Lesson 7

Implementing Authentication Controls

Topic 7A

Summarize Authentication Design Concepts

Syllabus Objectives Covered

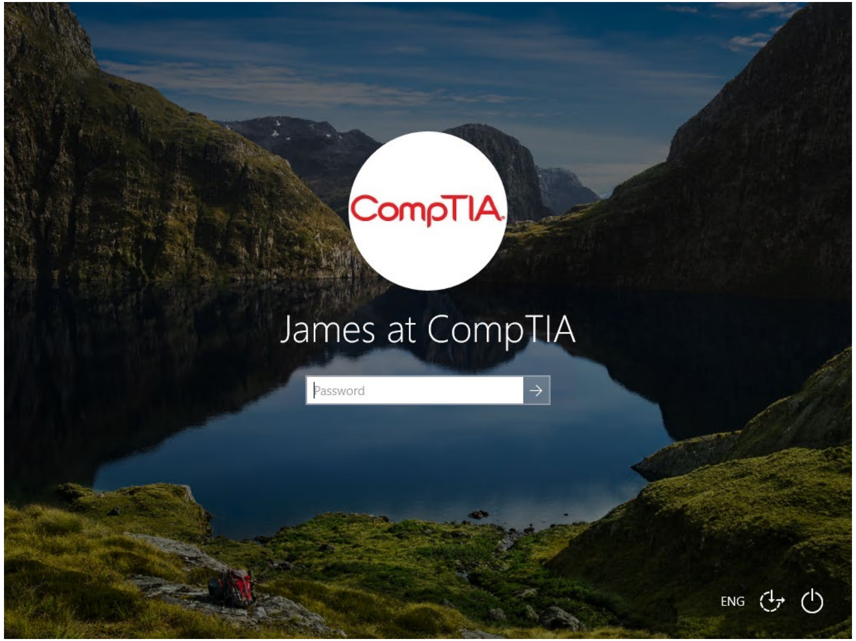
- 2.4 Summarize authentication and authorization design concepts

Identity and Access Management

- Subjects
  - Users or software that request access
- Objects
  - Resources such as networks, servers, and data
- Identification
  - Associating a valid subject with a computer/network account
- Authentication
  - Challenge to the subject to supply a credential to operate the account
- Authorization
  - Rights, permissions, or privileges assigned to the account
- Accounting
  - Auditing use of the account

Authentication Factors

- Something you know
  - Knowledge factor
  - Password
  - Personal identification number (PIN)
  - Swipe pattern
  - Challenge questions/password reset
- Something you have
  - Ownership factor
  - Hardware tokens and fobs
- Something you are/do
  - Biometric factor



Screenshot used with permission from Microsoft.

Authentication Design

- Meet requirements for confidentiality, integrity, and availability
- Confidentiality
  - Keep credentials secure
- Integrity
  - Threat actors cannot bypass or subvert the authentication mechanism
- Availability
  - The mechanism does not cause undue delay or support issues

Multifactor Authentication

- Strong authentication requires two (or three) types
  - Knowledge factor only is weak in terms of confidentiality
- Multifactor authentication (MFA)
- Two-factor authentication (2FA)
  - Something you KNOW and something you HAVE
  - Something you KNOW and something you ARE
  - NOT something you KNOW and something else you KNOW

Authentication Attributes

- Somewhere you are
    - Geolocation via location services
    - IP location (logical versus geolocation)
    - Switch port, virtual LAN (VLAN), or wireless network name
- Something you can do
    - Performing an action in a way that can be captured as a unique pattern
- Something you exhibit
    - A behavior or personality trait that can be captured as a unique pattern
- Someone you know
    - Web of trust

Topic 7B

Implement Knowledge-based Authentication

Syllabus Objectives Covered

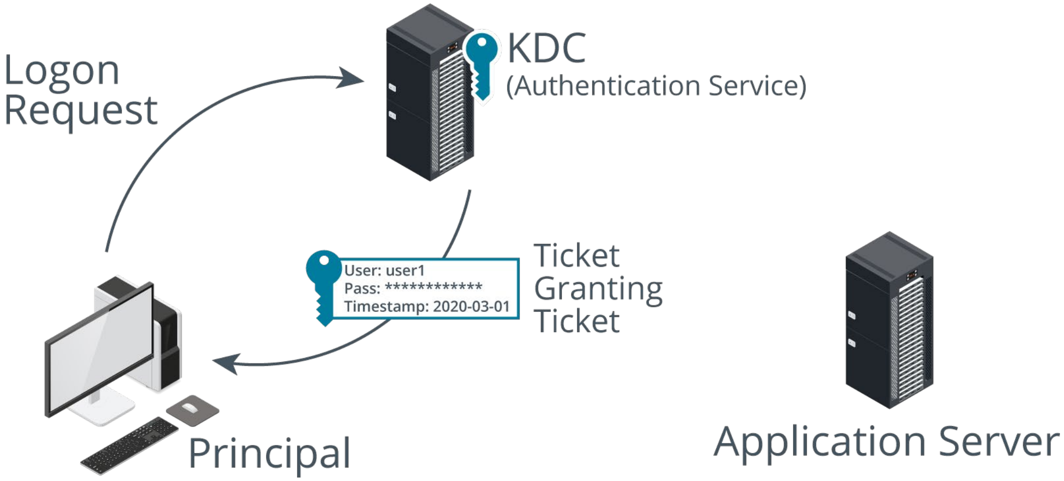
- 1.2 Given a scenario, analyze potential indicators to determine the type of attack
- 3.8 Given a scenario, implement authentication and authorization solutions
- 4.1 Given a scenario, use the appropriate tool to assess organizational security (Password crackers only)

Local , Network, and Remote Authentication

- Authentication providers
  - Passwords versus password hashes
- Windows authentication
  - Local sign-in
  - Network sign-in (Kerberos and NTLM)
  - Remote sign-in
- Linux authentication
  - /etc/passwd and /etc/shadow
  - Pluggable authentication modules (PAMs)
- Single sign-on (SSO)

Kerberos Authentication

- Single sign-on authentication and authorization provider
- Clients
- Application servers
- Key Distribution Center (KDC)
  - Authentication Service – Ticket Granting Ticket
  - Ticket Granting Service – Service Ticket



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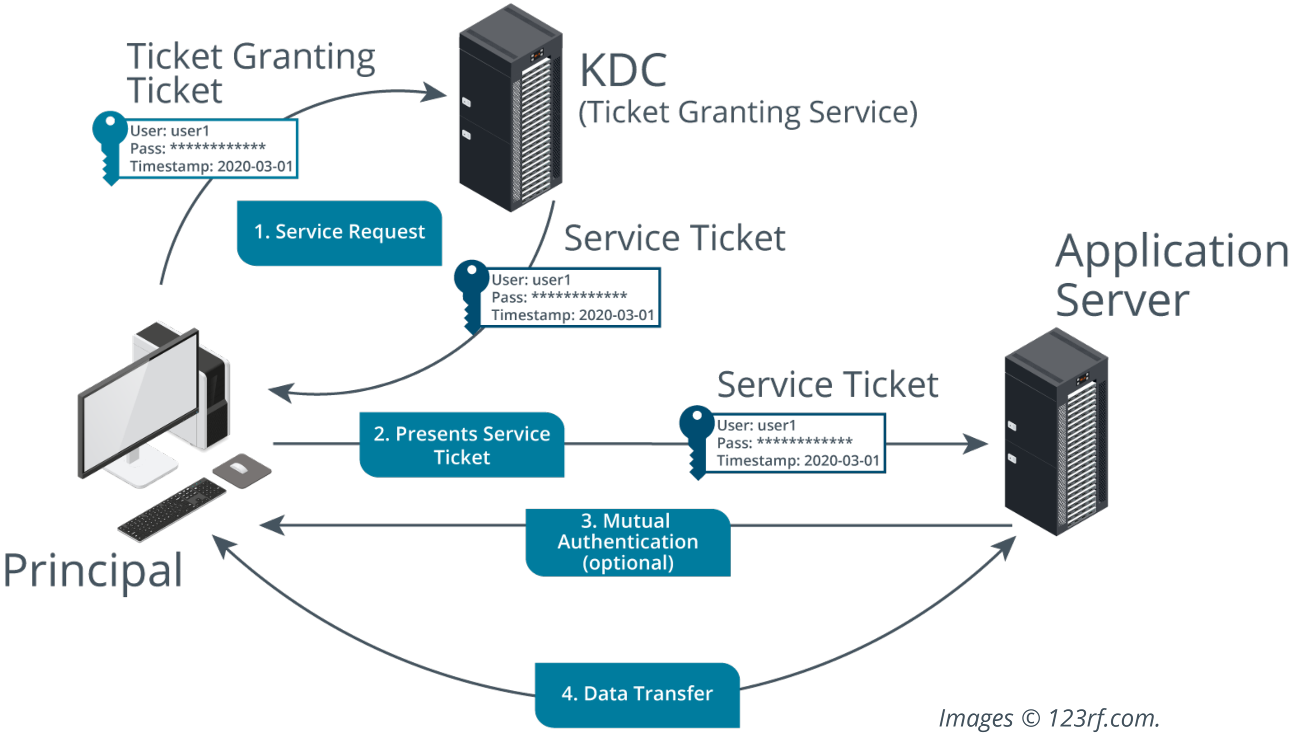
Kerberos Authorization



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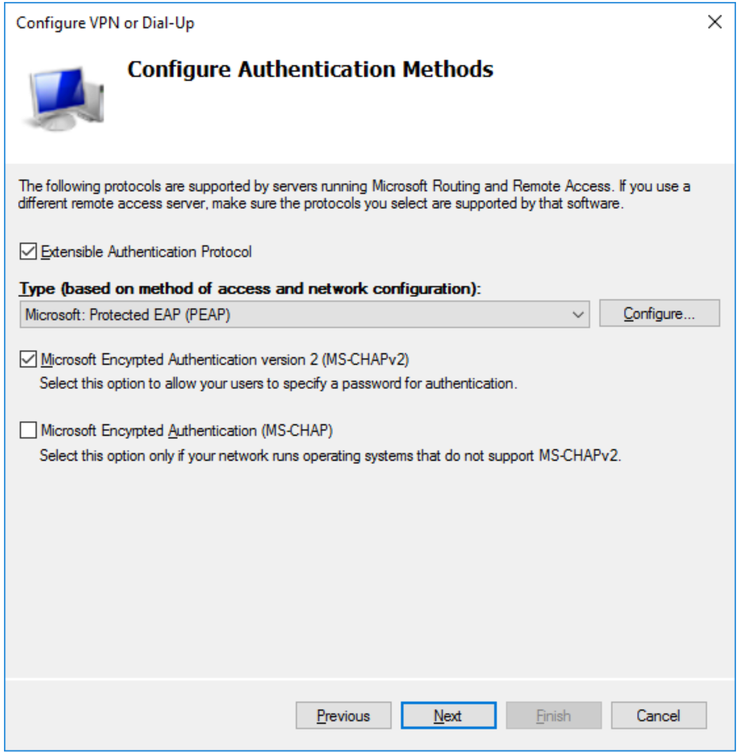
PAP, CHAP, and MS-CHAP Authentication

- Password authentication designed to work with remote access protocols (Point-to-Point Protocol)
- Password Authentication Protocol (PAP)
  - Completely unsecure
- Challenge Handshake Authentication Protocol (CHAP)
  - Challenge/Response similar to NTLM
  - Challenge is repeated during the session to prevent replay
  - Various implementations (Cisco, MS-CHAPv2)
  - Not secure enough to use without an encrypted tunnel



Configure VPN or Dial-Up

Configure Authentication Methods

The following protocols are supported by servers running Microsoft Routing and Remote Access. If you use a different remote access server, make sure the protocols you select are supported by that software.

☑ Extensible Authentication Protocol

Type (based on method of access and network configuration):

Microsoft: Protected EAP (PEAP)

☑ Microsoft Encrypted Authentication version 2 (MS-CHAPv2)

Select this option to allow your users to specify a password for authentication.

□ Microsoft Encrypted Authentication (MS-CHAP)

Select this option only if your network runs operating systems that do not support MS-CHAPv2.

Screenshot used with permission from Microsoft.

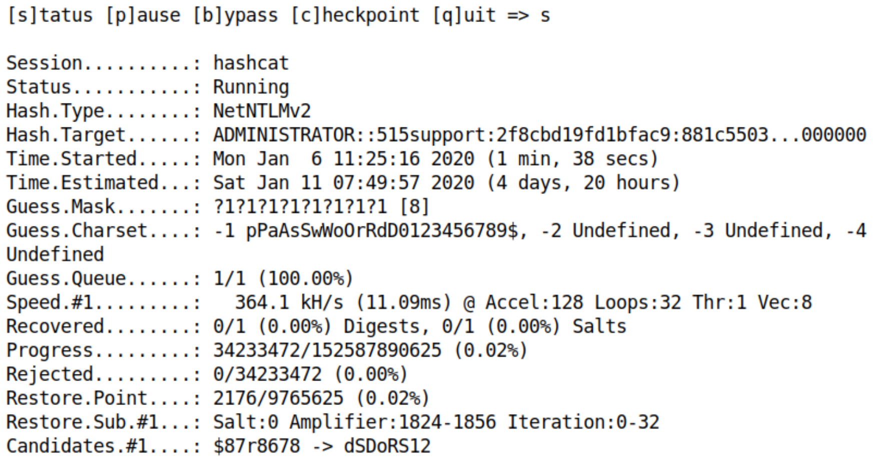
Password Attacks

- Plaintext/unencrypted
  - Sniffing passwords from unsecure protocols
  - Locating passwords in documents/code repositories
- Online password attack
  - Adversary interacts with authentication service
  - Restrict logon rates
  - Shun suspect hosts
- Horizontal brute force/password spraying
- Offline attacks
  - Password database
  - Hash transmitted directly
  - Hash used as key to sign an HMAC

Brute Force and Dictionary Attacks

- Exploit weak user password selection or weak cryptographic mechanisms
- Brute force attack
  - Generate every possible combination to match a hash
  - Large output space and sufficiently long input password increase time required
- Dictionary attack and rainbow tables
  - Use a dictionary to test common words or phrases first
  - Rainbow tables assist dictionary attacks against Windows password databases by precomputing hash chains
  - Using salt means hash chains cannot be pre-computed
- Hybrid attack
  - Dictionary and brute force
  - Fuzzing of dictionary terms (james1, james2, tom1, tom2,...)

Password Crackers



```
[s]tatus [p]ause [b]ypass [c]heckpoint [q]uit => s

Session..........: hashcat
Status...........: Running
Hash.Type........: NetNTLMv2
Hash.Target......: ADMINISTRATOR::515support:2f8cbd19fd1bfac9:881c5503...000000
Time.Started.....: Mon Jan  6 11:25:16 2020 (1 min, 38 secs)
Time.Estimated...: Sat Jan 11 07:49:57 2020 (4 days, 20 hours)
Guess.Mask.......: ?1?1?1?1?1?1?1?1 [8]
Guess.Charset....: -1 pPaAsSwWoOrRdD0123456789$, -2 Undefined, -3 Undefined, -4
Undefined
Guess.Queue......: 1/1 (100.00%)
Speed.#1.........:   364.1 kH/s (11.09ms) @ Accel:128 Loops:32 Thr:1 Vec:8
Recovered........: 0/1 (0.00%) Digests, 0/1 (0.00%) Salts
Progress.........: 34233472/152587890625 (0.02%)
Rejected.........: 0/34233472 (0.00%)
Restore.Point....: 2176/9765625 (0.02%)
Restore.Sub.#1...: Salt:0 Amplifier:1824-1856 Iteration:0-32
Candidates.#1....: $87r8678 -> dSDoRS12
```

Screenshot hashcat (hashcat.net/hashcat.)

- Cain and L0phtcrack
- Hashcat
  - Hash type
  - Attack mode
    - Dictionary/word lists
    - Brute force
    - Masked

Authentication Management

- Hardware and software solutions for storing and submitting multiple user passwords
- Password key
  - USB token
  - Possibly Bluetooth/NFC connectivity
- Password vaults
  - Software-based
- Federal Information Processing standard (FIPS 140-2)

Topic 7C

Implement Authentication Technologies

Syllabus Objectives Covered

- 2.4 Summarize authentication and authorization design concepts
- 3.3 Given a scenario, implement secure network designs (HSM only)
- 3.8 Given a scenario, implement authentication and authorization solutions

Smart Card Authentication

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- Kerberos-based smart card logon
- Card readers
- Card stores user's private key and certificate
- Use of card is protected by a PIN

Key Management Devices

- Provision keys with risk of insider threat reduced
- Smart cards and USB keys
- Trusted Platform Module (TPM)
    - Virtual smart cards
- Hardware Security Module (HSM)
    - Provision keys to devices across the network
    - Key archive and escrow
    - Reduced attack surface and tamper-evident
    - Cryptographically secure pseudorandom number generator (CSPRNG)
    - Plug-in card and network rack form factors

Smart Card Reader and Smart Card
SMART CARD
HSM
Hardware Security Module (HSM)

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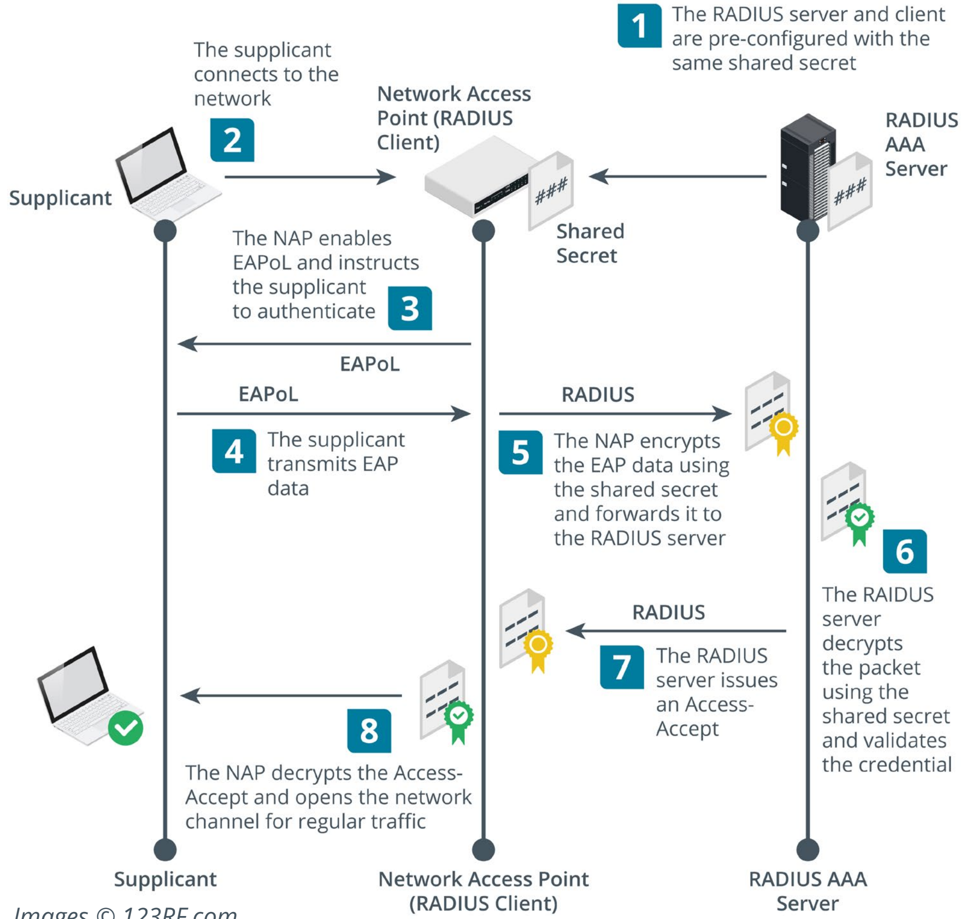
Extensible Authentication Protocol/IEEE 802.1X

- Authenticate user at network access devices
  - Wireless networks
  - Port authentication for switched networks
  - Remote access over a virtual private network
- Extensible Authentication Protocol (EAP)
  - Supports multiple authentication implementations
  - Certificates and smart cards
- IEEE 802.1X Port-based Network Access Control
  - Supplicant
  - Network access server (NAS)
  - AAA server

Remote Authentication Dial-in User Service



1 The RADIUS server and client are pre-configured with the same shared secret

2 The supplicant connects to the network

3 The NAP enables EAPoL and instructs the supplicant to authenticate

4 The supplicant transmits EAP data

5 The NAP encrypts the EAP data using the shared secret and forwards it to the RADIUS server

6 The RAIDUS server decrypts the packet using the shared secret and validates the credential

7 The RADIUS server issues an Access-Accept

8 The NAP decrypts the Access-Accept and opens the network channel for regular traffic

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Terminal Access Controller Access-Control System

- TACACS+
- Centralizing administrative logins for network appliances
- Reliable TCP transport (over port 49)
- Data encryption
- Discrete authentication, authorization, and accounting functions

Token Keys and Static Codes

- One-time password (OTP)
  - Generated by some algorithm and used only once
  - RSA SecurID
- Static code
  - “Dumb” smart cards
- Fast Identity Online (FIDO) Universal Second Factor (U2F)

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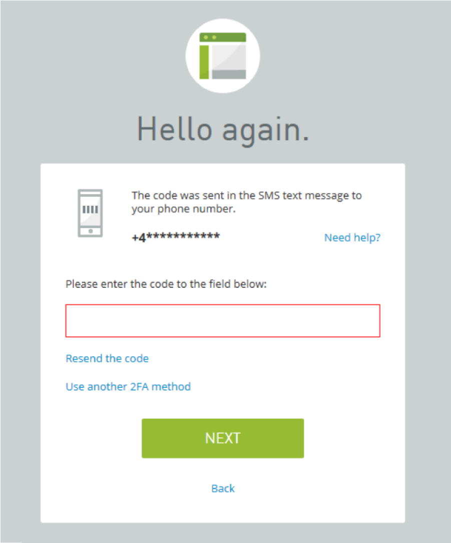
Open Authentication (OATH)

- HMAC-based One-time Password Algorithm (HOTP)
- Time-based One-time Password Algorithm (TOTP)



Hello again.

The code was sent in the SMS text message to your phone number.

+4***********

Please enter the code to the field below:

2-Step Verification

- Transmit a code via an out-of-band channel
    - Short message service (SMS)
    - Phone call
    - Push notification
    - Email account
- Possibility of interception

Topic 7D

Summarize Biometrics Authentication Concepts

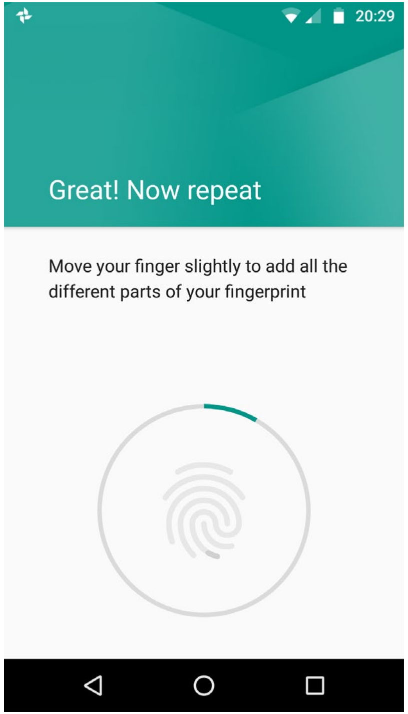
Syllabus Objectives Covered

- 2.4 Summarize authentication and authorization design concepts

Biometric Authentication

- Enrollment
  - Sensor and feature extraction
- Efficacy rates and considerations
  - False Rejection Rate (FRR) or Type I error
  - False Acceptance Rate (FAR) or Type II error
  - Crossover Error Rate (CER)
  - Throughput (speed)
  - Failure to Enrol Rate (FER)
  - Cost/implementation
  - Privacy concerns
  - Accessibility concerns

Fingerprint Recognition



20:29

Great! Now repeat

Move your finger slightly to add all the different parts of your fingerprint

Android is a trademark of Google LLC.

- Fingerprint sensors
  - Small capacitive cells
  - Easy to implement
  - Relatively simple enrollment
  - Quite vulnerable to spoofing
- Vein matching (vascular biometrics)
  - More complex scanner

Facial Recognition

- Facial recognition
  - Enrollment can be relatively slow
  - Privacy issues
  - Prone to relatively high false acceptance/rejection rates/spoofing
- Retinal scan
  - Pattern of blood vessels
  - Scanning relatively intrusive and complex
- Iris scan
  - Pattern of eye surface
  - Easier to scan
  - More vulnerable to spoofing

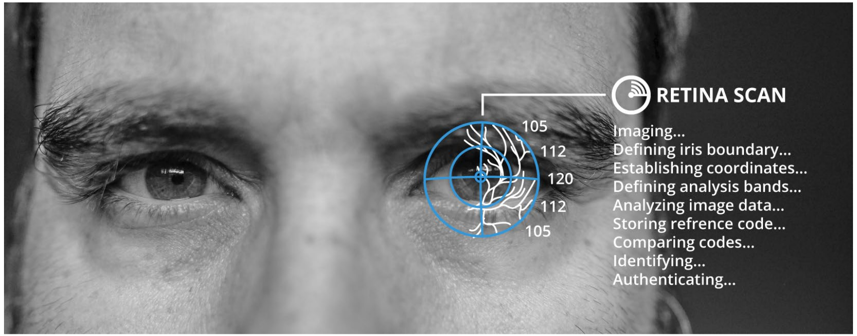


Photo by Ghost Presenter on Unsplash.

Behavioral Technologies

- Something you do
  - Voice recognition
  - Gait analysis
  - Signature recognition
  - Typing
- Other uses than authentication
  - Identification/alerting
  - Continuous authentication/account locking

Lesson 7

Summary