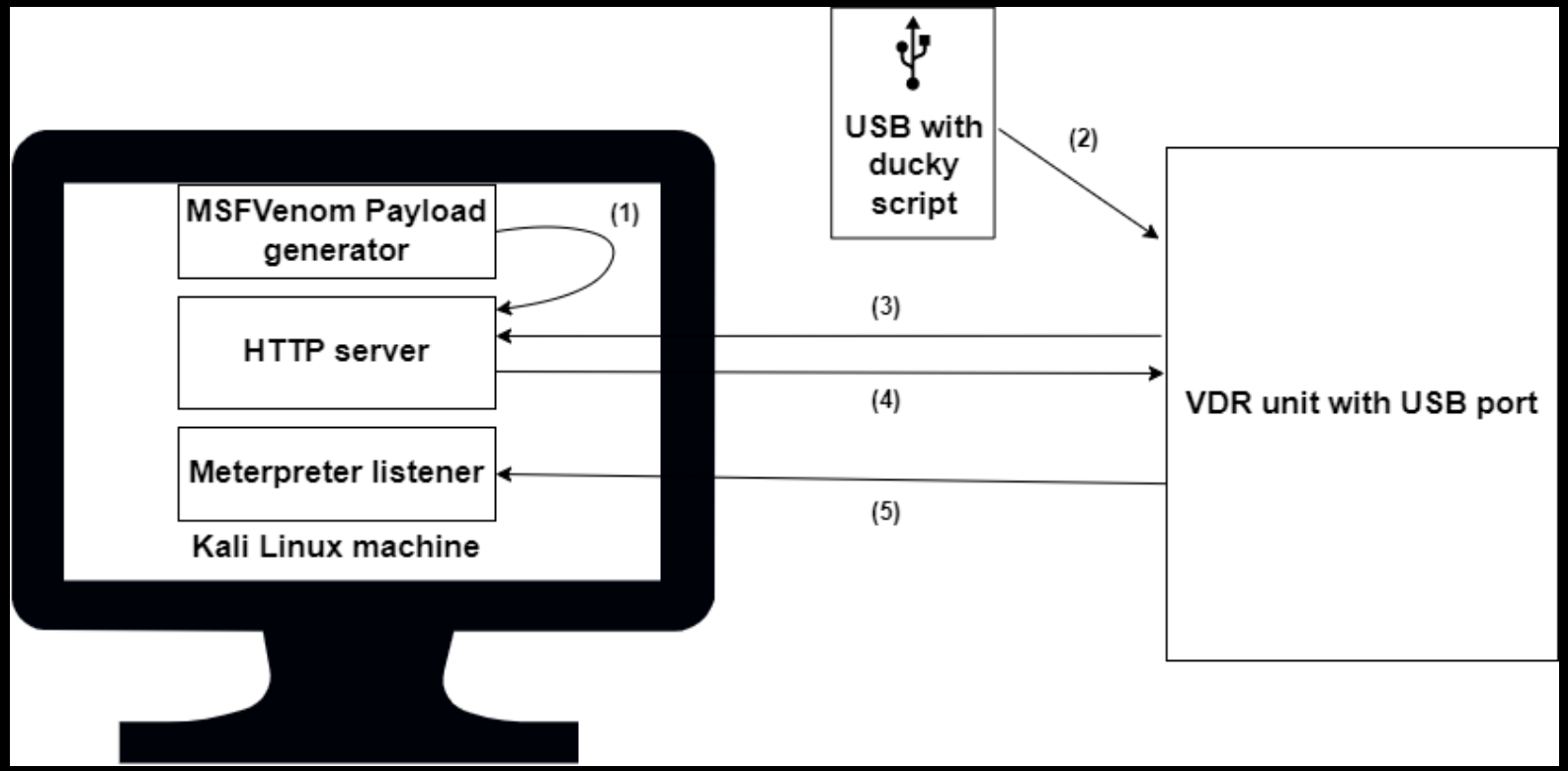
Tools used

- **System Under Test :** Off-the-shelf VDR from a global shipping equipment manufacturer – taken off from a ship – with data from the year 2018.
- **USB rubber ducky** [5] : Injects keystrokes.
- **Metasploit framework** [6]: Powerful pen-testing tool
- **ShinoLocker** [7] : Ransomware simulator developed by a security researcher, Shota Shinogi, for education and training purposes.
- **Nmap** [8]: Network scanning and auditing tool

Highlights of the testing

1. Reverse shell

Interactive shell connection from target machine to attack machine



(1) Payload generated (using Msfvenom [9]) and hosted in HTTP server
(2) Ducky Script written with commands to download payload
(3) Once USB blipped in, command to download payload
(4) Payload downloaded from server to VDR PC and executed
(5) Meterpreter listener receives connection from the VDR, and a session is opened.

Results :

- Reverse shell session obtained on the attack machine.
- VDR system running on Windows embedded standard 7 OS
- Privilege escalation.
- Retrieved 5 password hashes including that of administrator, captain and engineer accounts.
- Three blank passwords and the other two were simple ones.
- View, access and tamper files and folders.
- View, access and tamper logs and hiding the trace of manipulation.
- Affecting the ***Confidentiality, Integrity*** and ***Availability*** of data.

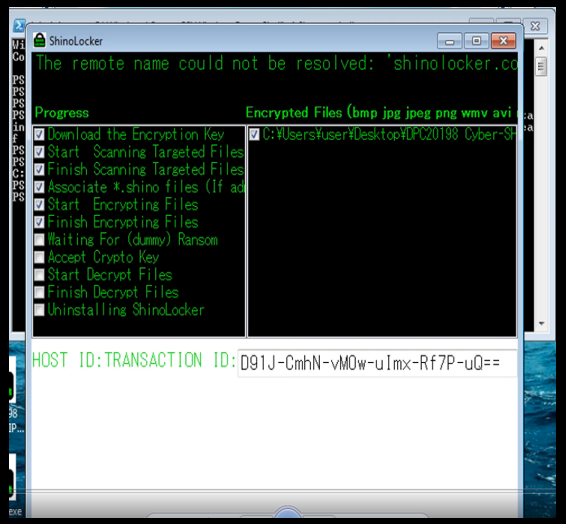
Suggestions:

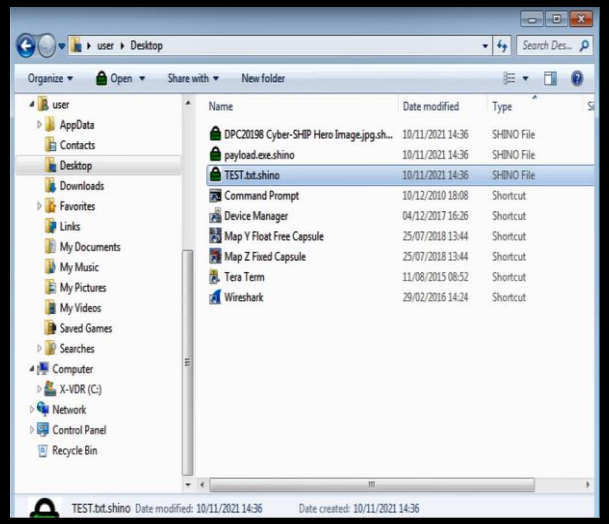
- Strong password policy as suggested by Cyber security guidelines onboard vessels document.
- Integrity checking mechanism.

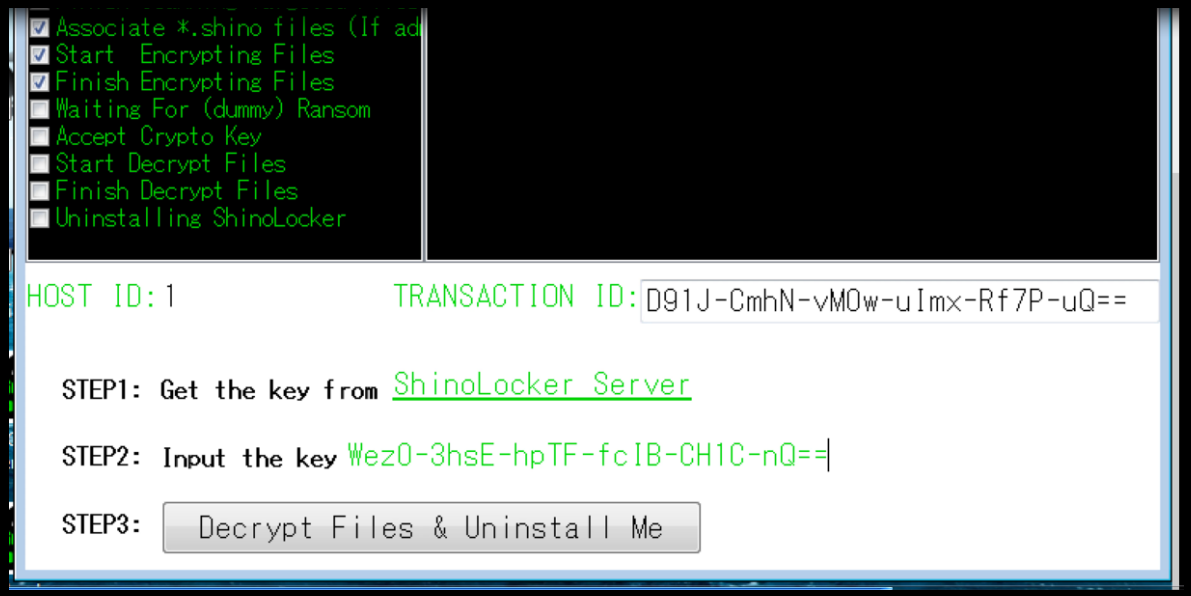
2. Ransomware

- Most common cyberattack these days.
- Leading source of cybersecurity threat risk to US ports and terminals [10].
- In the last five years, four major global shipping companies (CMA CGM, APM-Maersk, MSC and COSTCO) have been negatively affected by ransomware and their operations have been halted for weeks [11].
- Recently, a Singapore-based offshore operator - Swift Pacific Offshore has reported a data breach that experts believe to be a ransomware attack [12].

Changing ransomware motives : Attack on Belarus Railway systems to release fifty 50 high-risk political prisoners in addition to banning Russian soldiers from using Belarusian trains as the ransom [13].







ShinoLocker ransomware : Tool used for training and teaching purposes; appeared to be the most practical option without causing damage to the VDR.

- Payload created for png, jpeg, ppt, txt file types.
- Ducky script was written to download the payload on to the VDR PC.
- When USB with ducky script was plugged in to the VDR system, the ransomware started encrypting the files of the previously mentioned file types.
- Affecting the ***Availability*** of data.

3. Hard drive erasure

- Can be accomplished by few lines of ducky scripting.
- Denial of service.
- Affecting the ***Availability*** of data.
- Could be catastrophic and can lead to investigation dead ends.

Enrica Lexi case: In 2012, two Indian fishermen on a fishing boat ‘St.Anthony’ were killed off the coast of Kerala, India in a shooting incident mistaking the fishermen as pirates and India detained two Italian mariners on board the ship ‘Enrica Lexie’, an oil tanker, owned by a Milan-based company. VDR was retrieved, however, captain failed to preserve VDR data after the incident and the second officer of ‘Enrica Lexie’ stated that he did not press the VDR for recording[14].

4. Eternal Blue vulnerability

- Windows 7 Embedded standard OS on VDR found to be vulnerable with Eternal Blue exploit.
- Remote code execution vulnerability in Microsoft SMBv1 Servers with vulnerability entry of **CVE-2017-0143** [12].
- CVSS (Common Vulnerability Scoring System) score of **8.1(HIGH)** and the famous WannaCry attack used this exploit to spread infection.
- The session was not opened, however, **VDR crashed** with a blue screen of death and the machine needed to be manually rebooted.
- Denial of service (Affecting the ***Availability*** of data and system).
- Keeping the systems up-to-date.

Discussions

Improving information security of VDR data

- Raising the standards
- Automation and sector specific tools for testing
- Best operational practices

Thank you

For any questions contact: avanthika.vineethaharish@plymouth.ac.uk

Avanthika Vineetha Harish, Industrial Researcher and PhD student,
CyberSHIP Lab, University of Plymouth, United Kingdom
For more details, visit: https://www.plymouth.ac.uk/research/cyber-ship-lab

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