# Using Tripwire to check cluster system integrity

"Computing in High Energy and Nuclear Physics"

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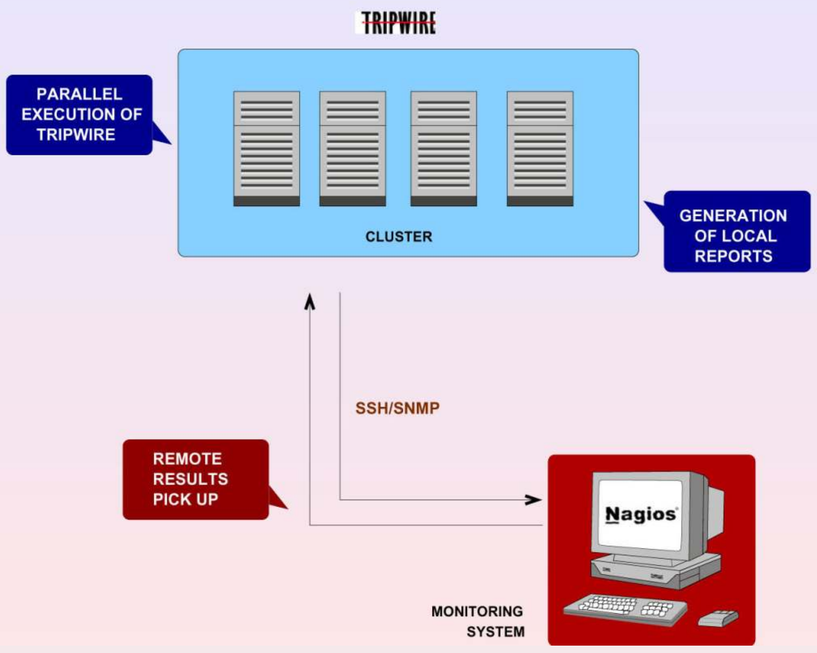
## Outline

- Increased security needed for large computing clusters:
  - Perimeter Security.
  - Intrusion Detection Systems (IDSs).
- The target of an IDS is early detection of an intrusion to minimize damages.
- Tripwire is one of the most powerful IDSs.
- Tripwire is oriented to monitor the status of files and directories to detect any changes: Integrity checking.

## Tripwire's Elements

- Policy and configuration files define Tripwire's behaviour.
  - Configuration file covers general options.
  - Policy file defines monitoring for each kind of file, depending of its characteristics and importance in system overall security.
- A original crypted database. The information is protected before being stored. That is a key feature of Tripwire that guarantees its own security and integrity.
- Reports generated by comparting the original database with the present status of the system. Reports include a general summary and a detailed list of any detected modifications.

## Tripwire at CIEMAT: Implementation (I)




## Tripwire at CIEMAT: Implementation (III)

- Implementation prototypes on LCG2 clusters at CIEMAT (35 machines monitored) and other collaborating institutes: UB (6 machines) and UAM (37 machines).
- Implementation in other computing clusters related to local scientific projects at CIEMAT.
- Wide clusters get global protection:
  - Cluster system integrity checking.
  - Large-scale centralized execution.
  - Remote control of execution results.
  - Administration interface using Nagios.

## How it works

- A snapshot of the system is taken, including information for any file or directory that should be protected (operating system files, core scientific software...)
- This information is stored in a crypted database to avoid any unauthorized modification. This database is kept and it is used for reference.
- System checks are performed regularly. Present situation is compared with the reference one. A report is generated for each check. Reports may be stored or sent by email automatically.

## Tripwire at CIEMAT: Policy and Configuration

**MAIN FILESYSTEM MONITORED PROPERTIES**

FILE ADDITION, DELETION AND MODIFICATION
FILE PERMISSIONS, PROPERTIES AND OWNER
FILE TYPE, SIZE AND BLOCKS ALLOCATED
INODE NUMBER, NUMBER OF LINKS AND
INODE GENERATION NUMBER
ACCESS CONTROL LISTS (ACLs)
TIMESTAMPS OF FILES AND INODES
HASH CHECKING

**MONITORING MODELS DEFINED IN POLICY FILE**

OPERATING SYSTEM CRITICAL FILES
FILES WITH SUID AND SGID BIT ON
OPERATING SYSTEM CORE BINARIES
CONFIGURATION FILES OF IMPORTANT APPLICATIONS
GROWING FILES (SUCH AS SYSTEM LOGS)
INVARIANT DIRECTORIES

## Tripwire at CIEMAT: Implementation (II)

- Large-scale and parallel execution of Tripwire at any computer in a network.
- Monitoration is implemented in a central computer:
  - Throws parallel executions of Tripwire in the cluster by SSH.
  - Gets information from the MIB tree of the cluster by SNMP.
- Use of a monitoring system (Nagios) as a visual interface for intrusion detection. Features:
  - Offers information about remote executions.
  - Sends alerts by email if a problem is detected.

## Conclusions

- Combining Tripwire and Nagios provides:
  - A very secure and versatile IDS tool.
  - Complete monitoring of system integrity.
  - Adaptable to the needs of a large cluster.
  - User friendly visualization and configuration interface.
  - Remote control using alarms.
  - Free software (GPL).
- Main references
  - Tripwire project: http://www.tripwire.org
  - Nagios monitoring system: http://www.nagios.org

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