An introduction to Network security

- we will cover
  - the CIA security model
  - the DDPRR (detect, deter, protect, react, and recover) security model

- examine
  - current state of legislation with respect to
    - security
    - encryption

Why is security important?

- for businesses:
  - IT is core to virtually all business processes within most organisations
  - many organisations could go out of business if IT was disrupted in a serious way

- legally, the Data Protection Act 1988 says:
  - ‘‘Appropriate security measures shall be taken against unauthorised access to, or alteration, disclosure or destruction of, personal data and against accidental loss or destruction or personal data’’

The nature of the beast

- Win Schwartz, Information Warfare, Thunder's Mouth Press 1996
  - ‘‘Your company will become a designated target of information warfare. If not yesterday or today then definitely tomorrow.’’
- Sunday Times, Computer Security, 1991
  - ‘‘95% of organisations that loose their corporate data fail within 18 months’’

The nature of the beast

Source of threat	Validated existence	Likely by 2005	Beyond 2005
Criminal hacker	Widespread		
Organised crime	Limited	Widespread	
Political dissidents	Widespread		
Terrorists	Limited	Widespread	
Spies	Limited		Widespread
Tactical disruption			Widespread
Strategic disruption			Limited

Security and the IS manager

- what does security mean to the IS manager?
  - understanding how a system can be misused and protect against it
- protect and manage technical and social aspects of a system

IS Manager uses

- security management
  - risk, threat and vulnerability assessment
    - BS7799
    - ITSEC (Information Technology Security Evaluation Criteria)
    - Orange Book
- security policies
  - real world security policy
  - security models
  - access control models
  - information flow models
- technical security
  - cryptography, penetration testing, backup of data

Three concepts of CIA security model

- confidentiality
  - information must not be disclosed to any unauthorised person

- integrity
  - system must not corrupt data
  - system must disallow unauthorised, malicious or accidental data changes
  - three aspects of integrity
    - authorised actions
    - separation and protection or resources
    - error detection and correction

Three concepts of CIA security model

- availability
  - presence of objects or service in a usable form
  - capacity to meet service needs
  - adequate timeliness of a service

Definition of security

- deter
  - to create and implement policies that allow us to generate a feasible and believable deterrence
- detect
  - to create and implement policies that allow us to detect how, when and where intrusion has taken place
- protect
  - to create and implement policies and procedures that allow us to manage people and the IS in an effective manner so as to protect against unauthorised usage

Definition of security

- react
  - to create and implement policies and procedures which define how we react to an intrusion
  - need to ensure that penetration does not happen again
  - vulnerability is eliminated

- recover
  - recover all data and programs from a breach in security

Mobile computing

- mobile phones can be scanned
- wireless networks can be scanned by laptops
  - see Pringle amplifier in the news

High profile cracking

- see ⟨www.2600.org⟩

Cracking history

- Trojan horse
  - in 1972 Dan Edwards of the NSA coined this term for a macro utility which had an undocumented side effect that violated security

- trap door
  - during 1973 and 1974 David Stryker, John Shore and Stanley Wilson of Navel research labs USA, subverted the EXEC VIII operating system of a UNIVAC 1108 by using a Trojan horse
  - 1972..1975 as a series of experiments for the US air force, Steven Lipner and Roger Schell used trapdoors and Trojan horses to subvert MULTICS into giving confidential information without leaving a trace

Wide area networks - the early days

- ARPANET 1969..1989, Internet 1977..present
  - ARPANET was the first WAN, started in 1969 with four nodes and became the model for todays Internet
  - TCP/IP (Transmission control protocol and Internet Protocol) designed in 1977 by Vinson Cerf and Robert Khan
  - ARPANET disbanded in 1989

Wide area networks - the early days

- UNIX-UNIX system mail (UUCP); mail trapdoors (1975)
  - UUCP allowed users on one machine to execute commands on another
  - used to transfer email and files automatically between systems
  - early versions of sendmail (an implementation of UUCP) under UNIX had a trapdoor
    - the **debug** option gave you a root shell!

Public key cryptography - the early days

- Public-key cryptography discovered by W. Diffe, M. Hellman, ‘‘New directions in cryptography’’, IEEE Transactions on Information Theory, Vol. 22(6), 1976
  - provides the mechanism whereby people and commerce to trade via an untrusted Internet
  - D.C. Lynch, L.Lundquist, ‘‘Digital money: the new era of Internet commerce’’, Wiley, 1996

Public key cryptography - the early days

- RSA Public-Key Cryptographic system
  - RSA algorithm is the oldest (so far unknown) to be unbroken. It provides:
    - confidentiality and authentication
  - security based on finding some very large prime numbers
    - R. Rivest, A. Shamir, L. Adleman, ‘‘A method for Obtaining Digital Signatures and Public-Key Crypto-systems’’, CACM, 21(2), 1978

Cracking - the early years

- Wiley hacker attack
  - an attacker intruded into computers at Lawrence Berkeley Laboratory, apparently looking for secret information. Clifford Stoll was a system manager at LBL and helped authorities arrest the attacker who was being paid by a foreign government.
    - C. Stoll, ‘‘The cuckoo’s egg’’, Doubleday, 1989
    - C. Stoll, ‘‘Stalking the wily hacker’’, CACM, 31(5), 1988

Cracking - the early years

- Internet worm
  - the first large scale attack against computers on the Internet
    - within hours it had invaded 3000..6000 hosts
    - 5..10% of the Internet at the time
  - it used well known and documented bugs and trapdoors to gain remote access to machines
    - E. Spafford, ‘‘Crisis and aftermath’’, CACM, 32(6), 1989

Email privacy - the early years

- PGP and PEM (1989)
  - email is vulnerable to forgery, spoofing, alteration and interception
  - Privacy Enhanced Mail and Pretty Good Privacy provide secrecy and authentication services for email
  - B. Schneiser, ‘‘E-Mail security: how to keep your electronic messages private’’, Wiley, 1995

- Anonymous Remailers (1990)
  - servers act as mail forwarder, hiding the identity of the sender by substituting a random string for the senders name
  - C. Gulcu, G. Tsudik, ‘‘Mixing E-mail with BABEL’’, proceedings of the symposium on network and distributed systems security, 1996

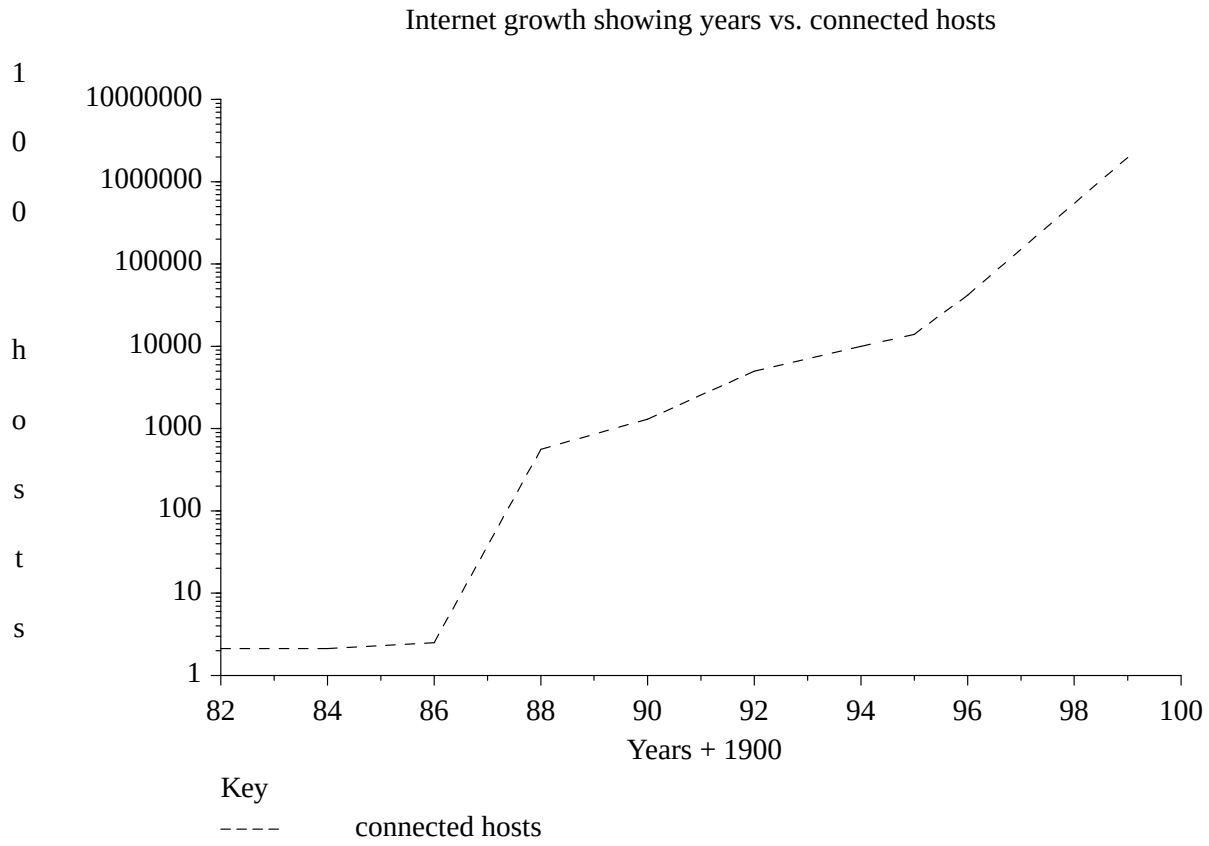
Packet spoofing and network sniffing - the early days

- Sniffing and spoofing 1993
- Internet protocols were designed on the assumption that no one could access the actual wires and listen observe the packets
  - in the last few years crackers have start to do just that
  - Steve Bellovin, ‘‘Security problems in the TCP/IP protocol suite’’, Computer Communications Review, 19(2), 1989
- methods called sniffing have been used to detect passwords transmitted in cleartext
  - attackers have also started to transmit their own packets containing false information
    - called spoofing

Java security problems

- there are many!
- Java is a language that allows you to write small applications called applets
- an applet can be down-loaded from a remote machine and executed on your local machine!
- can the user trust an applet?
- G. McGraw & E.W. Felton, Java Security, Wiley, 1997
- Scott Oaks, Java Security, O’Reilly, 1996

Growth in the Internet



Potted history of cracking

- 1969 John Draper (Cap’n Crunch) starts phreaking
- 1981 Chaos Computer Club (CCC) founded
- Kevin Mitnick first jailed
- 1984 the 2600 magazine founded
- 1985 Phrach e-zine founded
- C. Stoll publishes Cuckoo’s egg
  - Doubleday 1989

Potted history of cracking

- 1988 Robert T. Morris releases Internet Worm
- 1989 CERT founded ⟨http://www.cert.org⟩

Potted history of cracking

- 1990 Computer Misuse Act (CMA) becomes law in UK
- 1991 Kevin Lee Poulsen (‘‘Dark Dante’’) arrested
- 1993 Bedworth acquitted in first major Computer Misuse Act Trial
- 1994 Citibank hacked Vladimir Levin
- 1995 ‘‘Ardita’’, son of Argentinian General hacks NASA
- 1998 East Timorese Internet Domain Name Removed (.tp)
- 1998 cracker sentenced to death by a court in eastern China

Potted history of cracking

- 2000 CD Universe broken into a 30,000 credit card numbers stolen

Definition of Threat

- a possible danger to the system
  - Michael E. Kabay, Enterprise Security: protecting information asserts, McGreaw-Hill, 1996
- a circumstance that has the potential to cause loss or harm
  - Charles P. Pfleeger, Security in Computing, Addison Wesley, 1997
- a circumstance or event that could cause harm by violating security
  - Rita C. Summers, Secure Computing: Threats and safeguards, McGraw-Hill, 1997

Types of computer misuse

	Mode	Example
	External misuse	
1	Visual Spying	observation of keystrokes or screen
2	Misrepresentation	deceiving operators and users
	Hardware misuse	
3	Logical scavaging	Examining discarded/stolen media
4	Eavesdropping	Intercepting electronic or other data
5	Interference	Jamming, electronic or otherwise
6	Physical attack	Damaging or modifying equipment or power
7	Physical removal	Removing equipment and storage media

Types of computer misuse

	Mode	Example
	Masquerading	
8	Impersonation	using false identities external to the computer system
9	Piggybacking attacks	usurping communication lines
10	Spoofing attacks	Using playback, creating bogus nodes and systems
11	Network weaving	Masking physical whereabouts or routing

Types of computer misuse

	Mode	Example
	Pest programs	
12	Trojan horse attacks	Implanting malicious code, sending letter bombs
13	Logic bombs	Setting up time or event bombs (a form of Trojan horse)
14	Malevolent worms	acquiring distributed resources (rabbits and bacteria)

15	Virus attacks	attaching to programs and replicating

Types of computer misuse

	Mode	Example
	Bypasses	
16	Trapdoor	
	Impersonation	utilising existing flaws in the system
17	Authorisation attacks	Password cracking etc
	Active misuse	
18	Basic active attack	creating, modifying, entering false or misleading data
19	Incremental attack	Using salami attacks

Types of computer misuse

	Mode	Example
20	Denial of service	Perpetrating saturation attacks
	Passive misuse	
21	Browsing	making random and selective searches
22	Interference, aggression	Exploiting database inferences and traffic analysis
23	Covert channels	Exploiting covert channels and other data leakage