Malicious software.
Attacks and countermeasures,II

Antivirus Approaches

- **Prevention** : do not allow a virus to get into the system (in general, impossible to achieve);
- **Detection:** once infection has occurred, determine that it has occurred and locate the virus;
- **Identification:** once a virus is detected, identify it;
- **Removal:** once the specific virus has been identified, remove all traces of the virus and restores the infected programs to their original states.

Generations of antivirus software

- **First generation:** simple scanners;
- **Second generation:** heuristic scanners;
- **Third generation:** activity traps;
- **Fourth generation:** full-featured protection;

Simple scanners

- Require a virus signature to identify a virus;
- May detect viruses which have essentially the same structure and bit patterns in *all* copies;
- Signature-based scanners are limited to the detection of known viruses;
- May maintain a record of the length of programs and look for changes in length;

Heuristic scanners

- Rely on heuristic rules to search for *probable* virus infection.
- One may look for fragments of code that are *often* associated with viruses:
  - Encryption loop and a key in polymorphic viruses;
- One may use integrity checking:
  - Simple checksum;
  - Encrypted hash functions.

Activity detection

- Memory-resident programs that identify a virus by its *actions* in run time rather than by its signature or its structure;
- Here, it is not necessary to develop signatures and heuristics for various classes of viruses;
- It is necessary to identify the small set of *indicative* actions.

Fourth-generation antivirus packages

- Packages consisting of a variety of antivirus techniques used together:
  - Scanning;
  - Activity trap;
  - Control capability; etc
- Usually combined with other security defence systems (IDS, firewalls, etc)

Generic decryption and simulation

- Polymorphic viruses use *encryption* to hide malicious code;
- However, to execute such a code it has to be *decrypted*;
- Generic decryption (GD) tools are used to detect (fragments of) viruses at the stage they are decrypted and ready to be executed ;
- CPU simulator is used for this purpose.

Generic decryption and simulation

GD tools contain the following elements:

- **CPU simulator:** a software-based virtual computer. Instructions in an executable file are interpreted by the emulator not affecting underlying processor;
- **Virus signature scanner**: a module that scans the code looking for the signatures of known viruses;
- **Emulation control module:** controls the execution of the target code switching between simulation and scanning modes.

Behaviour-Blocking software

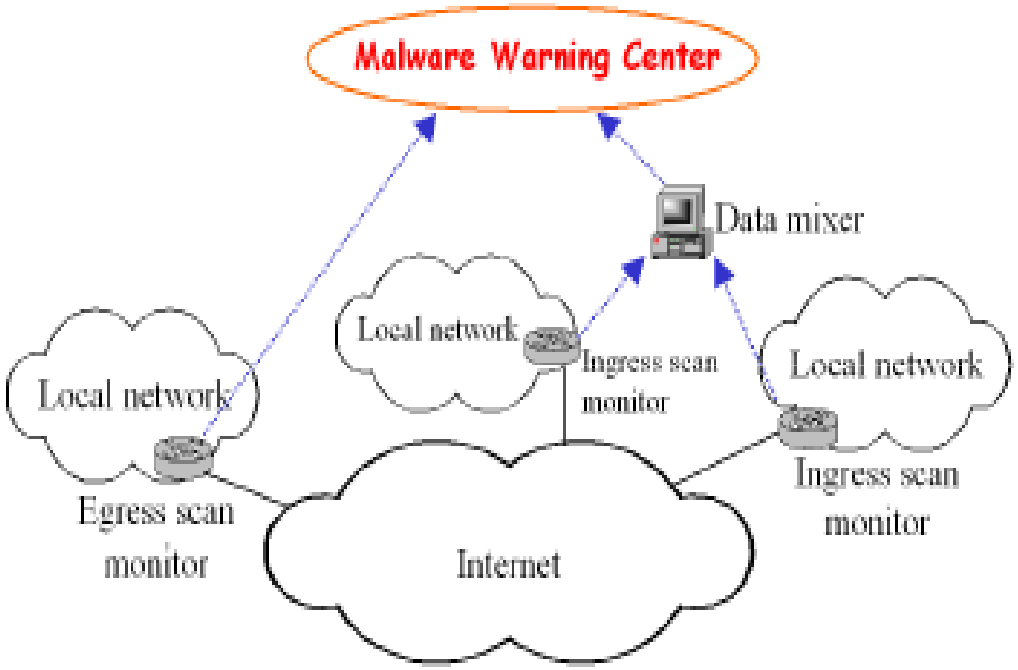
- Integrates with the operating system of the host computer and monitors program behaviour in real-time for malicious actions;
- Blocks potentially malicious actions before they affect the system;
- Potentially malicious actions may include:
  - Attempts to open, view, delete, modify files;
  - Attempts to format disk drives, etc
  - Modification of system settings (start-up,etc)
  - Initiation of network communication, etc

Monitoring and Detection of Internet Worms

- **Speed** is a crucial aspect here:
  - SQL Slammer worm, appeared in January 2003 and infected more than 90% of vulnerable computers in the internet within 10 minutes;
  - Successful worm attack typically lasts several days infecting hundreds of thousands of computers (*Code Red*, *Nimda*, *Blaster*,..);

- **Aim:** early detection.

Worm monitoring system



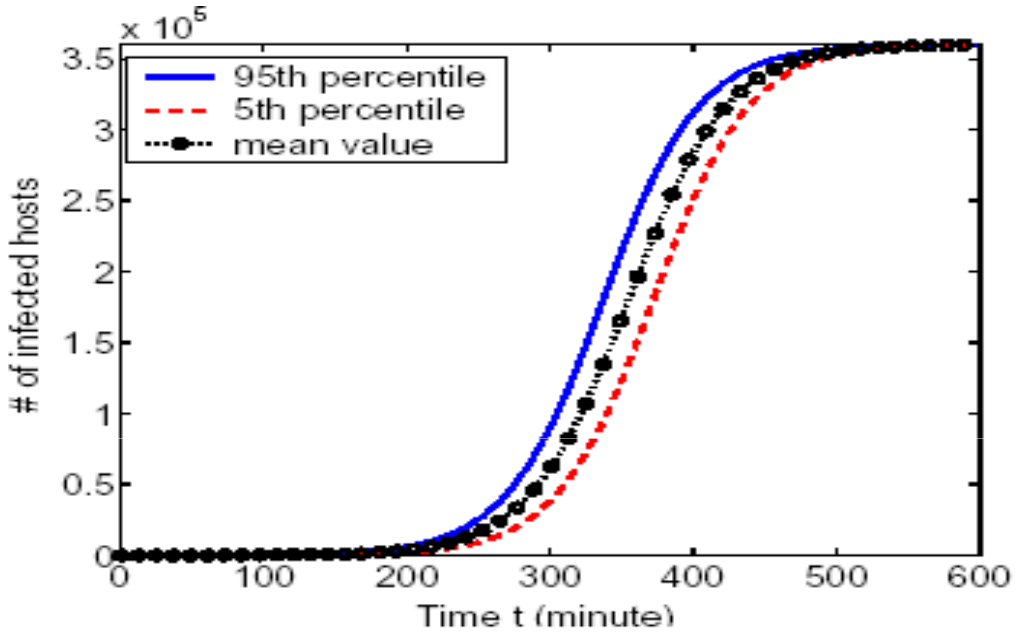
The system consists of

- **local scan monitors** for incoming and outgoing traffic;
- **data mixers** gathering information coming from monitors, or other data mixers (located at the lower levels in a tree structure)
- **warning center** accumulating information about the whole network and performing detection

Worm detection

- The whole range of methods developed for Intrusion Detection Systems can be used for worm detection;
- Special role of anomaly detection systems (suitable for detection unknown worms) :
  - **Threshold based:** detection of *bursts* of the network traffic;
  - **Trend based:** detection of *trends* in the network traffic.Based on a fact that at early stages a worm propagates exponentially.

Trend based detection



Picture by Cliff C. Zou, Weibo Gong, Don Towsley, Lixin Gao

Typical picture of the worm propagation: Code Red simulation.