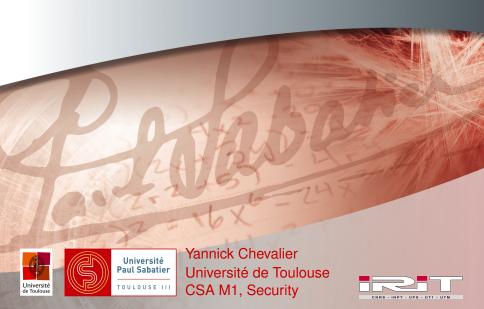
Separation



HISTORICAL BACKGROUND

BEFORE THE 1970s

- Computers only in physically secured environments
- Computers rebooted between each computation

ORIGIN OF SECURITY CONCERNS

- Time-sharing : organisations with different needs use a same computer for economical purposes (Multics, Unix)
- Security goal : Time-sharing should be as secure as non-Time-sharing systems

EXAMPLES

University and DoE/DoD use the same super-computer for simulation

Nowadays: exactly the same concern

Avionics : RTCA DO-255
Cloud computing









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SEPARATION INFORMAL STATEMENT

The execution of one program cannot influence in any way the execution of another program

- A program in an infinite loop cannot preempt the processor
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TRUSTED COMPUTING BASE (1/2)

ASSUME/GUARANTEE

When adding a new component to a system

- Except at the lowest level, use of other components based on assumptions
 - OS on the hardware
 - Applications/libraries on the OS and other applications/libraries
 - **.**..
- The new component guarantees (at some level of certainty) some properties:
 - no memory leaks,
 - bounds on execution time,
 - **...**







TRUSTED COMPUTING BASE (2/2)

SECURITY IN CS

- Formalisms to state and prove the guarantees provided by a component based on some assumptions on other components
- ► Trusted computing base : parts of a system that are not analysed and just assumed to provide the stated guarantees
- Example : processor state reset :
 - register reset not in early version of Unix (unused registers were left as is)
 - cache never resetted after a context change (leading to lot of security attacks, e.g. Spectre)
- problem compounded in current processors by pipeline, speculative execution, and on-the-fly code optimisation







PRINCIPLE

Ressources are statically allocated to consumers

SECURITY IMPLICATIONS: ACCESS CONTROL

- Access control policy : definition of the possible allocation of resources to consumers
- ► Must be defined before the start of the machine
- Cannot be changed while it is running

Static AC

- Example : bounds on execution time, memory available, etc.
- Unmutable policy :

Mandatory Access Control







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TIME SEPARATION

STATEMENT

The AC policy must specify the computation time allocated to each program

- Hard real-time systems
- Allocates a fraction of the processor cycles to each process
- In practice :
 - implemented in embedded and mission-critical systems for safety the ABS functionality cannot be affected when you start a new Ariana Grande song





SPATIAL SEPARATION

STATEMENT

Memory available to each application has to be allocated statically and be disjoint

- a.k.a. partitioning
- Implies no direct communication between applications (IPC system V), communication through the OS still possible
- In practice
 - RAM,HDD, SDD are sets of pages, and that set is partitioned, and each application receives one subset
 - No malloc/mmap, or a secure variant
 - Bounded stack
 - No pointers unless the Processor/OS guarantees that pointers never access a wrong page
- Very hard in practice
 - Need for a specific language (e.g. Lustre) or compiler
 - Registers and cache still have to shared on current processors







- ➤ TL;DR: very hard, but with some tolerance, achieved by current systems like Linux CGroups
- Incidentally, development driven by Cloud-hosting companies
- Known tolerances :
 - shared libraries
 - bounds on max memory available, but no hard partition
 - root still can do whatever he wants







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Partitioning in Information Systems

IN A COMPUTER NETWORK

- Tasks to be performed by a system are allocated to different computers based on their sensitivity
- ► The network is partitioned into zones for computers of similar security concerns
- Access Control on inter-zone exchanges (a.k.a. firewall)
- Example:
 - DMZ at the border between a corporate network and the outside (3 zones),
 - Firewalls to control packets between these zones

NOTE

- Outside of critical systems, there's no way to prove that all applications are secure
- ► First glimpse at Layered Security/Defence-in-Depth







NEAT SECURITY

- Non-bypassable : impossible to act outside of the bounds of the AC system
- ► Evaluatable : possible communications can be assessed before deployment
- Always invoked : no future rights, the AC system must always be queried
- ► Tamperproof : the AC system cannot be changed while the system is running
- These concerns are shared with safe systems
- Possible on systems dedicated to a task, not in general (e.g., no new file and no new user)
 - The CS Security dilemna:
 - we know how to secure a system
 - know how to have a usable system
 - we know how to build a cheap system









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