Daffodil International University

Topic 5:
Data Protection

Topic 5– Lecture 1:

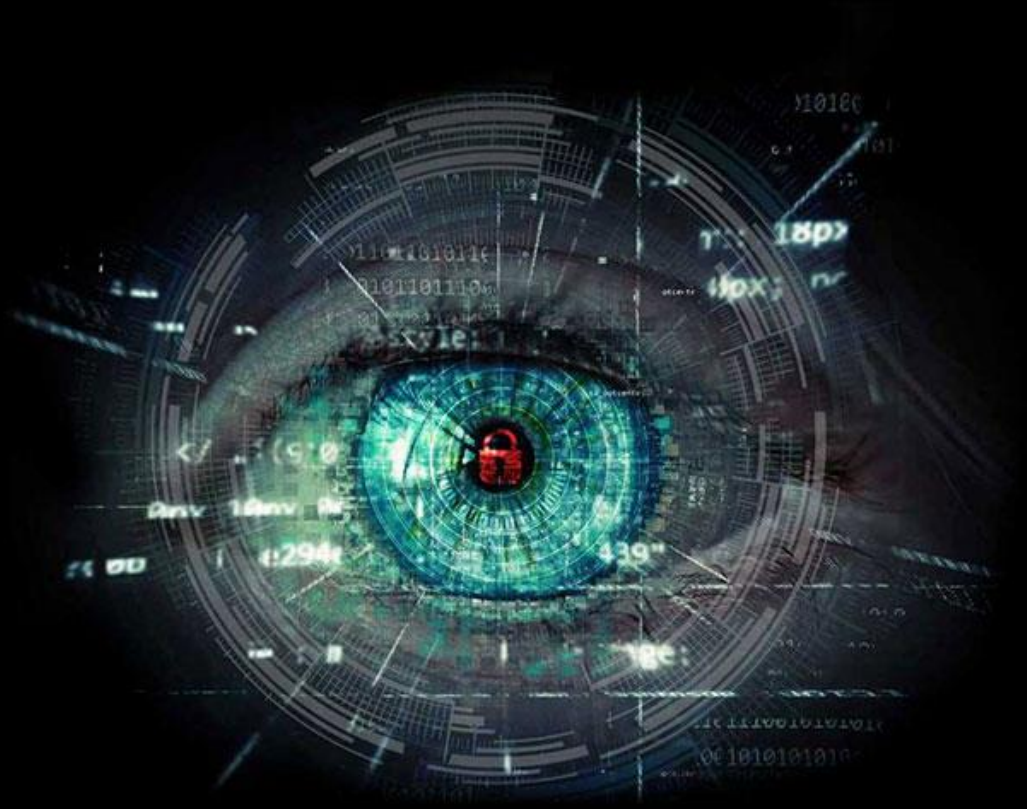
Protecting Stored Data

Network Security and Cryptography

Data Protection Topic 5 - 5.2

Scope and Coverage

This topic will cover:



01 Overview of data protection

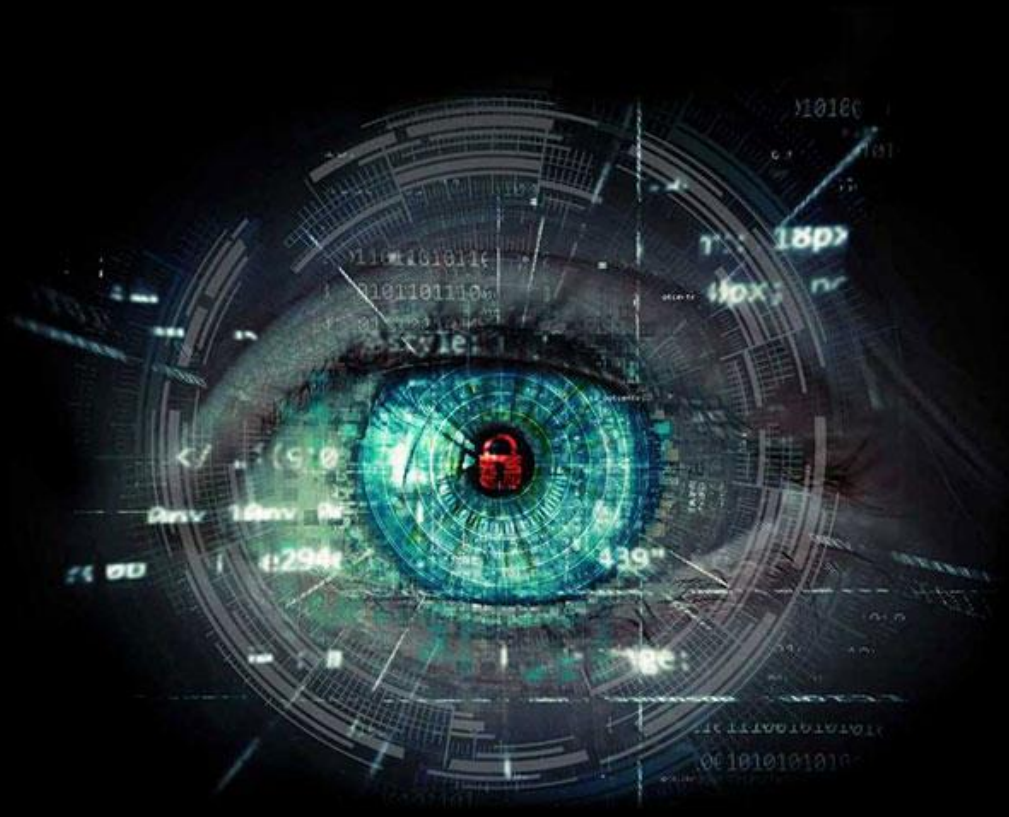
02 File encryption technologies

03 Disk encryption technologies

Data Protection Topic 5 - 5.3

Learning Outcomes

By the end of this topic students will be able to:



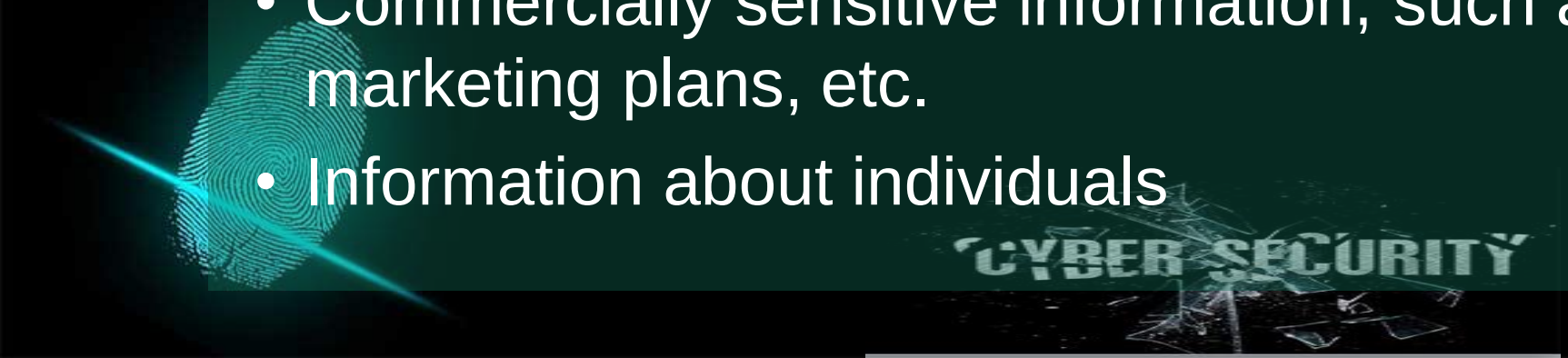
- Describe disk encryption mechanisms
- Deploy file encryption mechanisms

Why Protect Data?

- Every network is at risk from unauthorised users gaining access to data stored and transmitted on that network
- Outside hackers will try to access your data for illegal purposes or simply to prove that they can
- Internal users may also try to gain unauthorised access to applications and information stored on the network

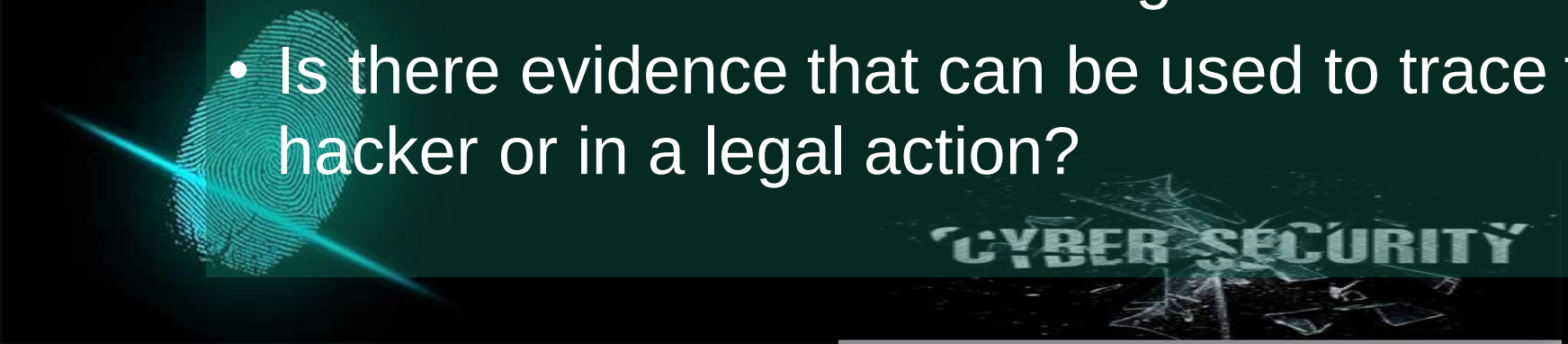
What Data is of Interest?

- Payment systems
- Research and development information
  - Where a company is trying to develop things that require patents or copyright
- Software that can be downloaded for free rather than paid for
- Commercially sensitive information, such as salary details, marketing plans, etc.
- Information about individuals



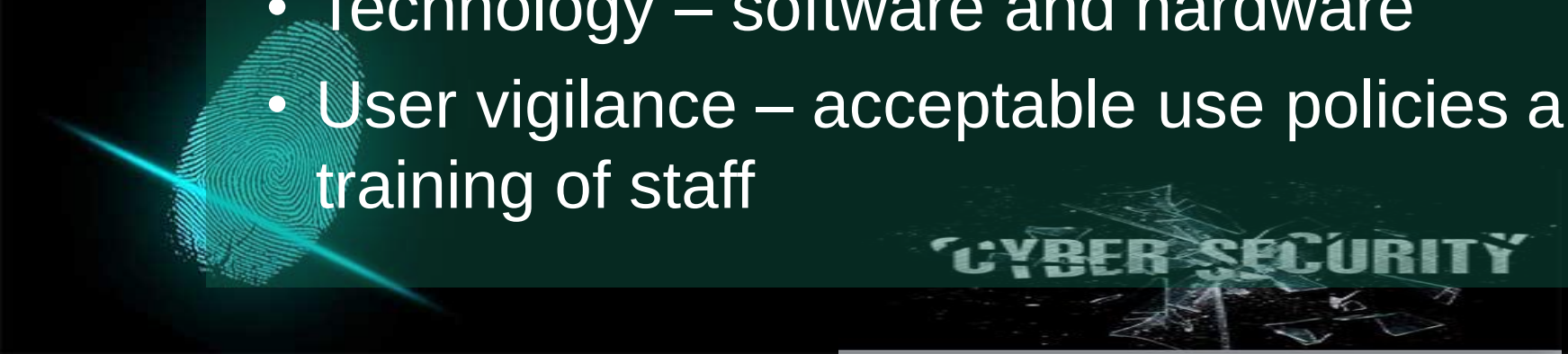
How to Respond to Hacking

- Depends upon the nature of the hacking
  - Serious fraud
  - Altering/deleting data
  - Prank
- How long has unauthorised access been going on?
- What is the nature of the data?
- Who knows about the hacking?
- Is there evidence that can be used to trace the hacker or in a legal action?



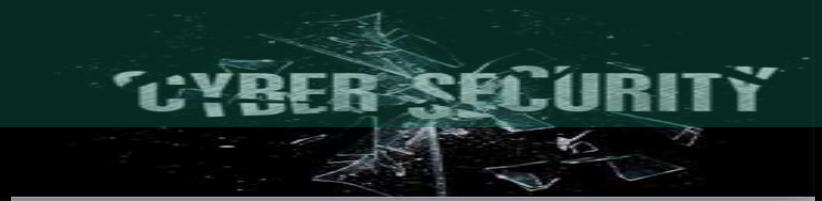
Preventing Unauthorised Access

- A combination of methods gives the best protection against unauthorised access
- A plan that includes:
  - Staff with key responsibilities
  - Policies for system use
  - Methods for dealing with security breaches
- Technology – software and hardware
- User vigilance – acceptable use policies and training of staff



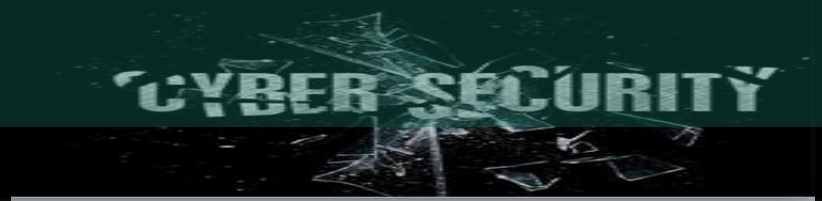
A Plan

- The plan should be a tool for managing all of the resources that prevent unauthorised access:
  - Who is responsible for checking log files?
  - How often are tools updated?
  - How often are plans and procedures reviewed?
- Should include details of:
  - Personnel
  - Software
  - Technology



Technology

- Firewalls
- Intrusion Detection Systems (IDS)
- Virus and content scanners
- Vulnerability assessment
- Patches and hotfixes



User Vigilance

- One of the best defences against hacking is an informed, vigilant workforce
- Computer systems are ideal for running repetitive tasks and are ideal at implementing rules that help protect the network
- But people are good at detecting the unusual
- Training staff is a cost-effective means of protecting your network

Protecting Your Data

- It is also wise to try and protect your data in the case of a hacker successfully gaining access:
  - Back up data - allows for data recovery in the event that data is deleted or corrupted
  - Have strong access control mechanisms
  - Password protect documents
  - Encrypt files
  - Encrypt disks

Data Back-up

- Your planning should include
  - What data is backed up
  - How often data is backed up
- There are many packages that allow for automated back up of data
- Enterprise databases include back-up facilities as part of the DBMS
- Back-up data should be stored securely
  - Data safe
  - Offsite

Access Control Mechanisms

- Access control mechanisms can be used to set access permissions to:
  - groups of network users
  - individual network users
  - other machines on the network
- These mechanisms can set permissions for:
  - Folders
  - Sub-folders
  - Individual files

Password Protecting Documents

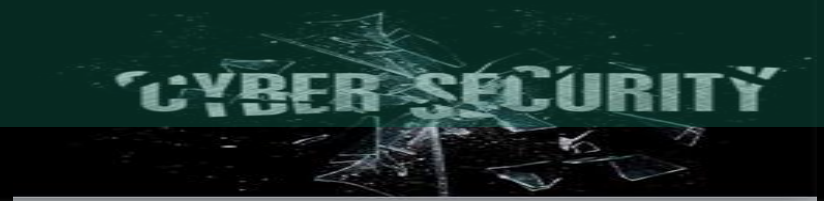
- Many software applications allow the user to password protect individual documents
  - Microsoft Office
  - Adobe Acrobat
- Usually not sufficient to deter serious hackers
- Will protect from the casual snooper

Encrypting Files

- Most operating systems support file encryption systems
- For example, Encrypting File System (EFS) is a feature of Windows OS
- You can easily store information on your hard disk in an encrypted format
- EFS protects data on the disk - if an EFS file is sent across the network it is not protected

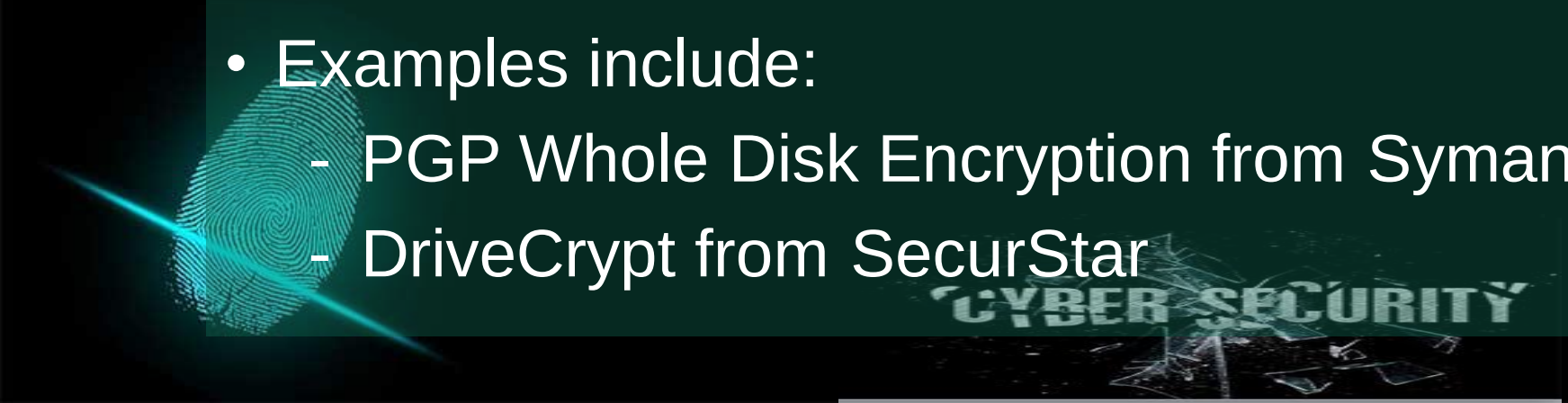
Encrypting Disks

- There are packages that allow the encryption of an entire disk
- This locks the entire contents of a disk drive or disk partition
- Automatic encryption of data occurs when it is written to the hard disk
- Automatic decryption occurs before being loaded into memory



Encrypting Disks

- Some packages create invisible folders that act like a hidden disk within a disk
- Other file storage hardware can be encrypted including:
  - Removable USB drives
  - Flash drives, etc.
- Examples include:
  - PGP Whole Disk Encryption from Symantec
  - DriveCrypt from SecurStar



Break

Daffodil International University

Topic 5:
Data Protection

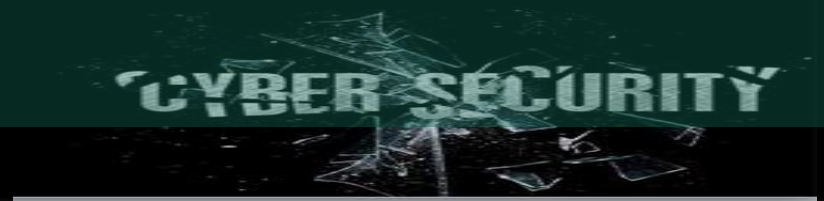
Topic 5 – Lecture 2:

File Encryption & Disk Encryption

Network Security and Cryptography

File Encryption

- Also known as folder encryption as files and folders can both be encrypted
- Individual files or individual folders/directories are encrypted by the file system
- Encrypting a file or folder with most operating systems is usually simple
  - Select a checkbox in Windows



Advantages of File Encryption

- Each file can be encrypted with its own encryption key
- Encrypted files can be managed on a file by file basis
- Public-key cryptography may be used for access control
- Memory only holds the cryptographic keys while the file that is decrypted is open

General File Management Systems

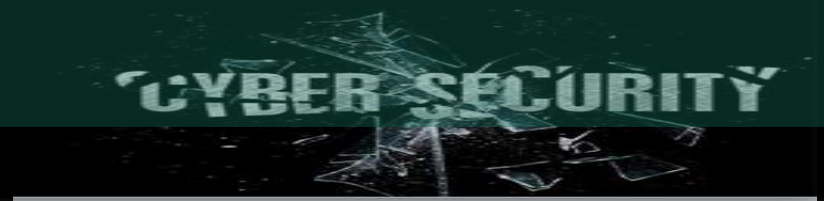
- Most general purpose file management systems do not usually encrypt the metadata:
  - Directory structure
  - Filename
  - File sizes
  - Timestamps
- Makes the system less secure
  - When files are stored with unencrypted file names, access to the physical disk will show documents stored on the disk but not the contents

Cryptographic File Systems

- Specialised file systems designed specifically for encryption
- Encrypt all data including metadata
- Usually operate on top of existing file systems
  - in a specific directory within a general file system
- Usually offer advanced features
  - Deniable encryption
  - Secure read-only file system permissions
  - Different views of the structure depending on the user

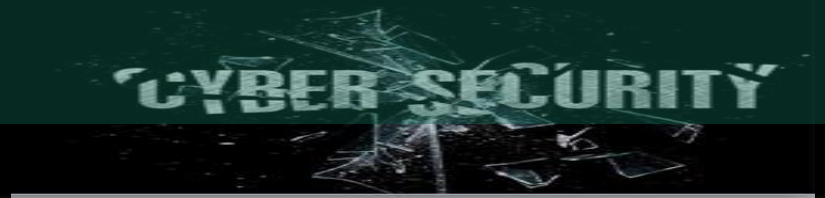
Deniable Encryption

- Allows an encrypted message to be decrypted into several readable plaintexts
  - Depends upon the key used to decrypt the file
- And/or makes it impossible to prove that the original message exists without using the proper encryption key
- Attacker does not know:
  - If the data is encrypted
  - If the file owner can decrypt it



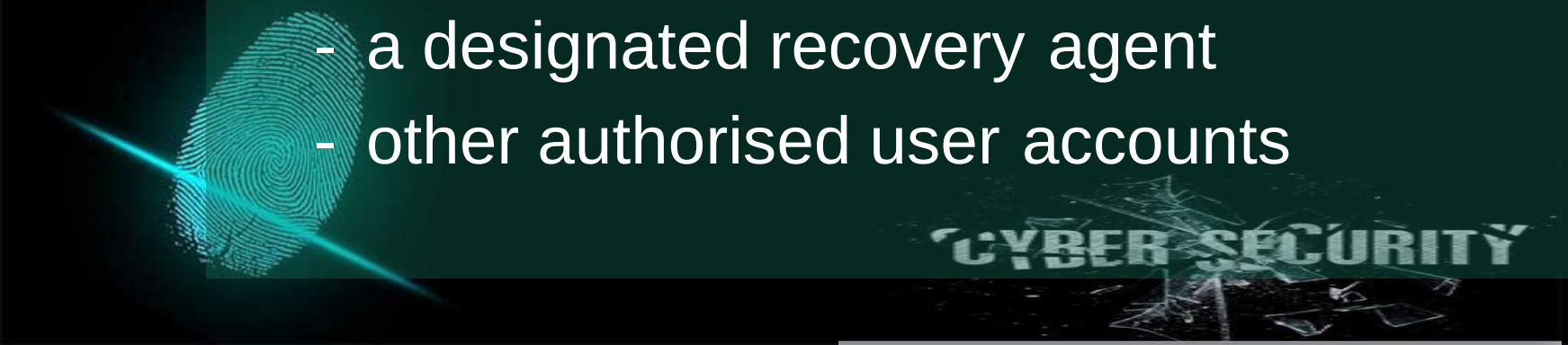
File Encryption with MS Windows

- Available on all recent version of Windows
- Employs the Encrypting File System (EFS)
- Uses a built-in encryption method that uses certificates
- Can protect individual files and/or folders
- To encrypt a file or folder you simply select a check box



Encrypting File System

- Employs a combination of asymmetric and symmetric encryption
- User must have an EFS certificate to encrypt a file
  - from a Windows certification authority
  - or self-signed
- EFS files can be opened by:
  - the user who encrypted them
  - a designated recovery agent
  - other authorised user accounts

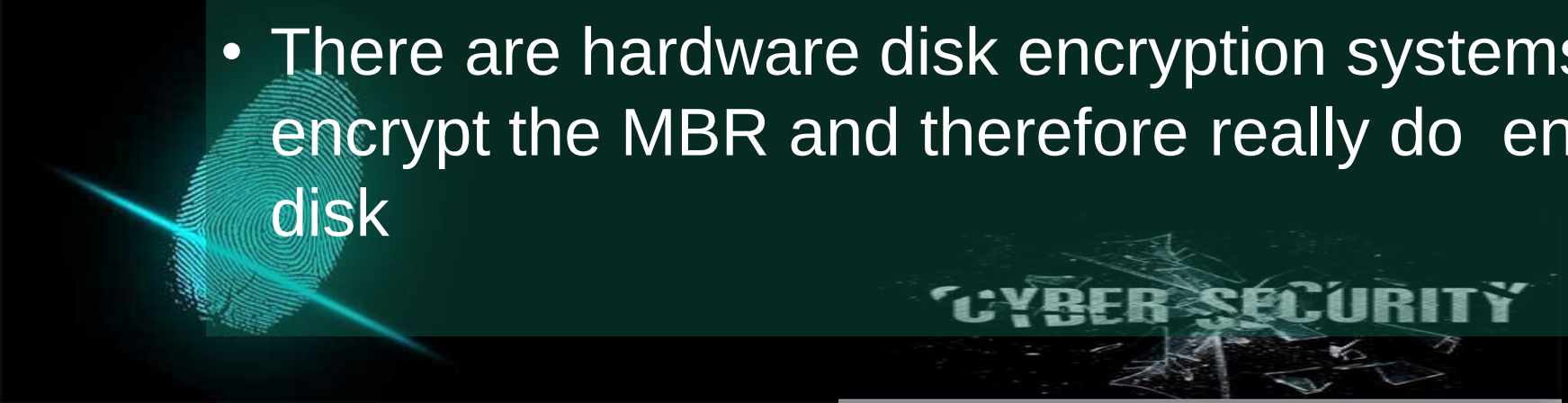


Disk Encryption

- Software or hardware is used to encrypt all data that is written to a disk or disk volume
- It prevents unauthorised access to data storage areas
- Full disk encryption, also known as whole disk encryption, is a term used when everything on a disk is encrypted

Full Disk Encryption

- Everything written to a disk is encrypted, including data and bootable OS partitions
- Some systems still leave the master boot record (MBR) unencrypted
  - This means there is a part of the disk that remains unencrypted
- There are hardware disk encryption systems that can encrypt the MBR and therefore really do encrypt the whole disk

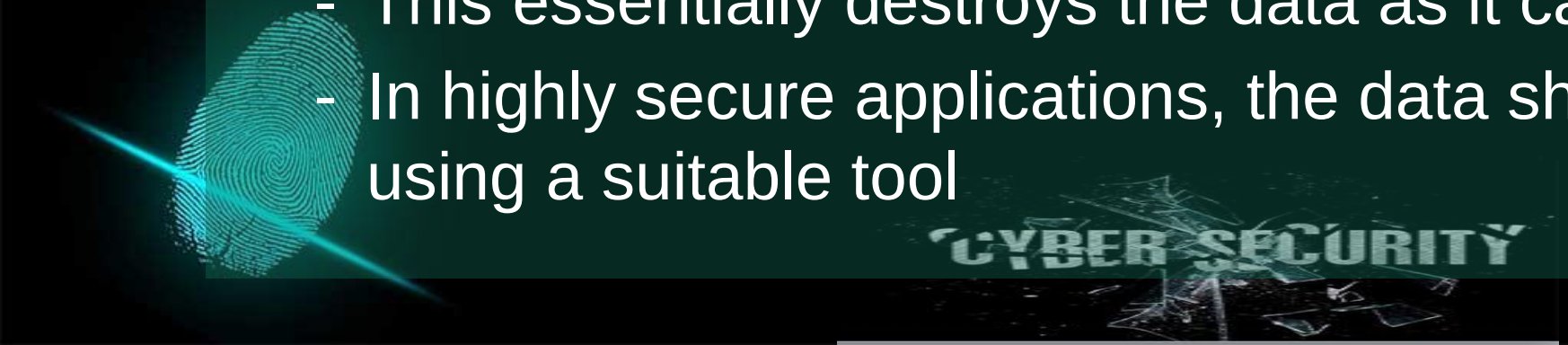


Disk Encryption Keys

- Often the same key is used for encrypting the whole disk
- Some solutions use different keys for encrypting different partitions
  - This is a more secure solution

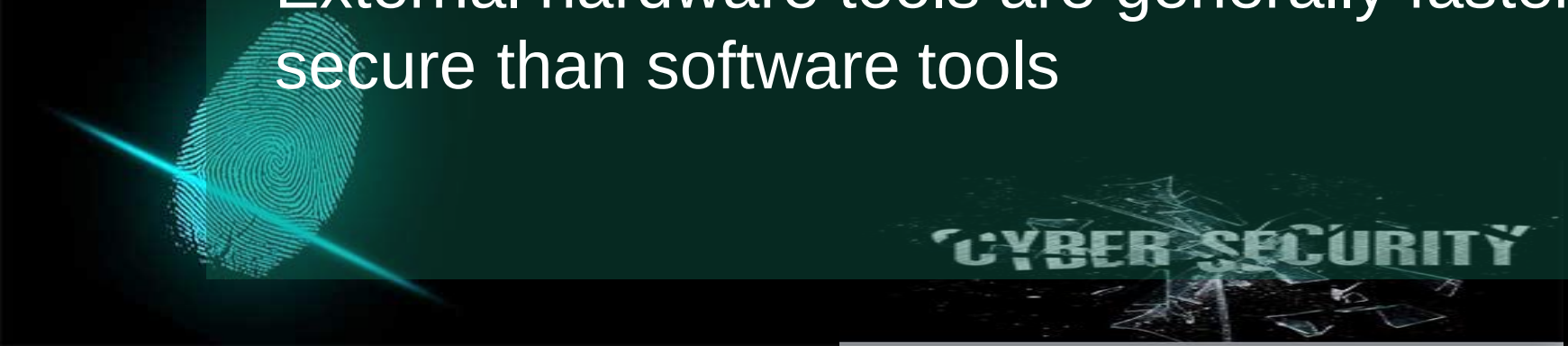
Advantages of Disk Encryption

- Disk encryption has some advantages over file encryption
- Temporary files are also encrypted
- All individual files are automatically encrypted
- Data is made unusable by destroying the cryptographic keys
  - This essentially destroys the data as it cannot be read
  - In highly secure applications, the data should be wiped using a suitable tool



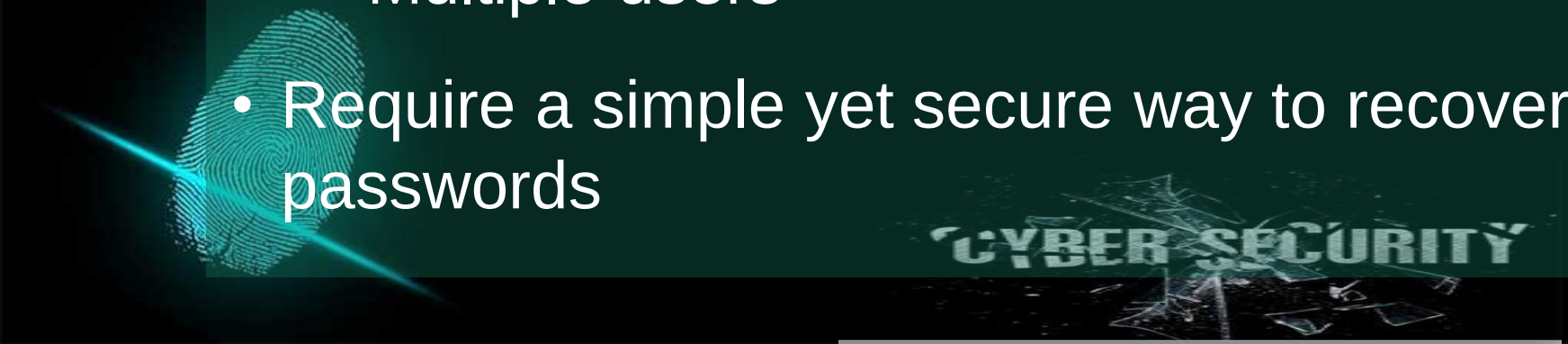
Disk Encryption Tools

- There are many tools with a variety of features
- Hardware-based tools residing within a storage device (self-encrypting drives) have no impact on system performance
  - As the encryption key is stored on the device it is not open to OS virus infections
- External hardware tools are generally faster and more secure than software tools



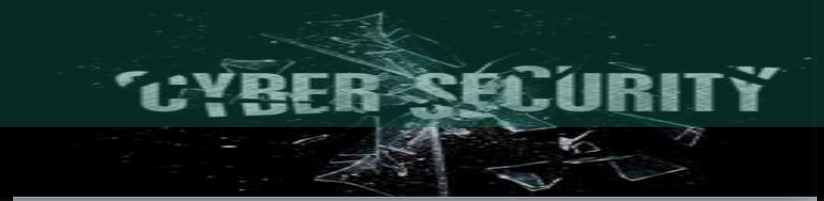
Losing the Password

- It is essential to have a password recovery system
  - User may leave the organisation
  - User may simply forget the password
- Important in any large organisation using disk encryption to protect data
  - Multiple users
- Require a simple yet secure way to recover any “lost” passwords



Challenge/Response

- System challenges user and requires correct response
- Allow passwords to be recovered
- Advantages:
  - No need to store recovery encryption key
  - No need to exchange secret data during recovery
  - Not open to sniffing attacks
- Can be used remotely without the need for a network connection

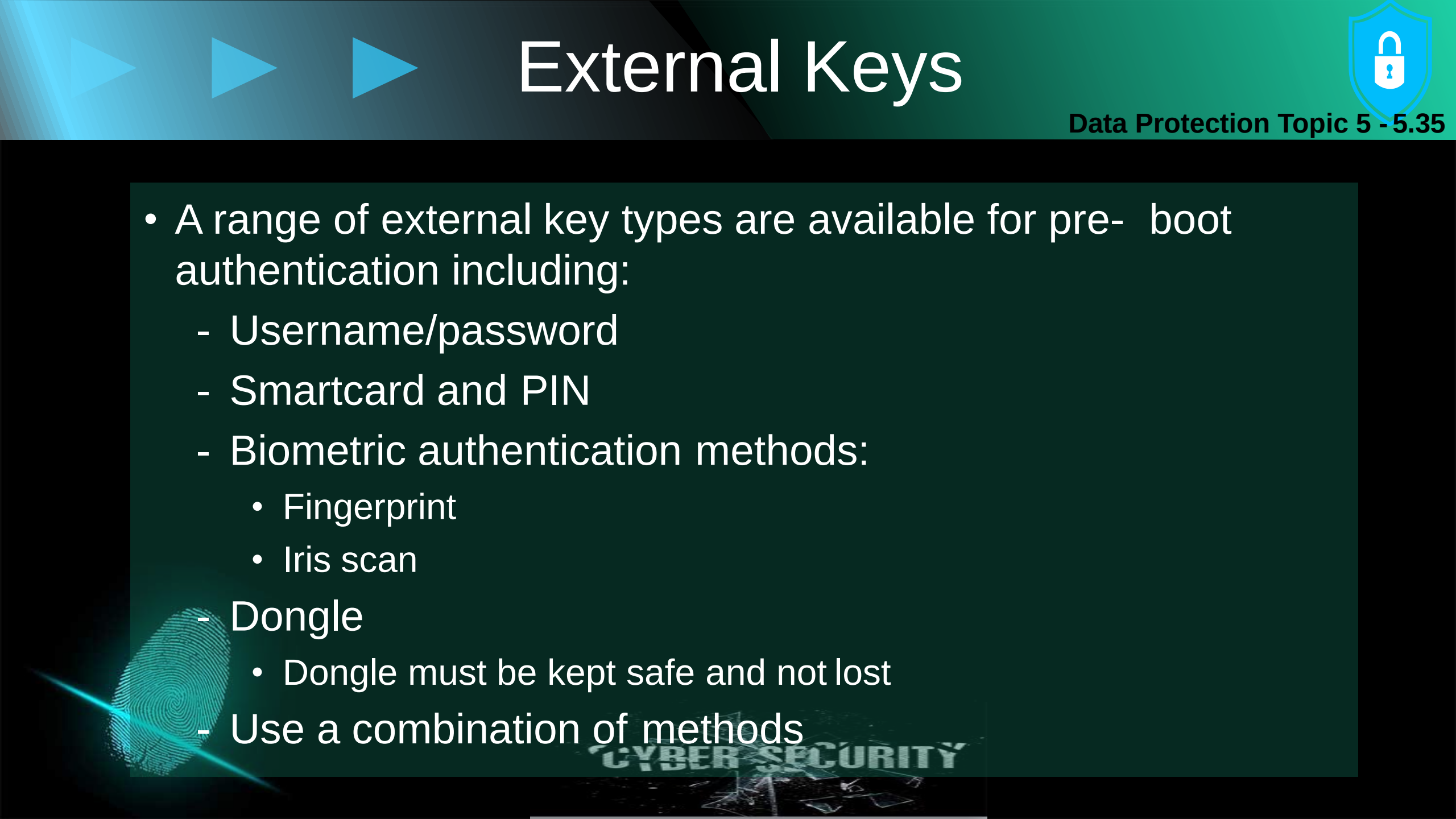


Booting with Full Disk Encryption

- When the whole boot disk is encrypted the blocks storing the OS are also encrypted
- This means some decryption is required before the OS can boot
- Many solutions have a small and secure pre-boot OS that allows for authentication before the full OS is launched
- Requires some external key to launch the full OS

External Keys

- A range of external key types are available for pre- boot authentication including:
  - Username/password
  - Smartcard and PIN
  - Biometric authentication methods:
    - Fingerprint
    - Iris scan
  - Dongle
    - Dongle must be kept safe and not lost
  - Use a combination of methods



References

- Scambrey, J., McClure, S. and Kurtz, J. (2001). *Hacking Exposed: Network Security Secrets & Solutions*, 2nd Edition. McGraw Hill.
- Cobb, C. (2004). *Cryptography for Dummies*. John Wiley & Sons.

THANK YOU

Any Question?

Topic5 – Data Protection