

Secure and Resilient Networks

SWINBURNE UNIVERSITY OF TECHNOLOGY

Access Control

Lecture twelve

Outline of Lecture

- Kerberos
- One-time passwords
- Biometrics



Learning goals

- You should be able to
 - Describe the operation of Kerberos
 - Describe one-time passwords
 - Describe the main forms of biometric measures along with their strengths and weaknesses



Kerberos

- Single Signon System
- Enables user to prove identity once and then be able to access all authorised resources without subsequent authentication
- Users sign into the Kerberos server, and are issued a ticket, which their client software presents to servers that they attempt to access
- Integral part of Windows Server



Kerberos

- Based purely on symmetric keys
 - Shared secret keys
 - Session keys
- Makes use of multiple layers of encryption
 - Session keys will be encrypted and transmitted within shared secret keys
- Kerberos is very cleverly designed to ensure that users do not give themselves privileges that they are not entitled to
- Main entities are
 - Authentication server
 - Ticket granting server
 - Kerberos enabled application or server



Kerberos

Service request User logs in and enters **Authentication Server** password and requests Ticket and session key Verifies access rights in service database. Creates ticket **Ticket Granting Server Ticket** Station sends ticket and TGS decrypts ticket and authenticator to Ticket authenticator. A match creates **Granting Server Ticket** ticket for host that user wants to access **Ticket Server Containing** Station sends ticket and **Application** authenticator to host Service If both match user is granted access to service



Kerberos animation



kerberos07.swf



Question

• Why in Kerberos is the TGT encrypted with the TGS' secret key and then encrypted with the user's secret key?



Some weaknesses of Kerberos

- KDC can be a single point of failure
- KDC needs to be scalable
- Secret keys stored user's workstations
 - Possibly compromised
- Session keys stored on workstations
 - Possibly compromised
- Relies on passwords
 - Could be subject to dictionary attack



One-time passwords

- A one-time password is used exactly once, after which it is no longer valid.
 - Very strong defence against eavesdroppers, and replay attacks
- Usual technique is built around a handheld device that generates the password
 - The password is valid only once
 - prevents replay attack
 - The password is valid for only a short period of time
 - typically one to two minutes
 - Only one login per minute (or so) is permitted
 - SecurID most commonly used



One-time passwords

- Typically generate passwords based on a hash function
 - Reminder as to what hash functions are
 - A hash function takes a number as an input and generates an output
 - It is impossible to generate the input from the output even if the algorithm is known
 - MD5, SHA-1, SHA-256, SHA-3 examples of hash algorithms
 - Sometimes 'trap-door' functions
- One time password will usually generate the hash based on a PIN number and the current time
 - The device generates the hash function value based on its inputs
 - This is transmitted to the authentication server
 - It uses the same information to generate the hash
 - If equal then authenticated.



One-time passwords

- Some difficulties with One-time passwords
 - device needs to be kept secure
 - PIN used on it needs to be kept secure
 - Time skew between the host and the authentication server.
 - usually dealt with by the server keeping track of several candidate hash values
- The database on the authentication server needs to be fast, available and secure



One-time passwords using Lamport's Method

- One-time password schemes can be implemented without special hardware (Lamport, 1981)
 - Construct a sequence of hashes of hashes starting with some starting password
- Calculated values are used progressively
 - Need to keep a track of number of times the password sequence has been used
- Creates a virtual list of passwords
 - Need to use from the bottom up



One-time passwords (Lamport) example

- The user has some password 'x' and a password sequence number
- The password sequence generated from 'x' can be used 1000 times before being reset.
- First time through the password sequence number is set to 10000
- The user system calculates $F(F(F(....(F(x))))..) = F^{1000}(x)$
- The first password used is $F^{1000}(x)$
- The user calculates this and submits it during authentication
- The authentication system also knows 'x' and does the same calculation
- If the value it calculates matches then the user is authenticated
- Both the user and authentication system decrement the password sequence number to 999.
- The next password expected is $F^{999}(x)$



Question

• Why do we work backwards from $F^{1000}(x)$? Why don't we start from $F^{1}(x)$ and work forwards?



Biometrics

- Useful for where strong authentication needed
- 3rd factor
 - Something you have
 - Token
 - Smart card with private key
 - Something you know
 - Password
 - PIN
 - Something you are
 - Biometrics



Biometrics

Mechanism

- Takes a measure of some physical characteristic
- Compares it with a stored version of the characteristic
- If a good enough match then access will be granted
- An analogue measure
 - Usually scope for false positives
 - Identify a recorded and physical measure as being the same when they are not
 - False negatives
 - Reject a recorded and physical as being the same when they are



Biometric false negatives

- Types of errors
 - Type I error
 - False positive
 - Type II error
 - False negative
- Cross over error rate
 - Percentage at which false rejection rate equals false accepance rate
 - Typically used to measure the effectiveness of a Biometric system



Biometrics

- A good biometric is
 - Universal
 - It can be measured for everyone
 - Unique
 - It is different for every person
 - Permanent
 - It doesn't change as you grow older, fatter, thinner, balder, hairier
 - Collectable
 - It can be measured by a machine
 - Is easily measured
 - It is collected and can be compared with the stored measure quickly



Biometrics

- A good biometric is
 - Acceptable
 - No use if people refuse to use it
 - Difficult to circumvent
 - Can't be faked
 - Portable
 - Equipment is low cost and easy to move and install



- Signature
 - Well accepted
 - Can be forged
- Face geometry
 - Measure some key aspects of face
 - Distance between eyes
 - Location of mouth, eyes, ears
- Facial thermogram
 - Uses an infrared camera to measure heat dispersion on the face
 - Very accurate method
 - Good acceptance
 - Can't be forged or tampered
 - Expensive equipment



- Fingerprint
 - Unique
 - Unchanging
 - Well understood and accepted
 - Cheap and portable equipment
- Hand geometry
 - Takes a number of measures of the hand
 - Length of fingers
 - Area of palm
 - Simple to use
 - But fairly low accuracy and hardware is bulky and expensive



- Retina and Iris scans
 - Scans blood vessel pattern at back of eye (retina)
 - Scans patterns, shapes, colours of coloured part of eye (iris)
 - Very reliable technology
 - Difficult to circumvent
 - Expensive
 - Lots of public resistance
- Voice
 - Not fully unique
 - Can be circumvented fairly easily
 - Low cost hardware



DNA

- Entirely unique
- Expensive and slow
- Lots of public resistance

Signature dynamics

- Signatures usually signed in the same way and speed every time
- Physical motions captured as signals
- Very reliable

Keyboard dynamics

- Characteristic way in which a person types a certain phrase
- Surprisingly reliable
 - Very difficult to repeat a person's typing style





Difficulties with Biometrics

- Where does biometric data get stored and how do you protect it?
- Biometrics do not work for some part of the population
 - Construction workers and elderly people often have fingerprints that are worn down and cannot be read (3-7% of the population)
 - Voice doesn't work for someone who through surgery can no longer talk
 - Signatures don't work for people who are illiterate



Difficulties with Biometrics

- Some biometrics are poorly accepted
 - Laser based retinal scanning
 - Laser based iris scanning
 - DNA testing
- Biometrics cannot be changed
 - General principle is that authentication data should change periodically
 - Cannot change fingerprints
- Biometrics can be obtained easily and possibly spoofed
 - Fingerprints on glass
 - Voice can be recorded
- Can be easy to spoof some biometrics
 - Fake fingerprints made out of gelatin
 - Face recognition software fooled by life-sized photographs



Conclusion

- Kerberos
 - Multiple layers of encryption
- One time passwords
 - Based on hash functions
- Biometrics
 - Biometrics a third factor in authentication
 - Used in 'strong authentication'
 - Many possible biometrics but lots of resistance
 - Can be faked
 - Can't be changed

