New technologies and future security challenges

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Goals

- Examine two key issues for future cyber security:
  - **Technology trends** – what do they mean for future cyber security?
  - **Conflicting requirements** – security/privacy requirements versus economic and technological pressure.

1. Technology trends

- We look at four key emerging technology trends with serious security and privacy implications:
  - Ubiquitous/ambient computing;
  - Clouds/proxies/Grids;
  - Growing system and component complexity;
  - Integrated peripherals.

Ubiquitous computing

- The advent of always connected devices is already with us (mobile phones, wireless PC connectivity, RFID, ...).
- Systems have evolved piecemeal – no overall security architecture.
- Network access protocols offer very limited security (device authentication of network is sometimes non-existent):
  - ‘fake network’ attacks (GSM, 802.11, ...);
  - compromised access points (either by software or hardware attack).
- Similarly, pair-wise device authentication is sometimes not robust.
- Growing risk of widespread malware attacks, as devices become more ‘smart’ and flexible.
- Apart from poor security fundamentals, privacy is a major issue – device tracking is far too simple.

Third party computing

- There is growing trend to move data and processing to the cloud.
- Security and privacy concerns are widely documented – especially as the cloud providers offer very little guarantees about security, privacy and availability.
- This is just one part of a long-term trend to outsource IT provision.
- Users of outsourced services need to start asking deep questions about security and availability.

Complexity

- Another long-term trend is that towards increasing complexity, covering:
  - hardware of individual devices;
  - software running on devices (e.g. move towards general purpose OSs on special purpose devices);
  - system itself – growing interconnectivity adds huge complexity.
- Long known that complexity is the enemy of *assurance*.
- A lot of wishful thinking about emergent properties permeates the industry ...

Ubiquitous peripherals

- Ubiquitous computing devices come equipped with growing numbers of external interfaces – cameras, microphones, biometric readers, ...
- Who controls these?
- Do you trust all your applications running on all your devices not to misuse these functions?
- These peripherals represent a huge threat to personal and organisational security and privacy.
- Ubiquitous sensors pose a related threat.

Other issues I

- Privacy technology – requirements for providing anonymity will make it more difficult to trace attacks.
- We can expect continued growth in orchestrated attacks, by governments or other organisations (e.g. terrorist groups, criminal gangs, protesters, ...).
- New and unexpected types of malware are bound to emerge. Also, malware will spread across multiple platform types – e.g. rootkits on mobile phones ...
- Security threats to embedded devices pose an ever-increasing safety threat through their control of physical devices (e.g. vehicle control systems, radio power control and battery management systems in mobiles, ...).

Other issues II

- Provenance of software/hardware has become almost impossible to determine – how do we know our systems do not incorporate deliberately engineered vulnerabilities?
- Automatic updating of complex software is both very helpful and a huge risk – e.g. through ownership/influence of large corporates and foreign governments.
- User authentication techniques are not getting any better – still overwhelmingly rely on passwords (tokens, public keys, etc. are still not widely used).

2. Growing conflicts

- Requirements:
  - High robustness – because of criticality of IT;
  - Privacy protection – growing legal frameworks and user interest.
- Economic/technological factors:
  - Increasing complexity (inevitable technological drift) directly threatens robustness;
  - Increased use of third parties (outsourcing) makes privacy and security assurance very hard.
  - Smarts everywhere (flexibility) also threatens robustness.

Efficiency versus robustness

- Efficiency pressures:
  - use of third party providers;
  - integration across sectors;
  - just in time issues (minimise IT investment);
  - green/environmental issues.
- Robustness requirements:
  - avoid reliance on systems outside of direct control and single points of failure;
  - avoid possibility of cascading failures;
  - redundancy (multiple systems, …).

Efficiency versus diversity

- Efficiency pressures:
  - minimise number of types of platform/system to reduce maintenance and purchasing costs;
  - minimise number of suppliers (economies of scale).
- Diversity requirements:
  - reduce impact of vulnerabilities by using diverse systems;
  - spread risk through diversity.

Complexity versus reliability

- Complexity pressures:
  - hardware and software development more and more removed from human understanding – more complex – more intermediary layers (libraries, CAD tools, …).
- Reliability requirements:
  - the simpler a system is, the easier it is to make it reliable.

Flexibility versus stability

- Flexibility pressures:
  - re-use of a standard platform (e.g. a PC), even in embedded applications, reduces cost;
  - end users want flexibility to gain maximum benefit from their investment.
- Stability requirements:
  - keeping things simple increases assurance;
  - flexibility vastly increases the attack surface.

3. Are we all doomed?

- Conclude by highlighting some areas in which we might discern security-positive events:
  - growing diversity of platform types (e.g. games platforms as IT platforms);
  - better software;
  - growing awareness of seriousness of security threats;
  - possible future in ‘locked down’ devices.