System-level Support for Intrusion Recovery

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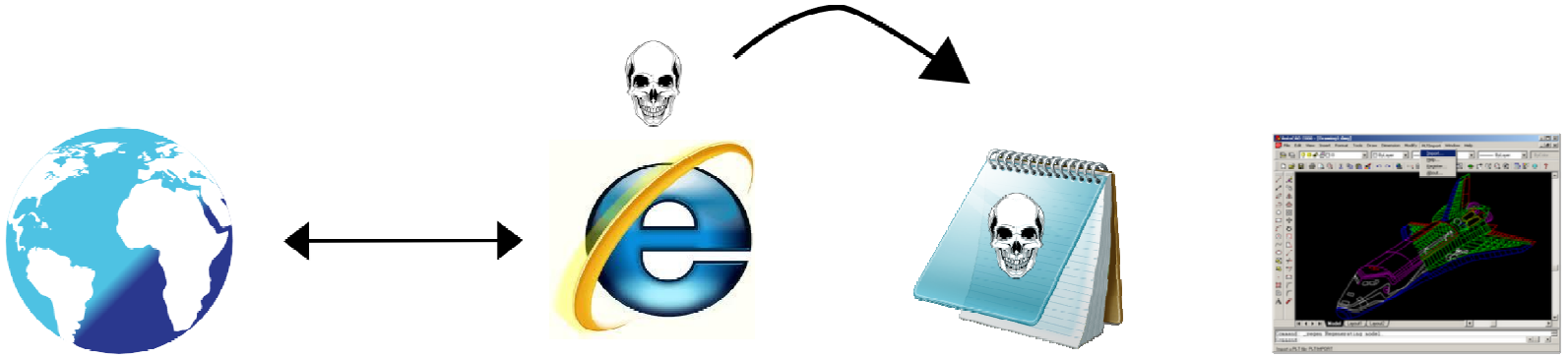
Introduction

- System compromise is common
- Typically the attack is detected later
- Can the user still trust the user data created after the attack?

Attack example

Attack example



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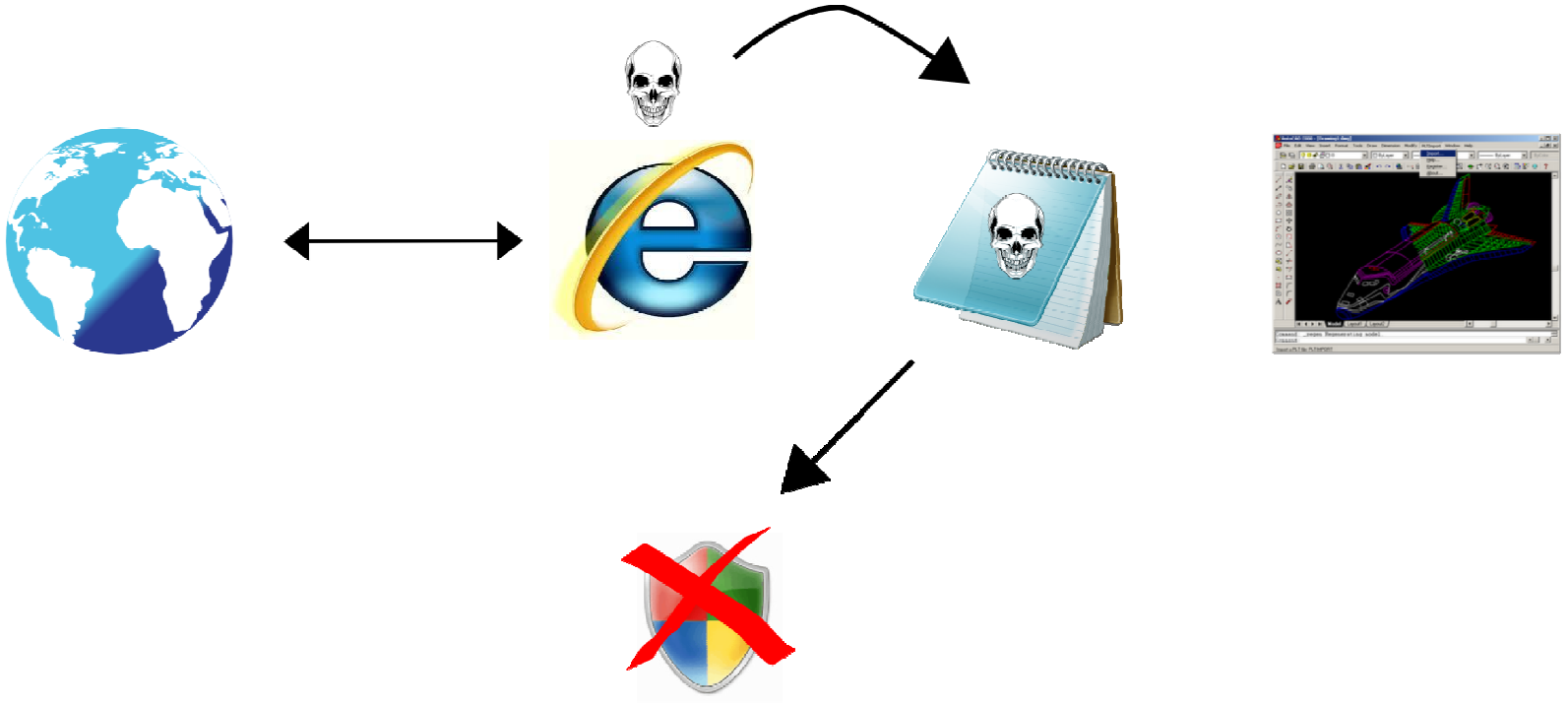

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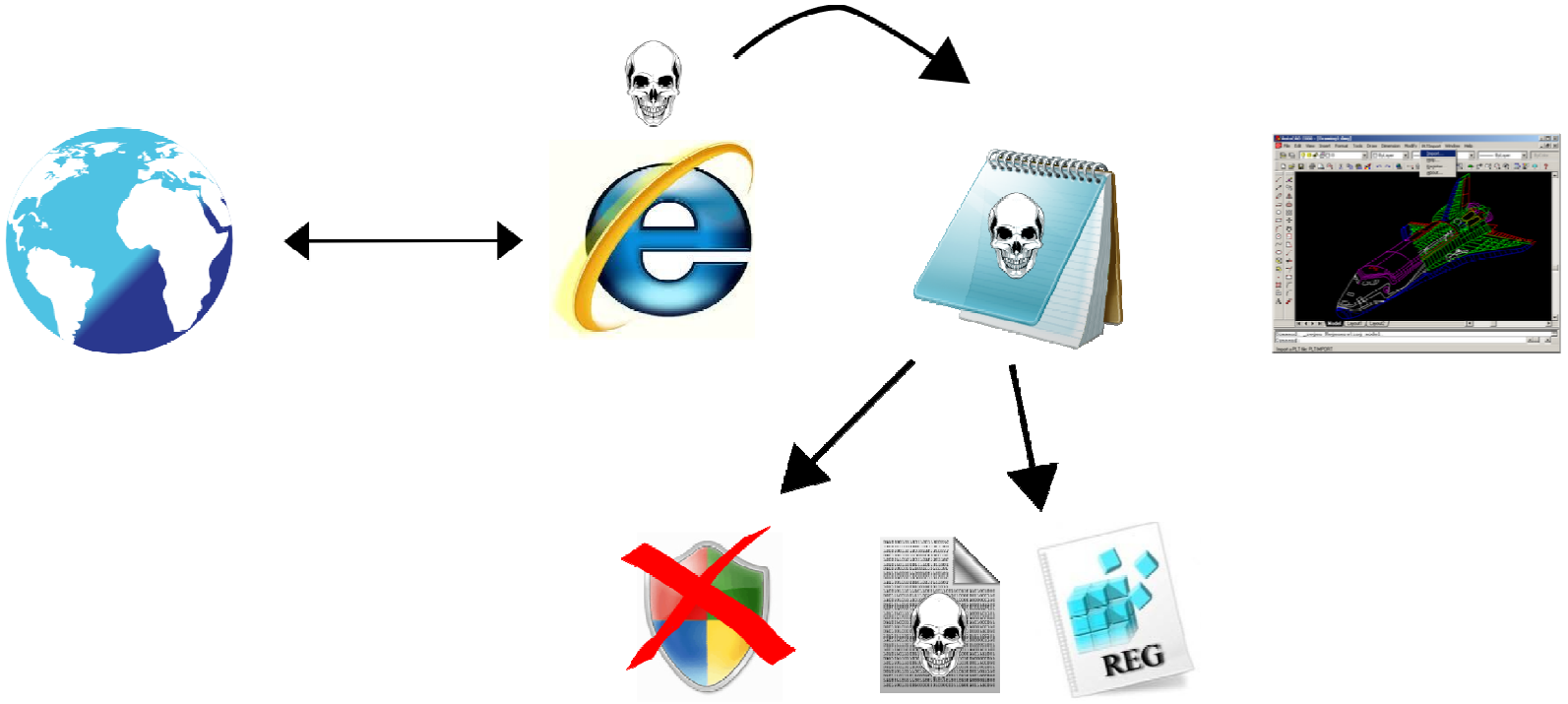

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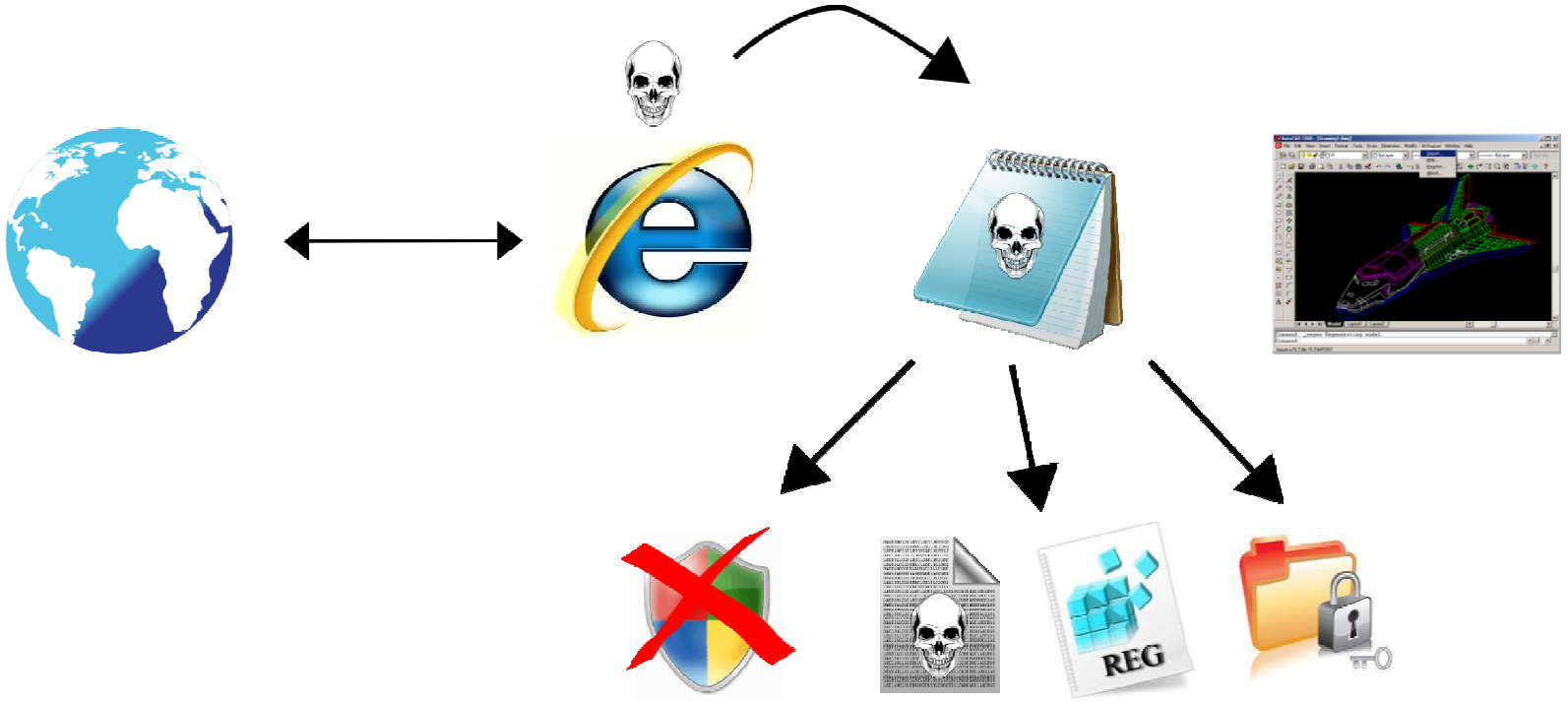

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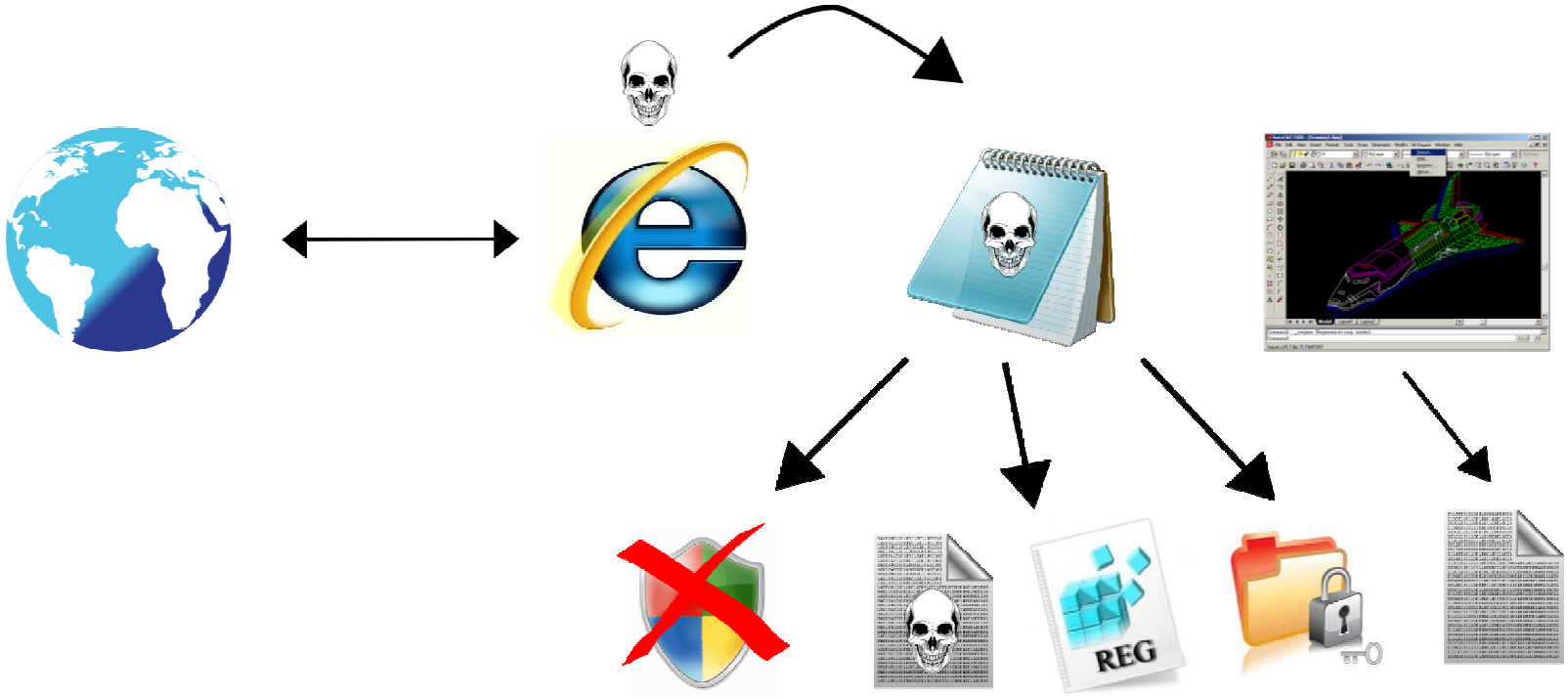


Recovering from attacks

- AV scanners
  - signatures are always late
  - may not clean all infected data

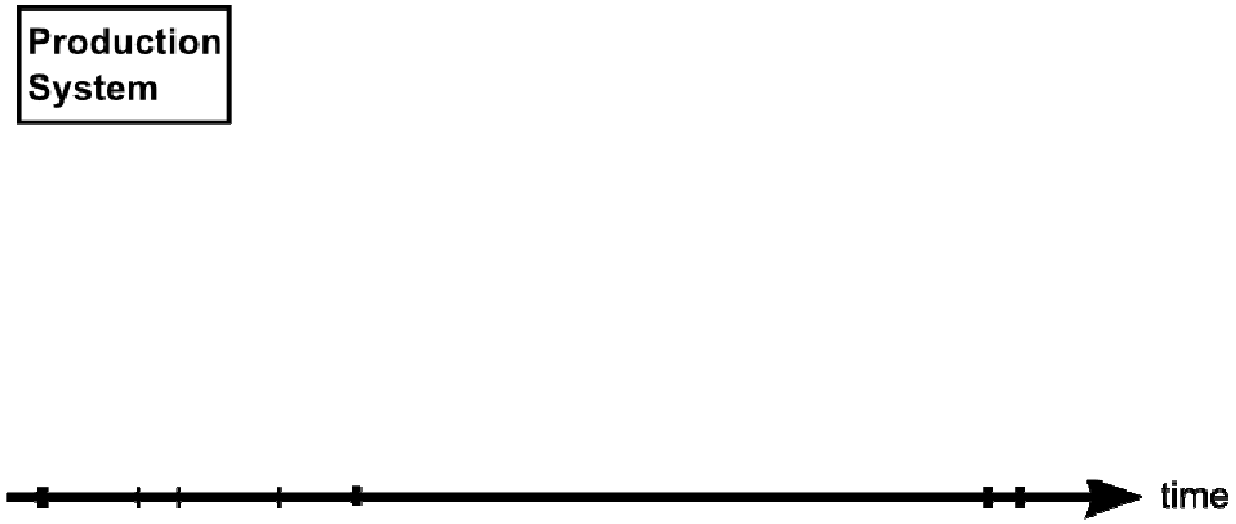
- Restore from backups
  - recent changes are lost

DiskDuster

- Recover user data produced after the attack.

- Recover even if the malware was active for a longer time period.

Recovery in decoupled security



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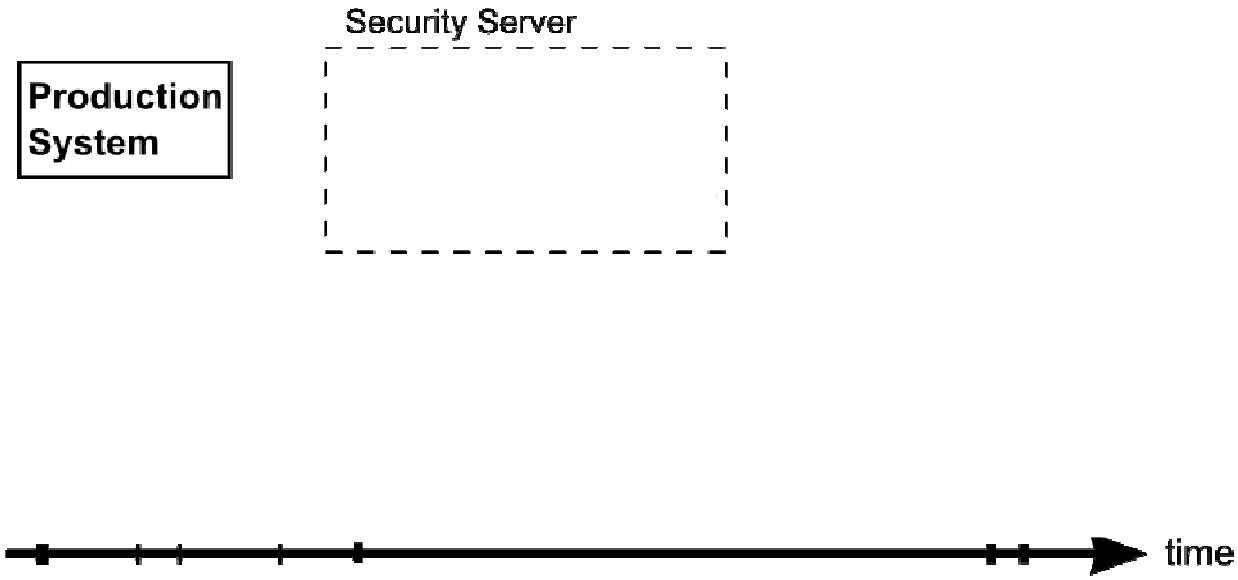

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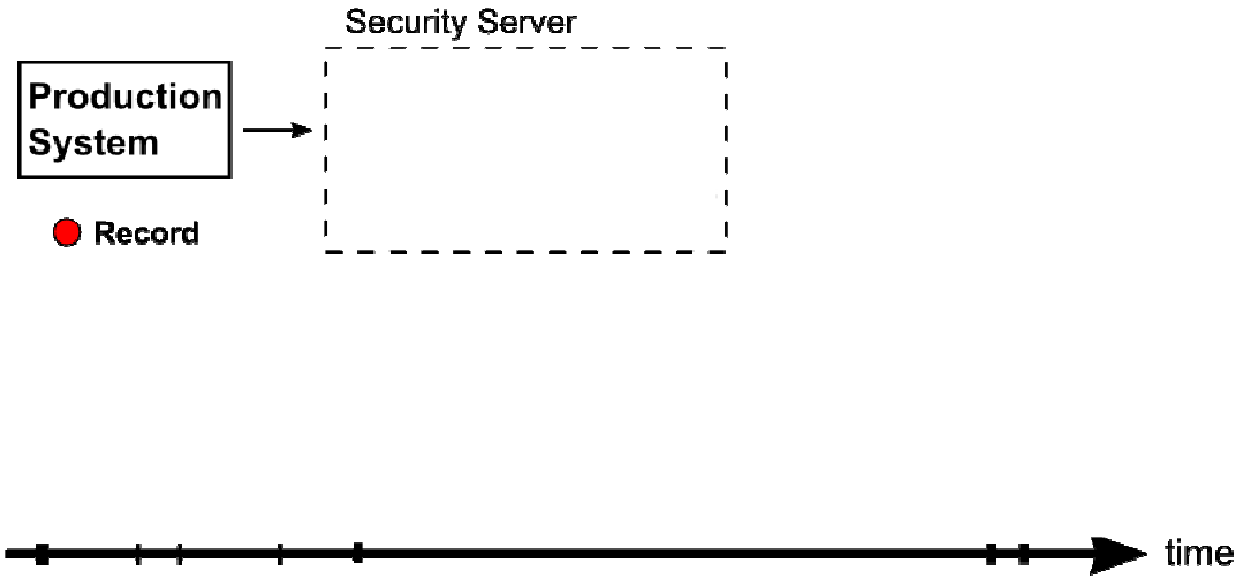

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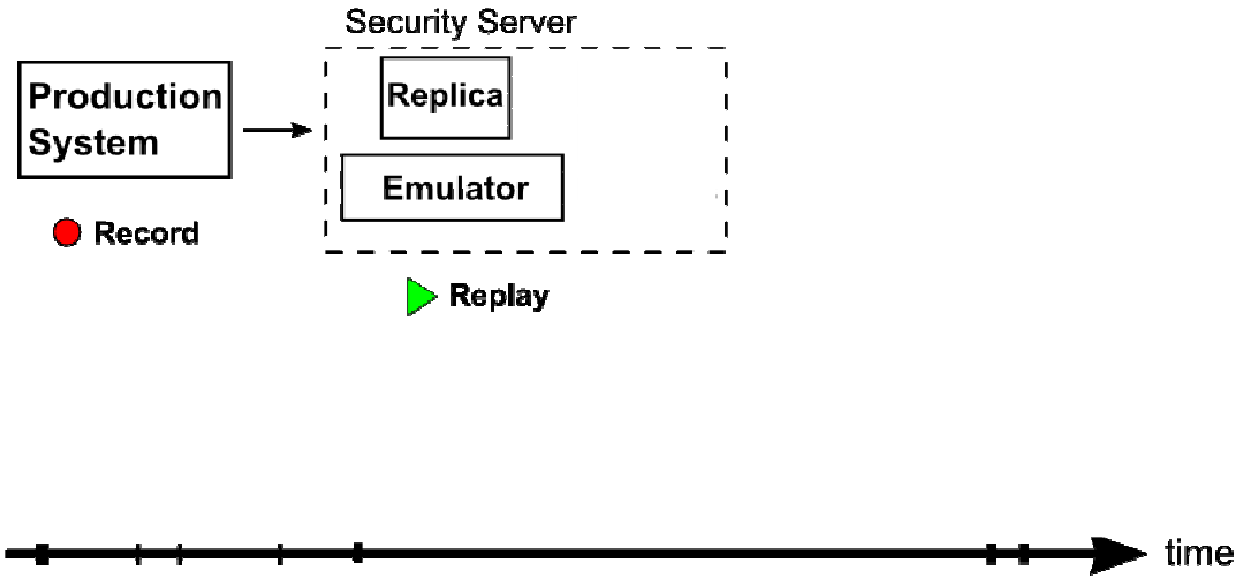

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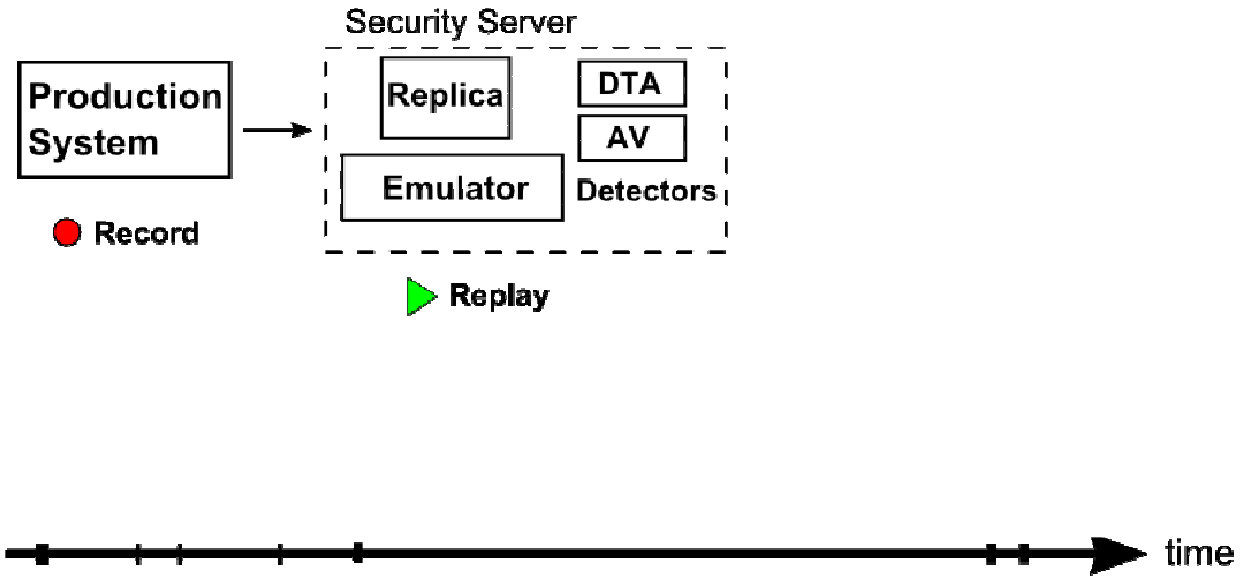

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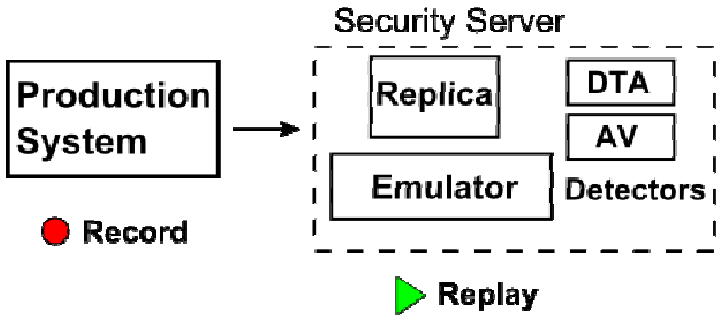

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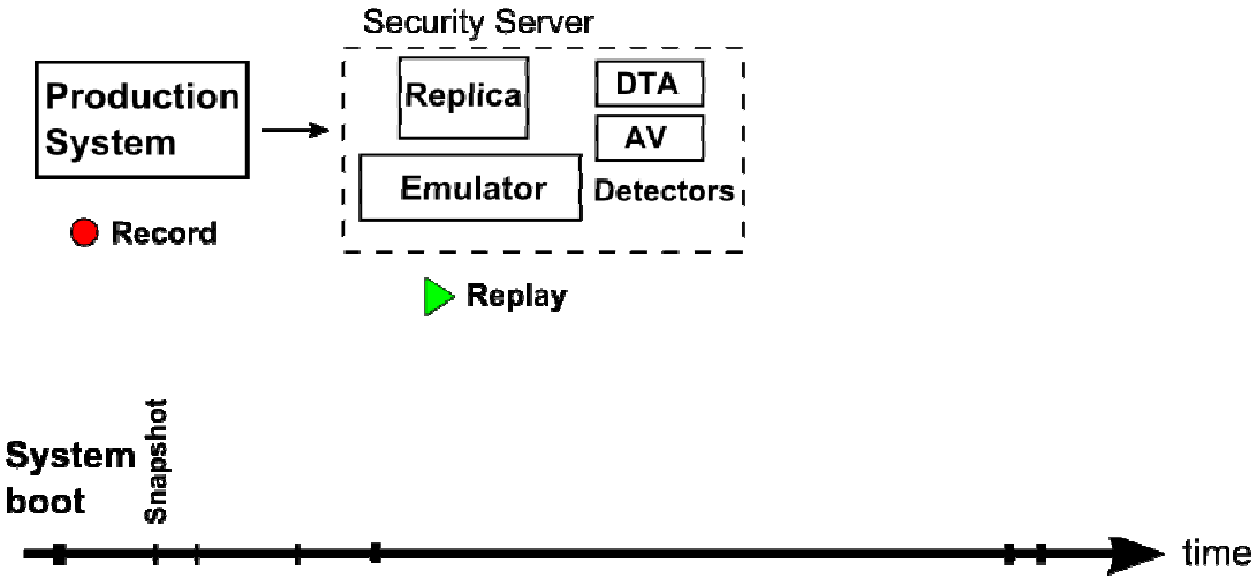

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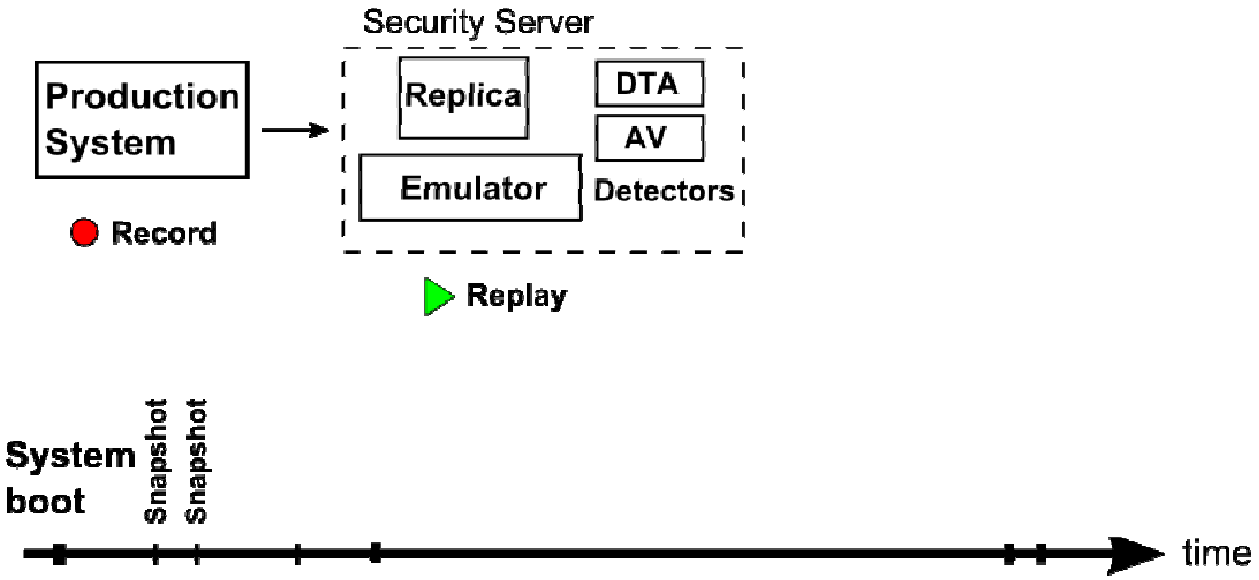

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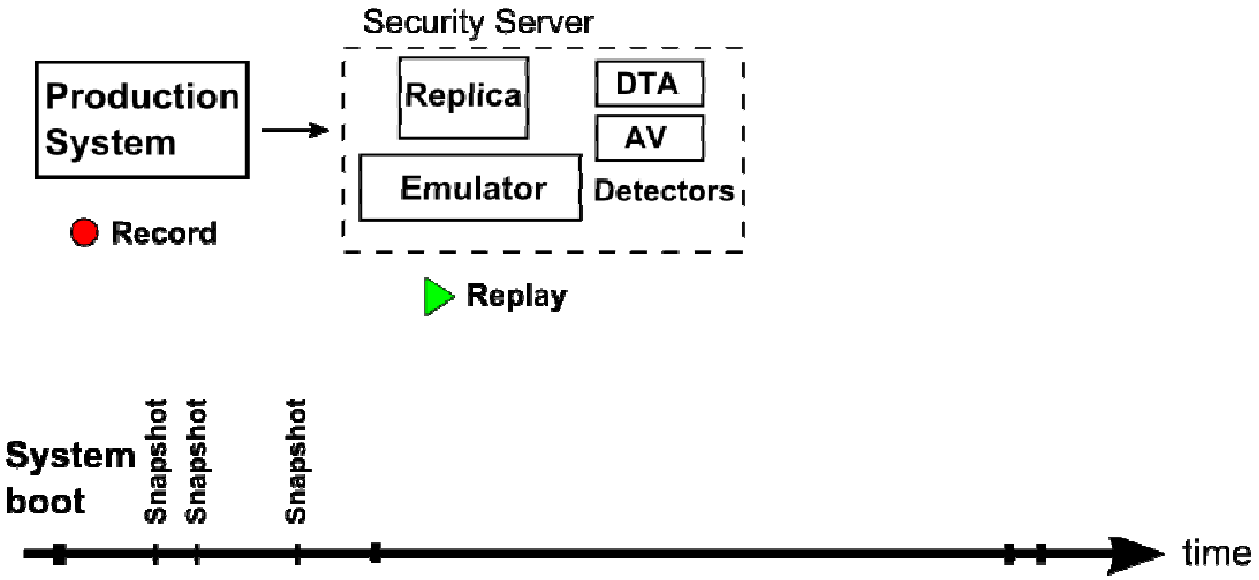

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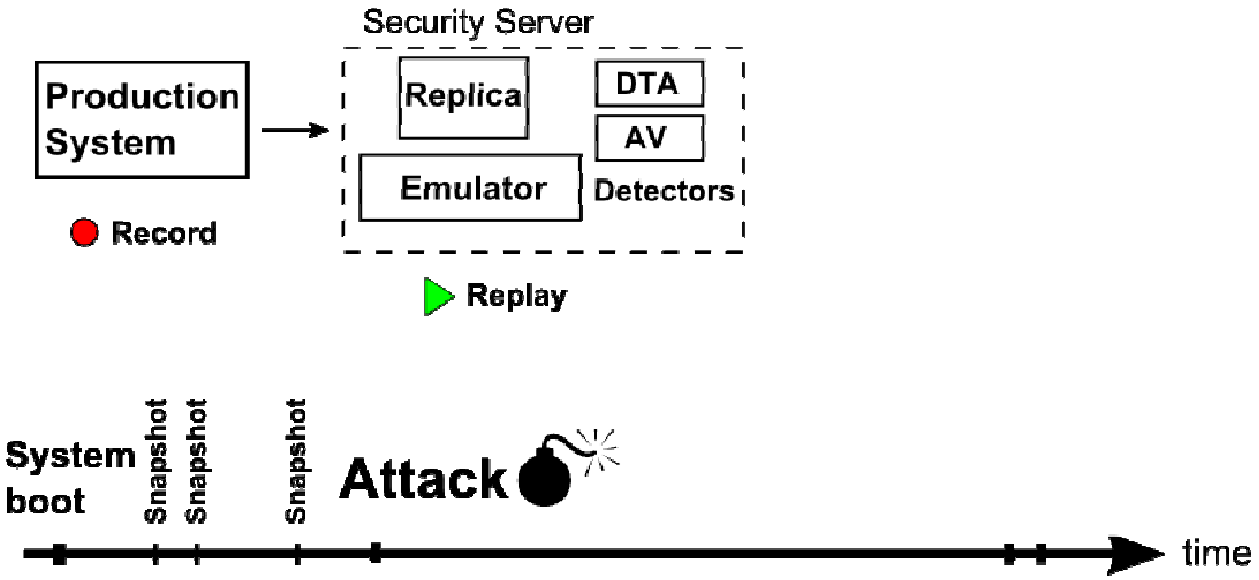

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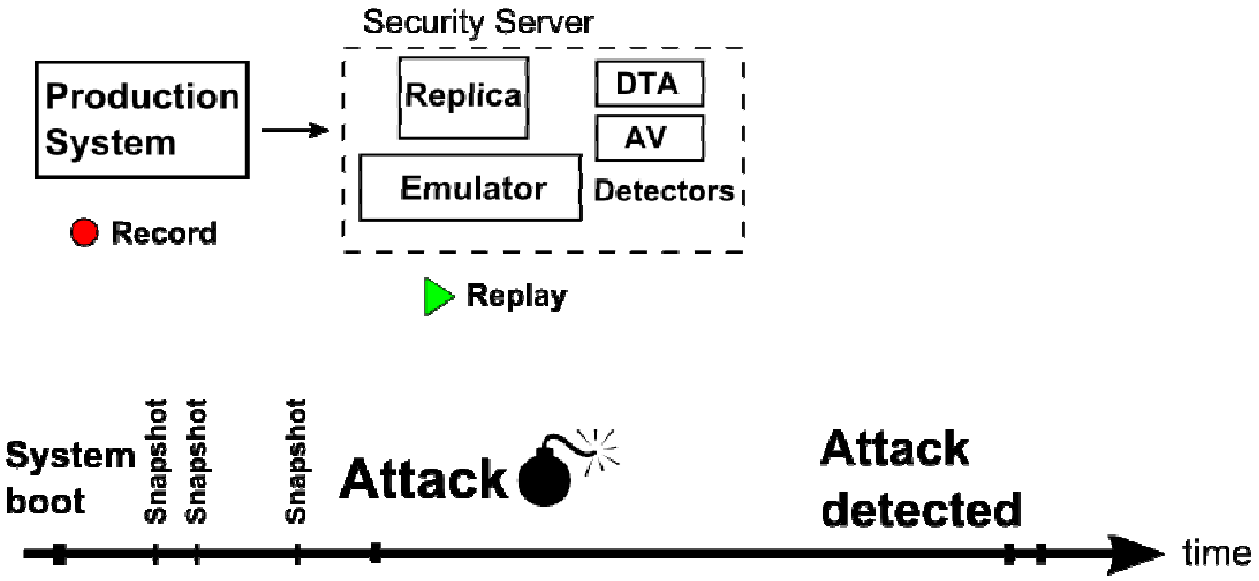

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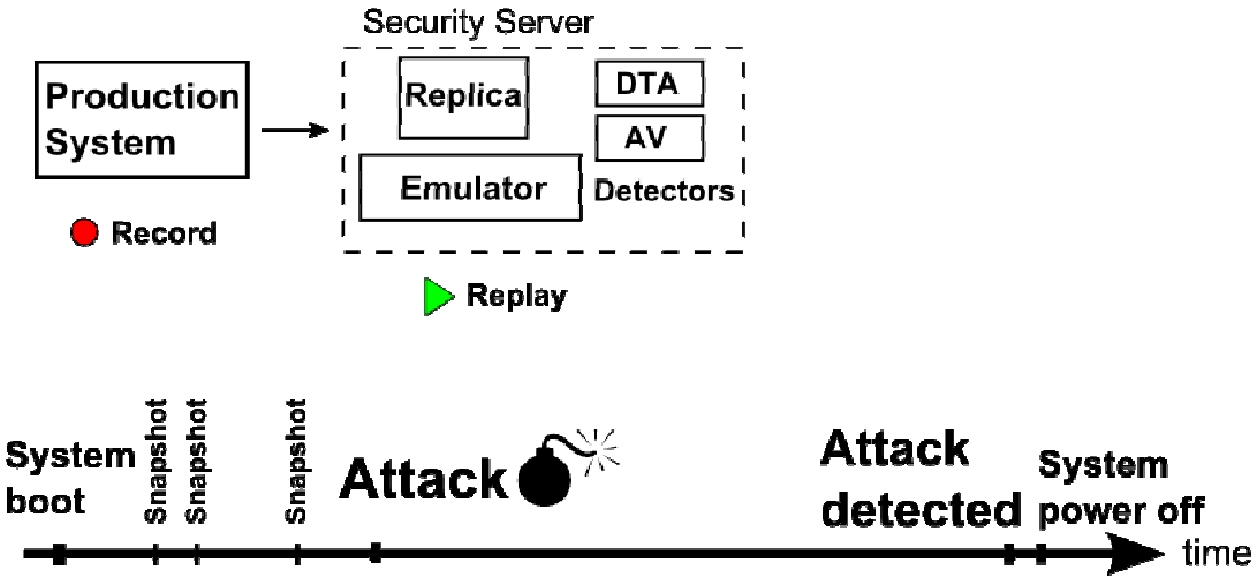

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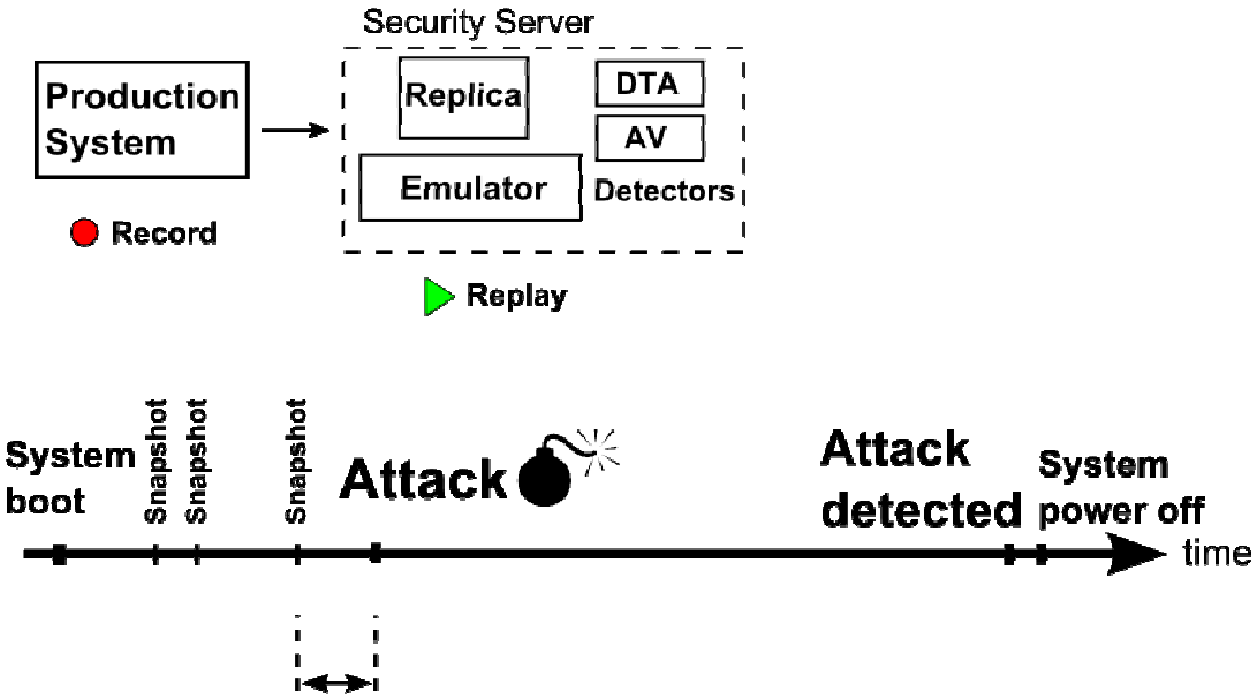

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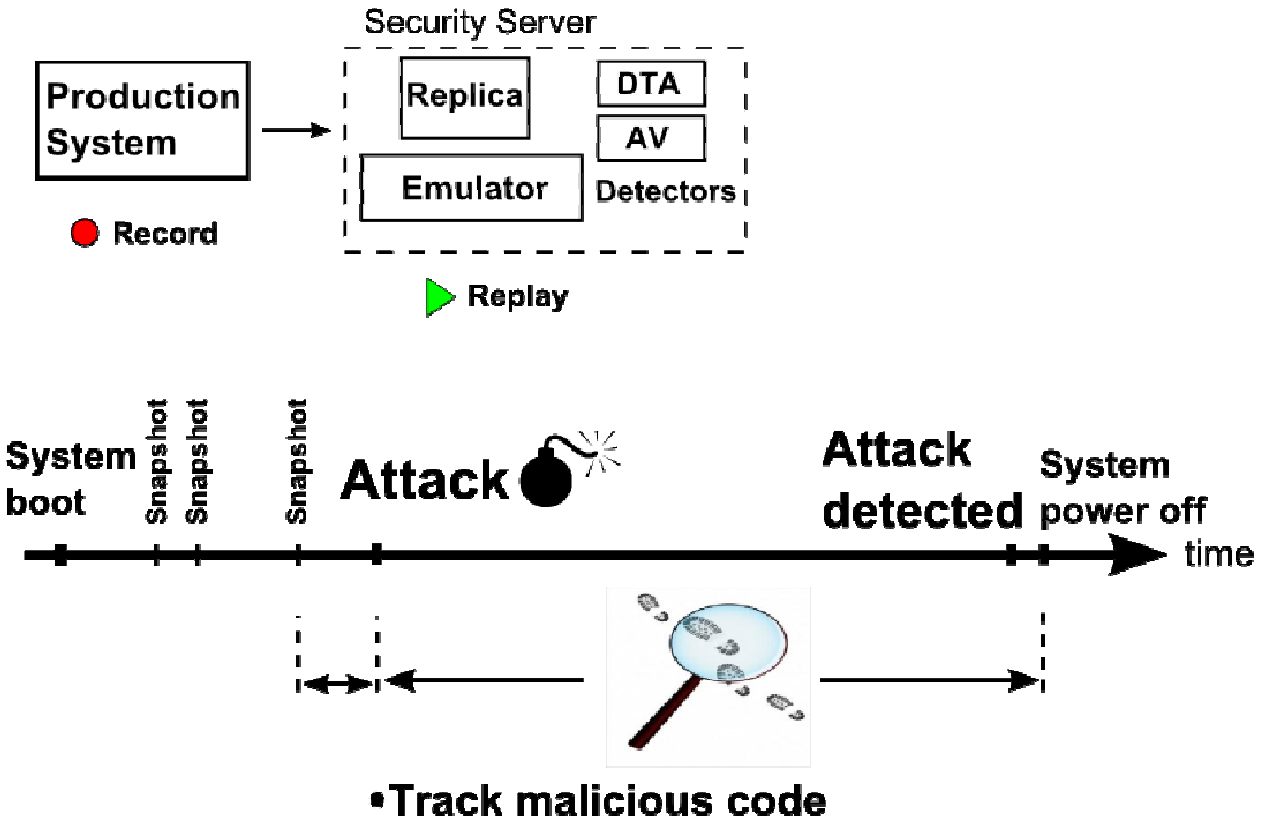
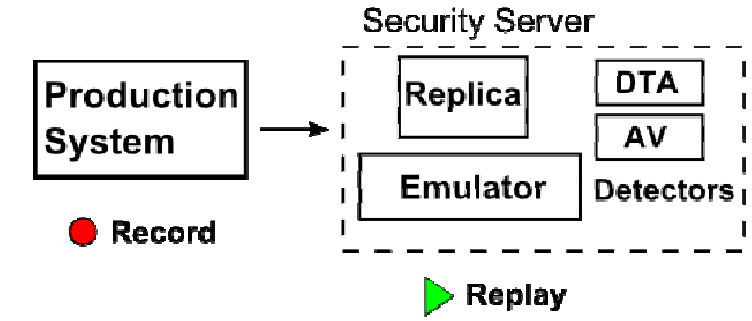
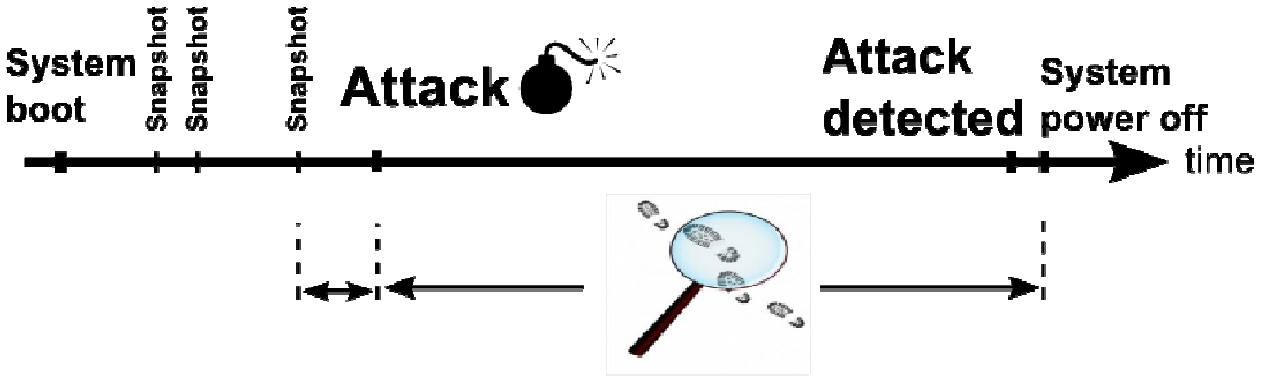


- Track malicious code

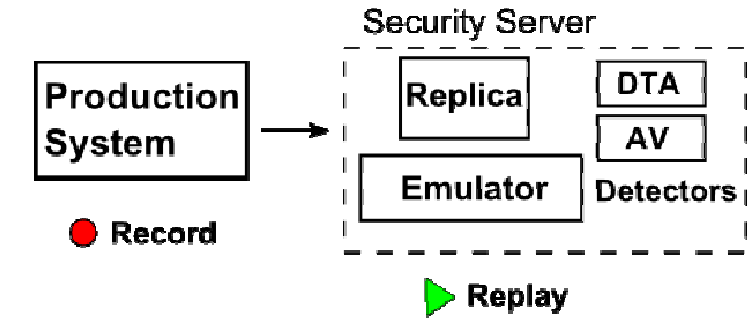
Recovery in decoupled security

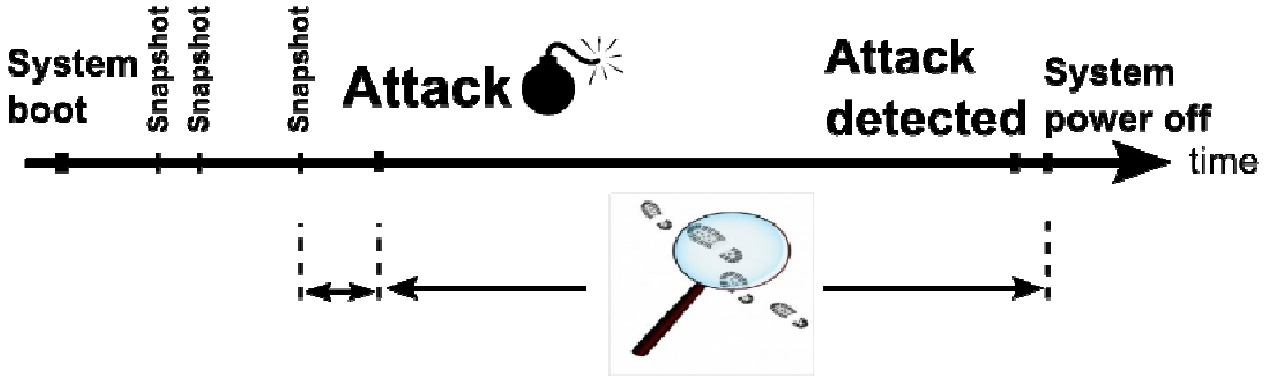




- Track malicious code
- Classify data: malicious, suspicious, clean

Recovery in decoupled security



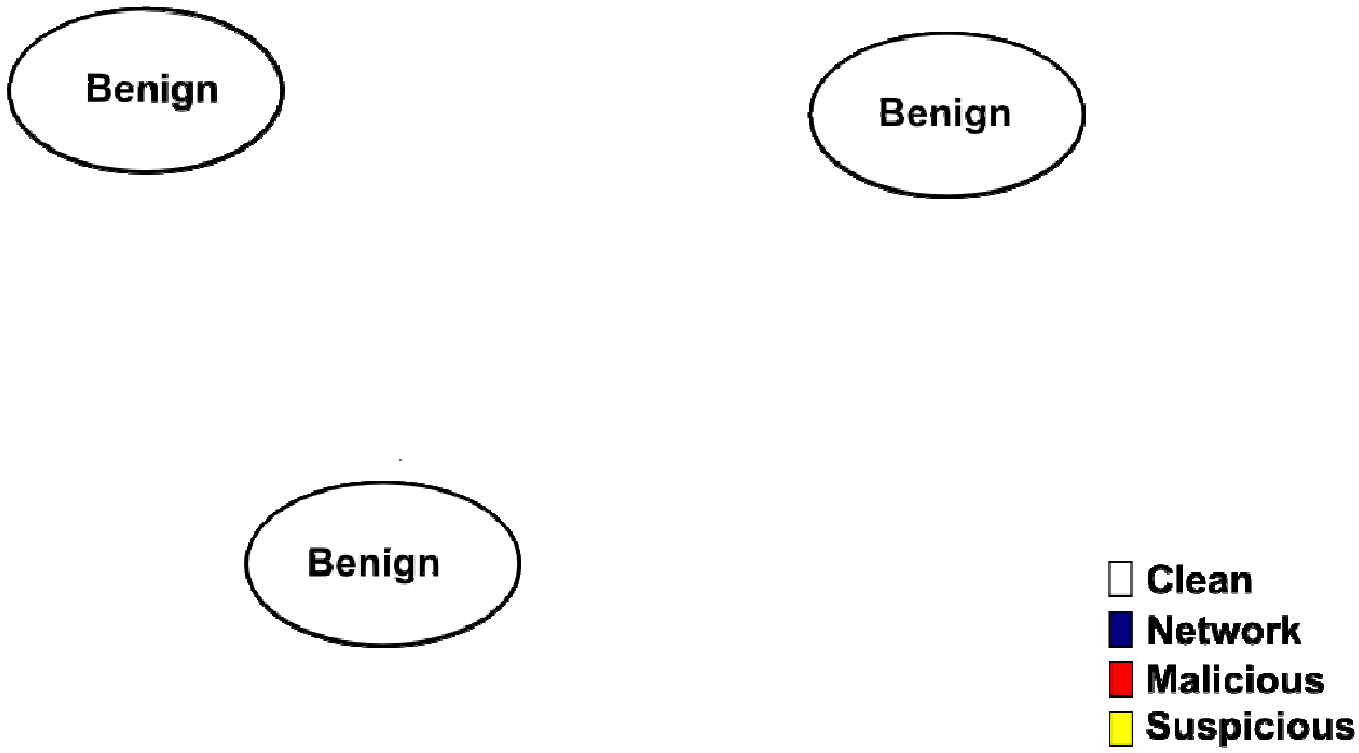


- Track malicious code
- Classify data: malicious, suspicious, clean
- Recover

Attack detection

- Dynamic taint analysis (DTA):
  - Taint data from the network
  - Propagate taint on data copy, arithmetic operations.
  - Raise an alarm when network bytes modify the control flow of an application.
- AV:
  - Raise an alarm when a signature is detected in an application

Taint Analysis – process tracking



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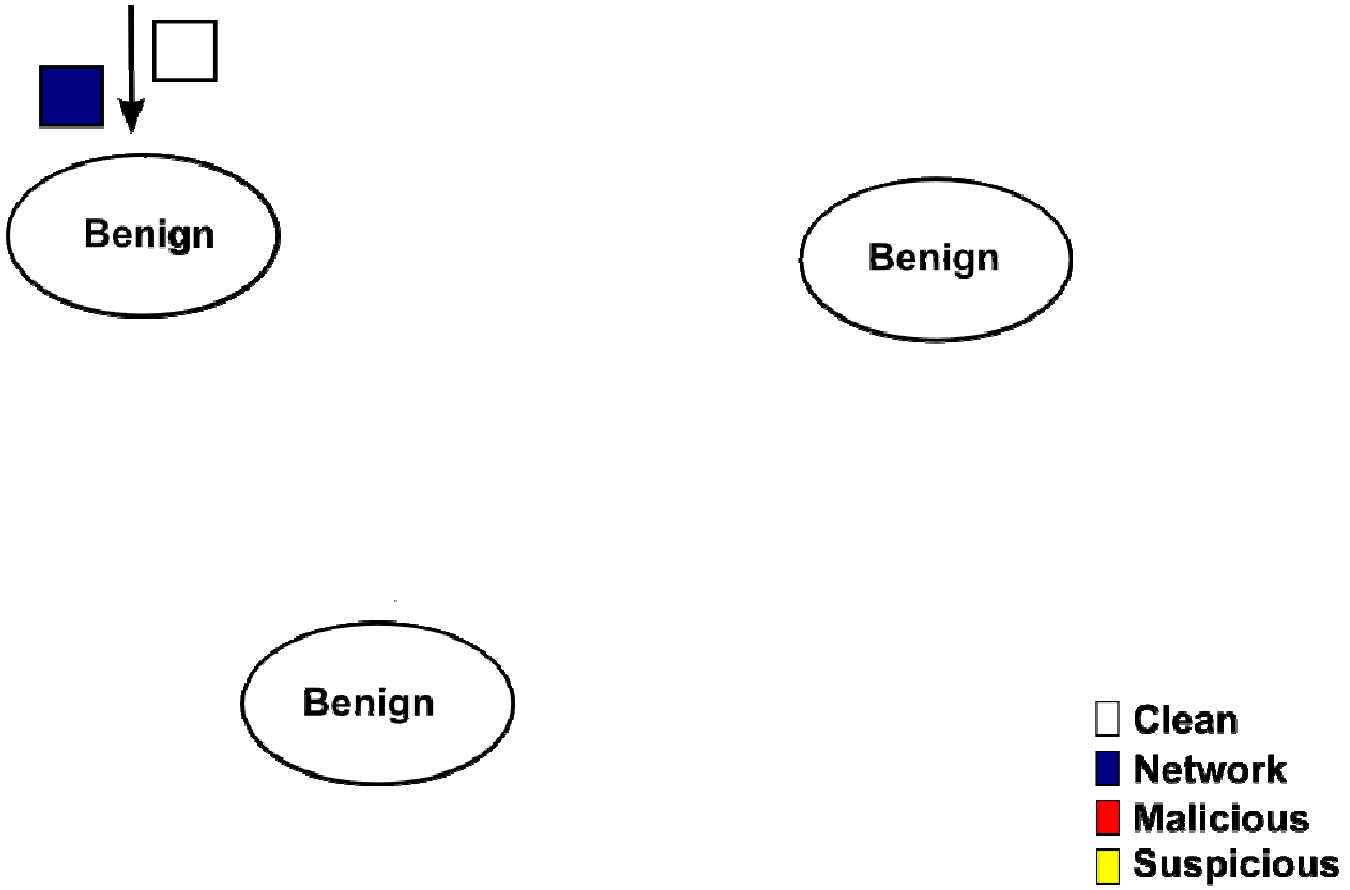

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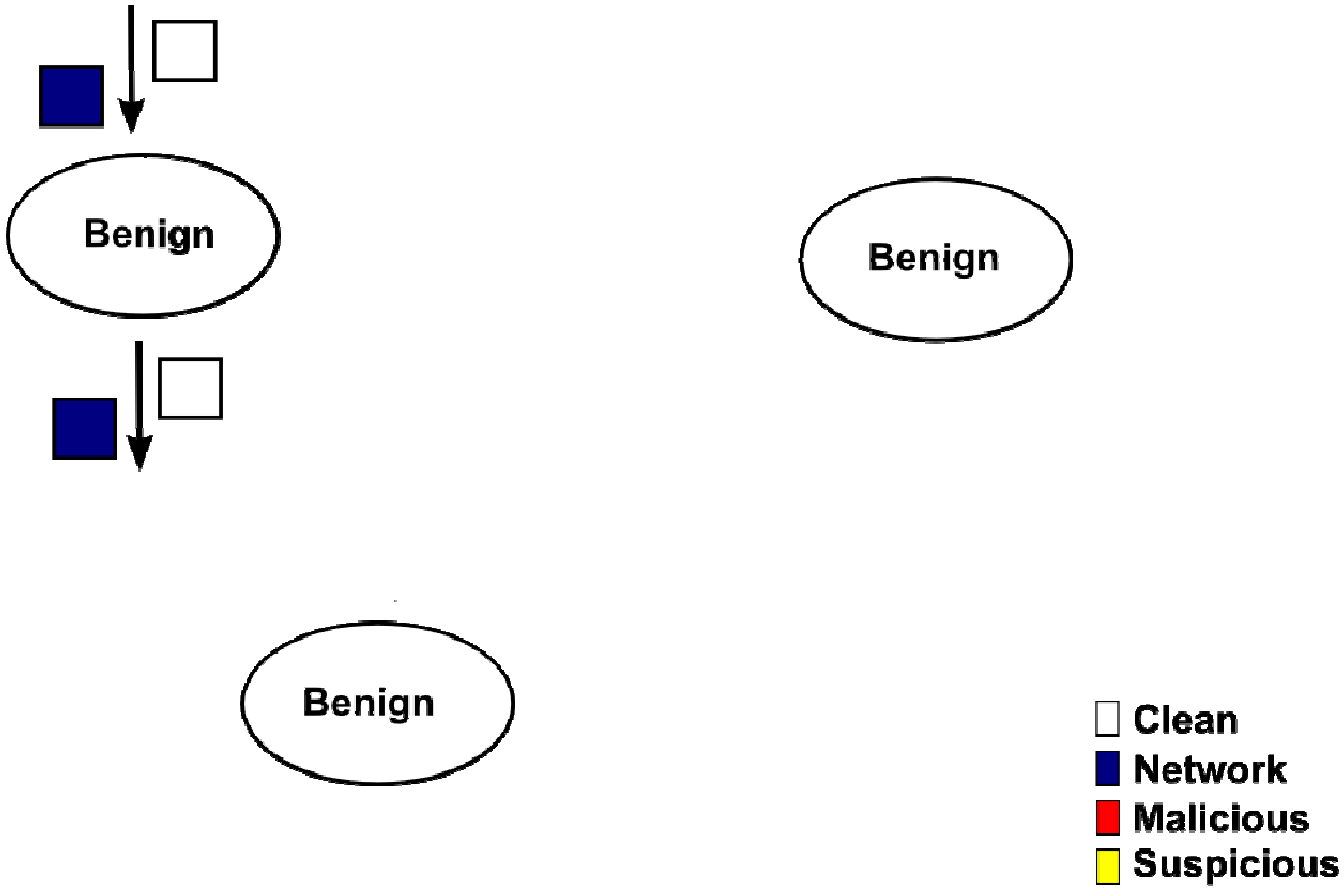

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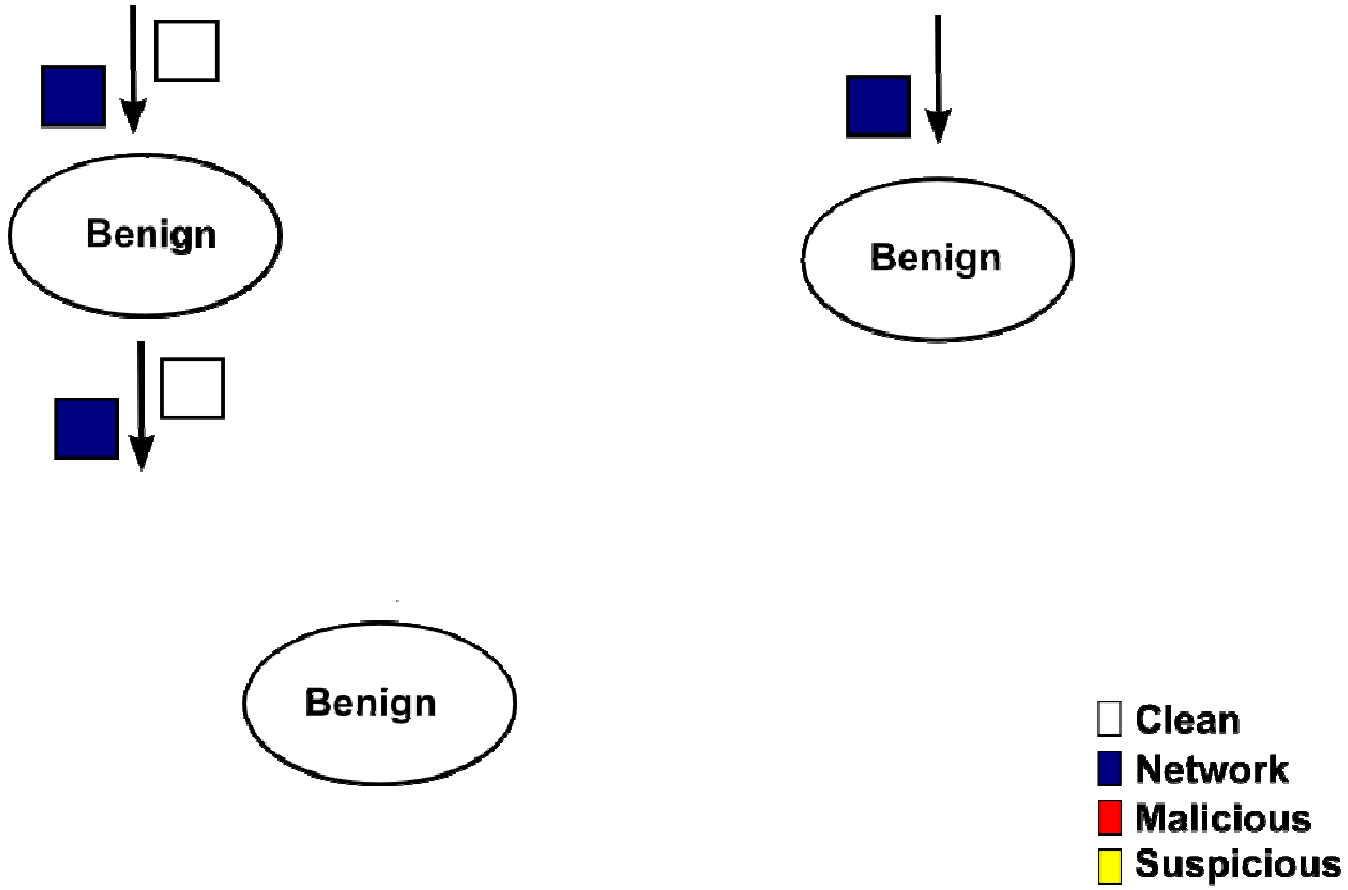

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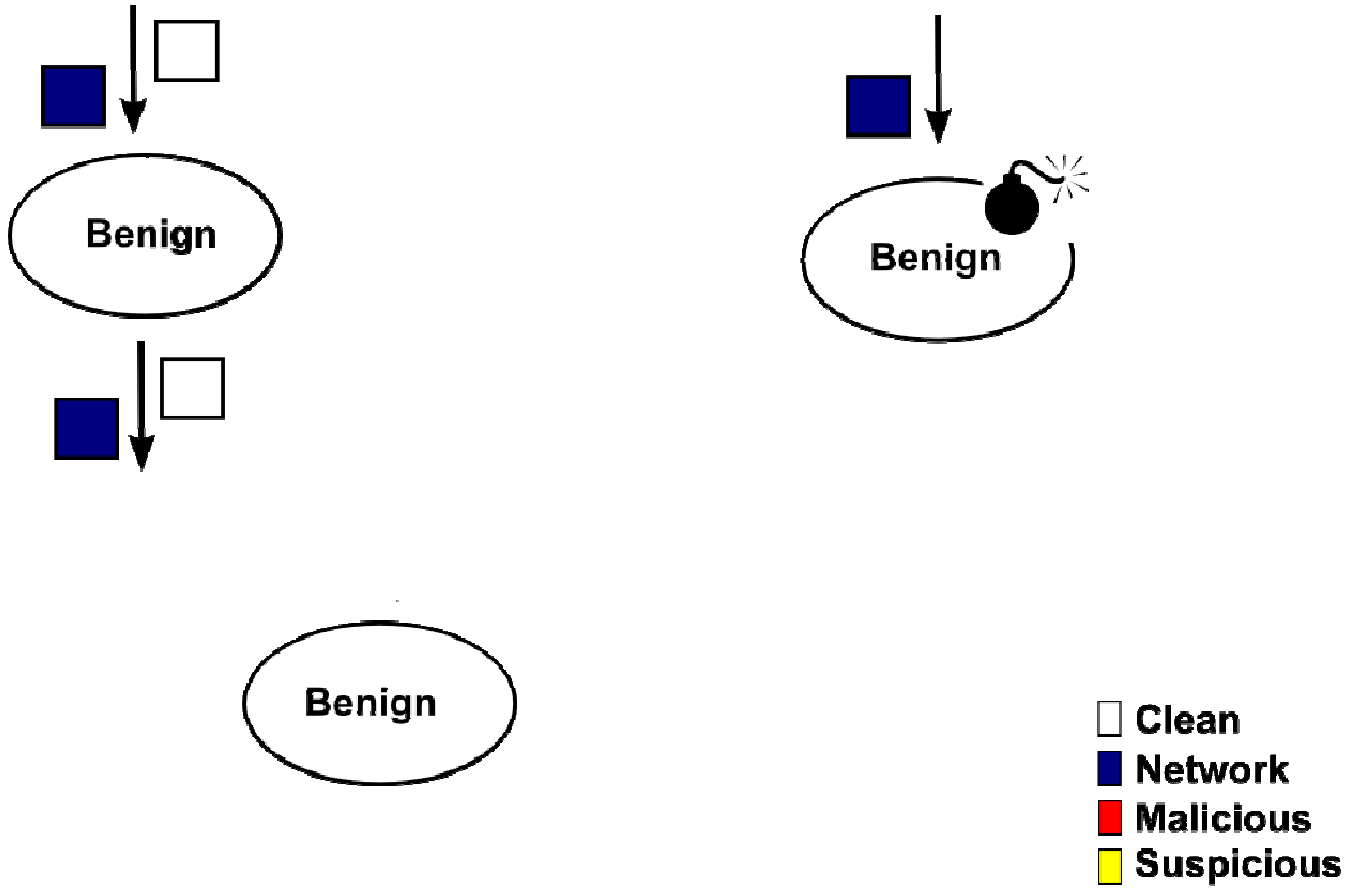

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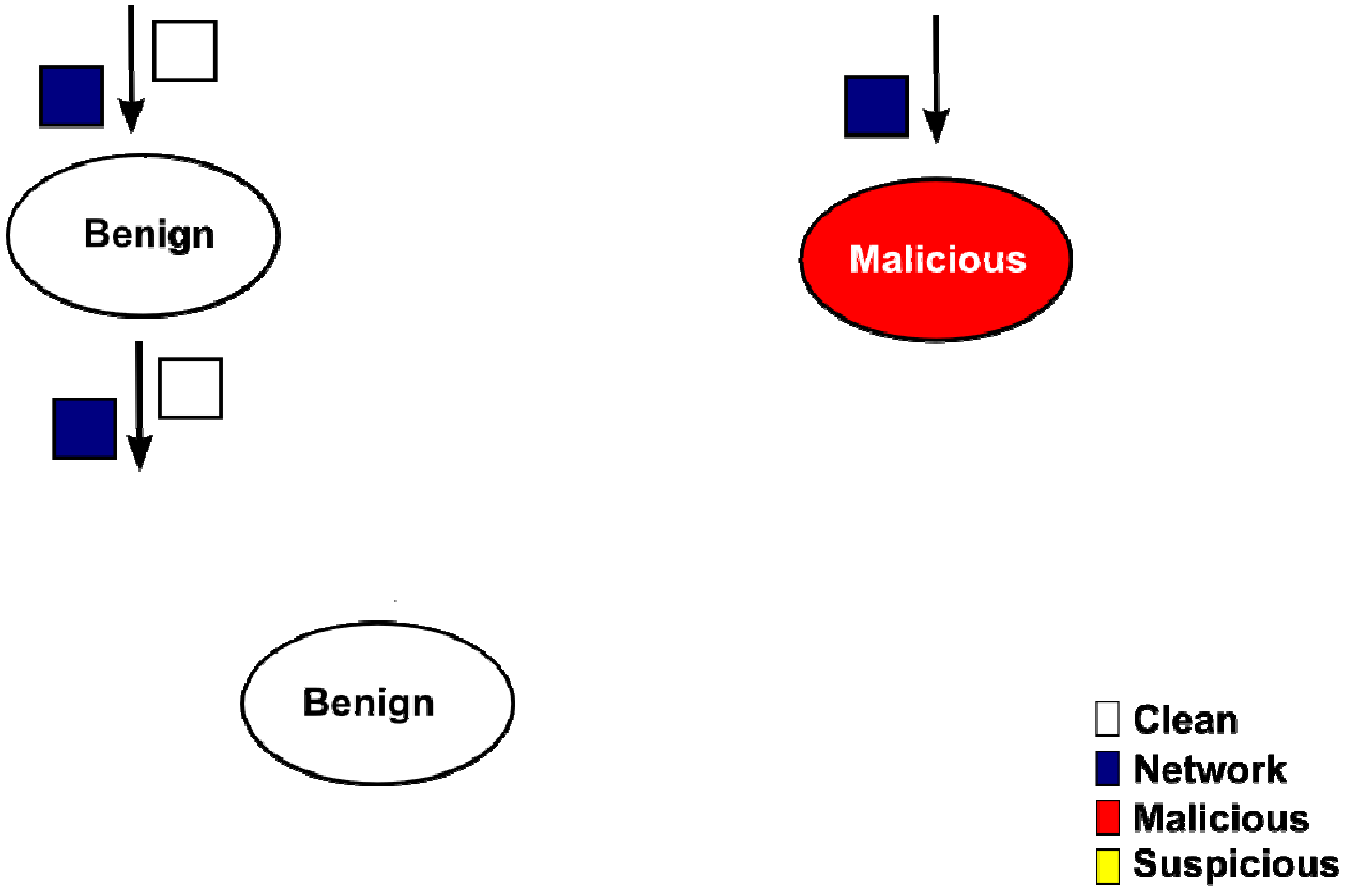

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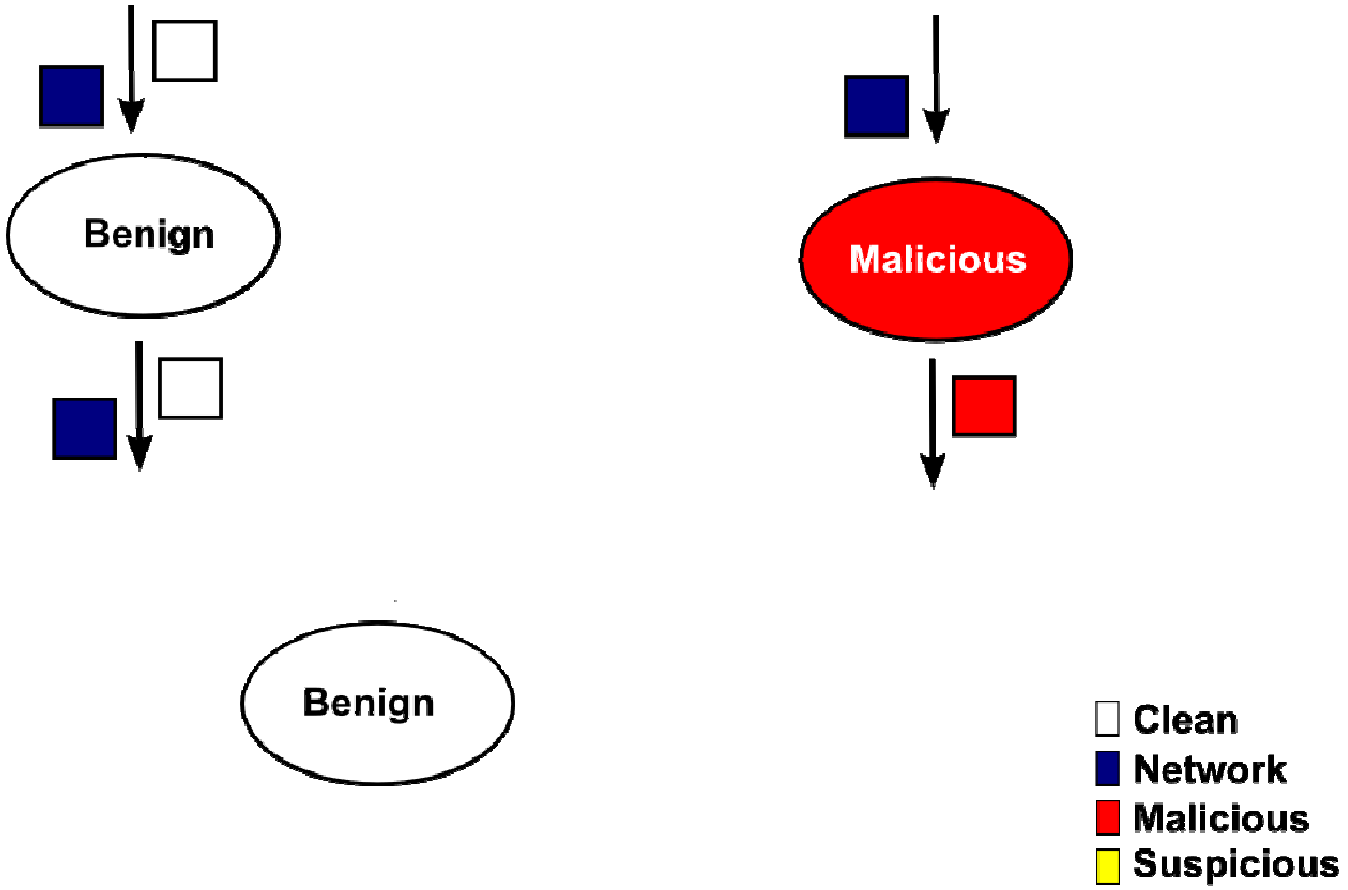

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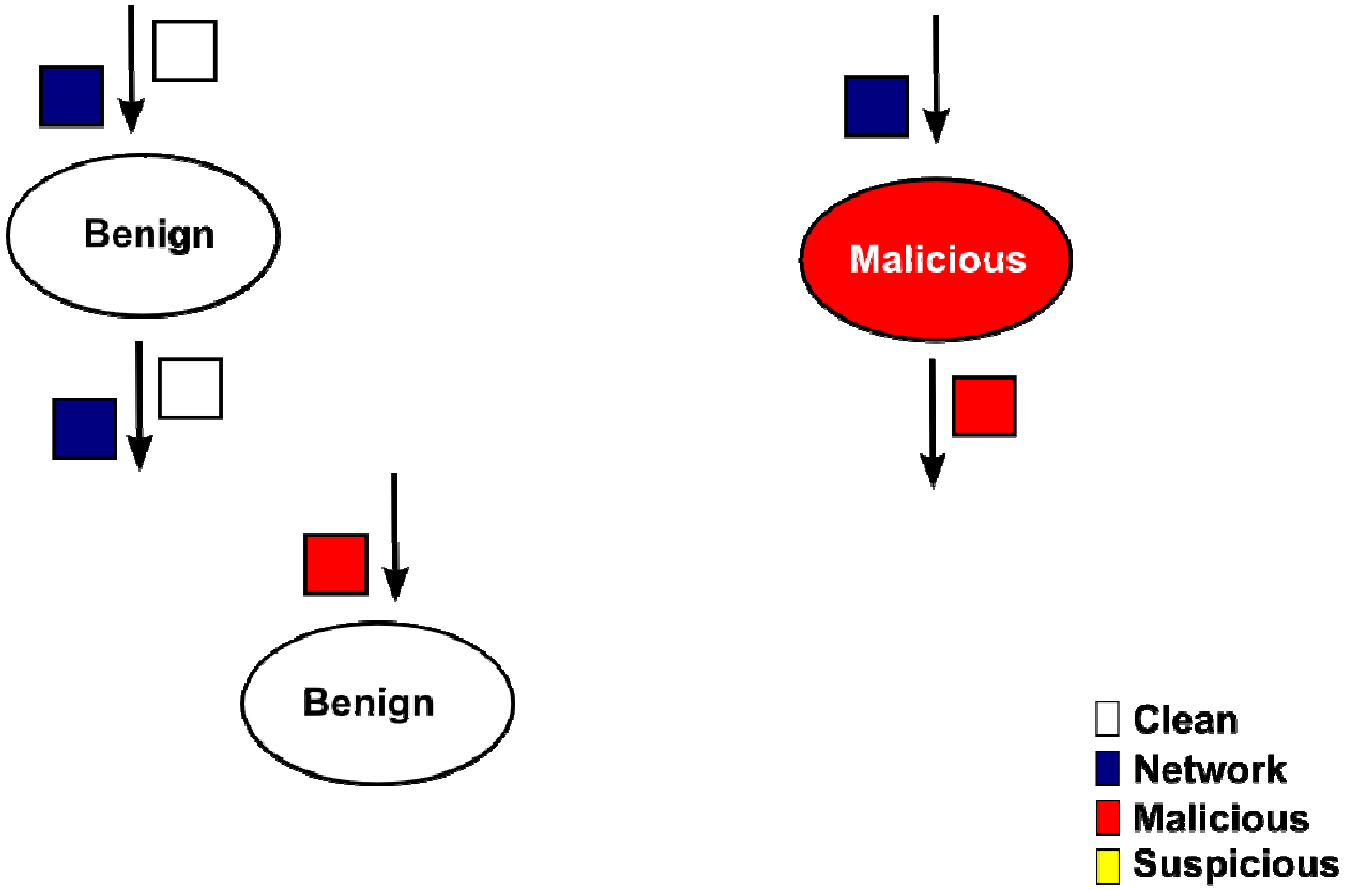

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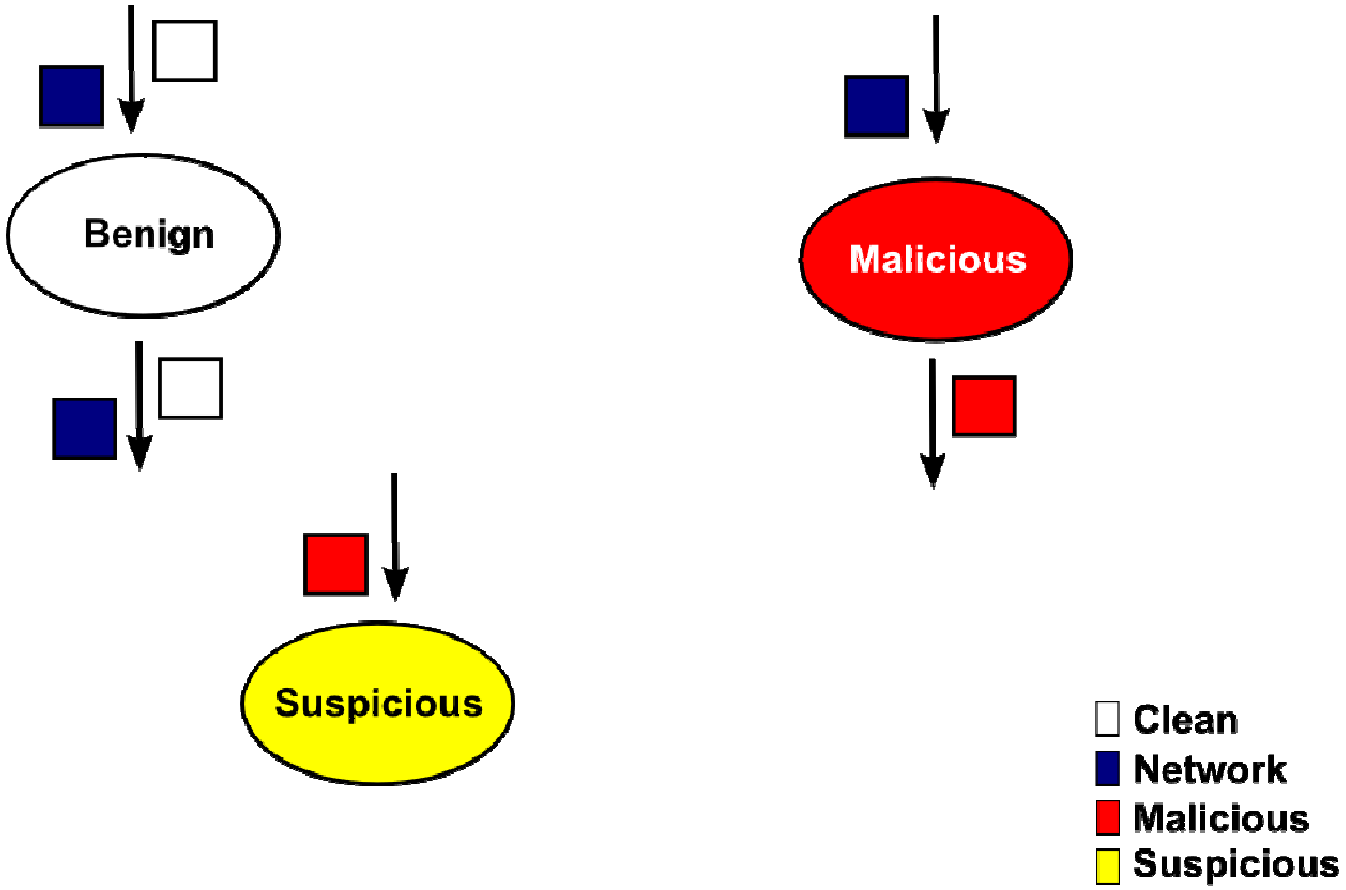

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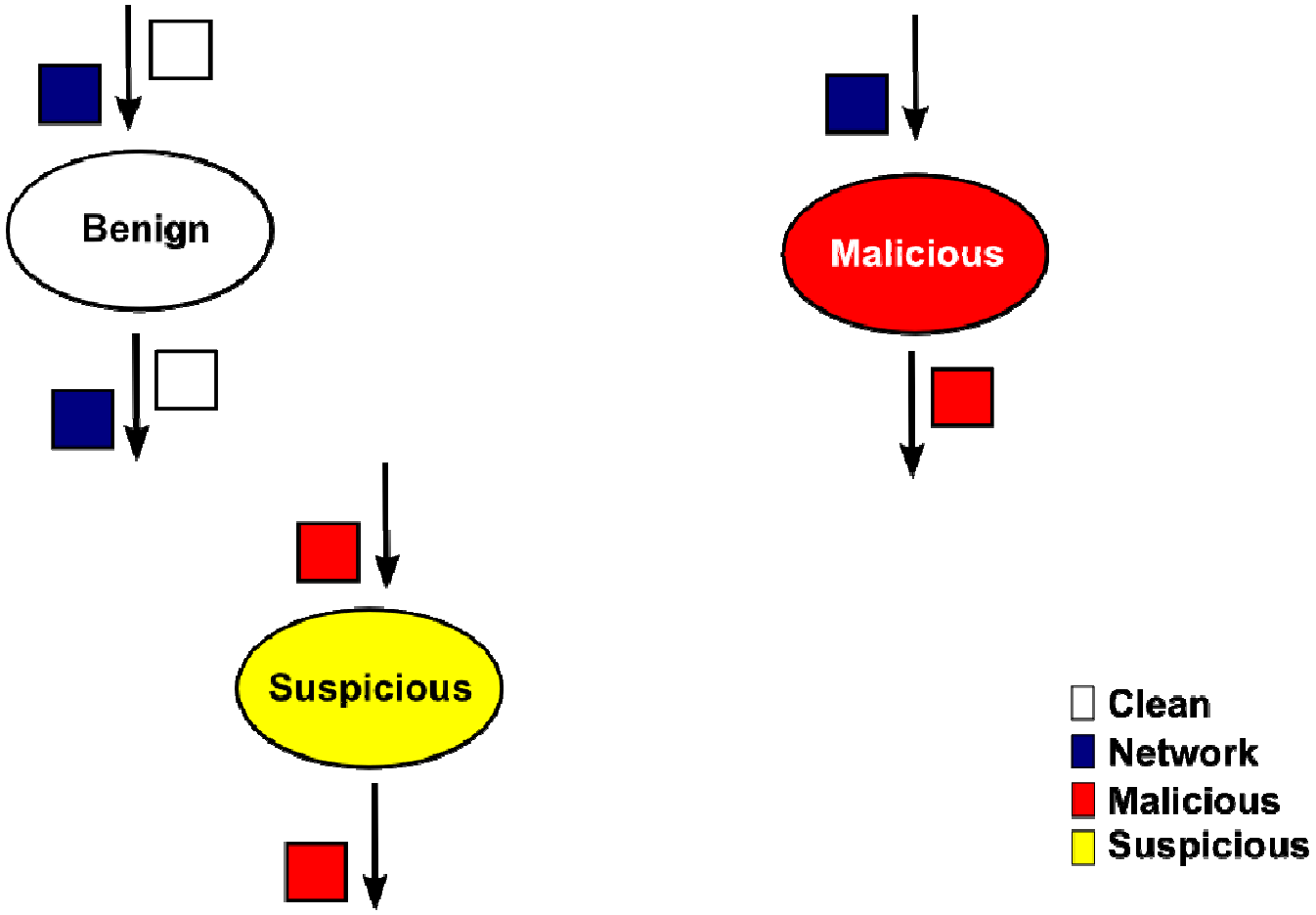

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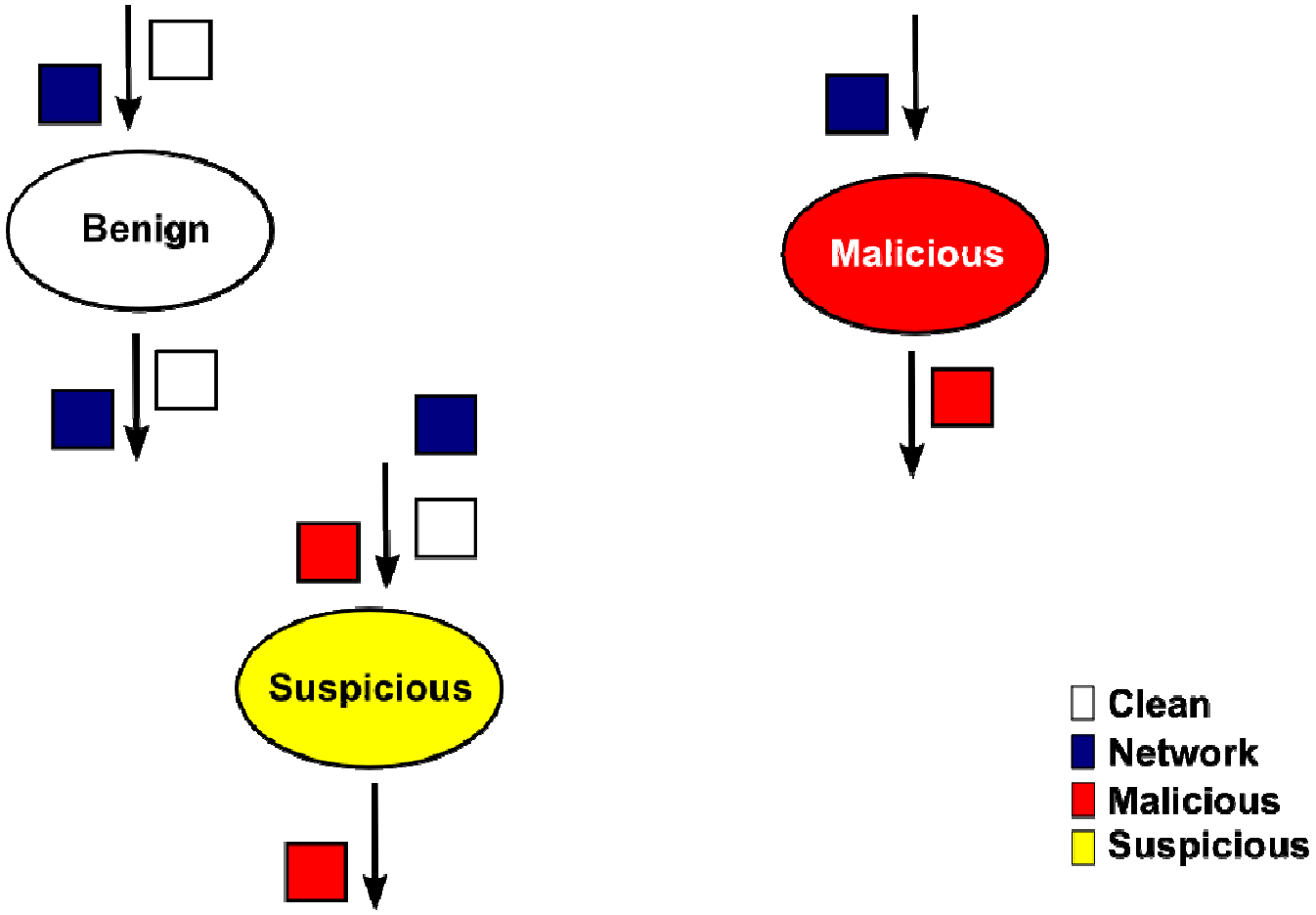

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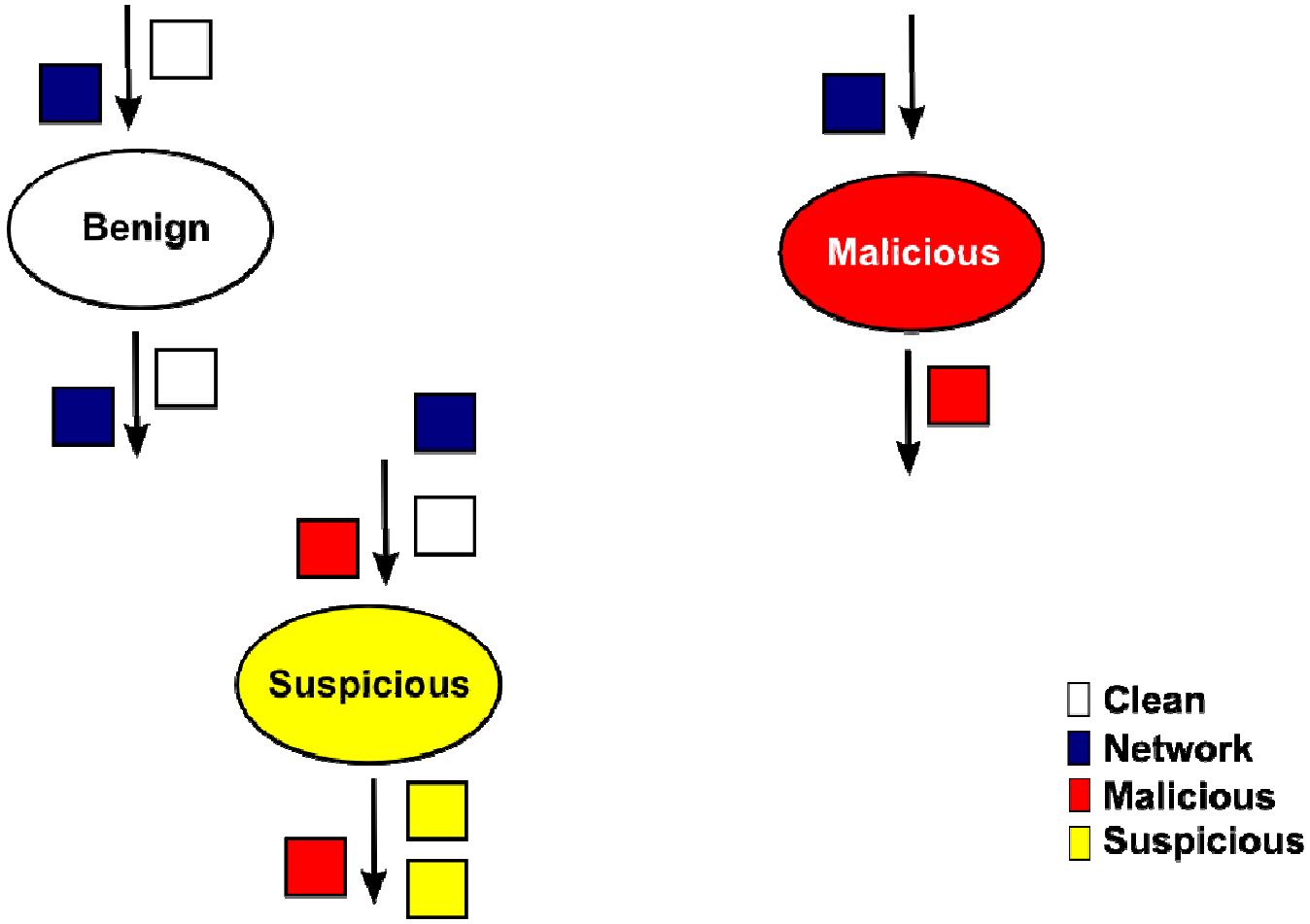


Recovery

- Rollback to the initial intrusion moment.

  - DTA: a process control flow is modified.

  - AV: first write operation which contains a signature.

- Using the analysis logs recover only the benign data.

Evaluation

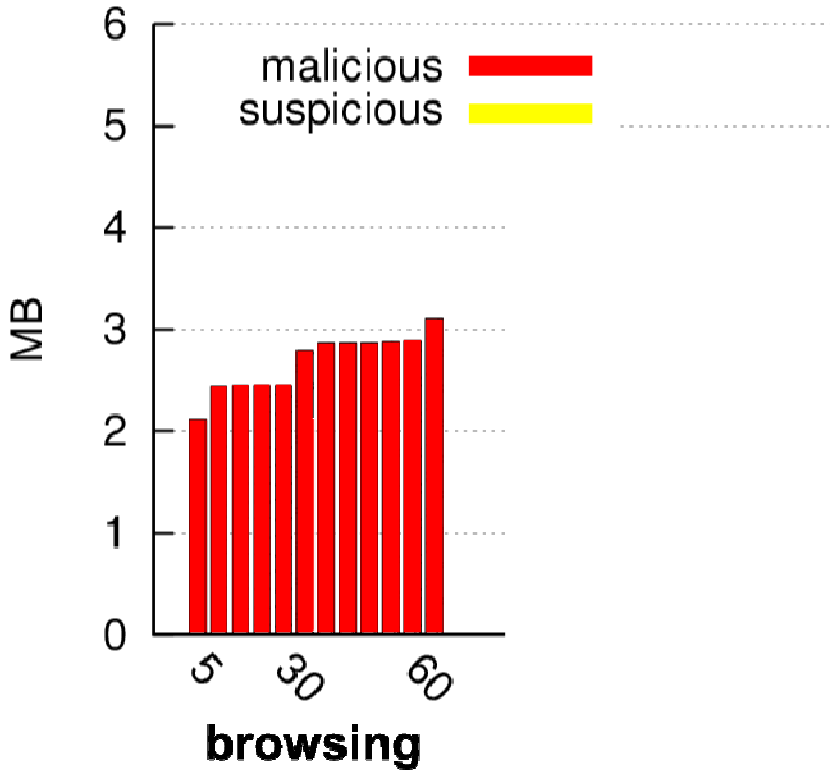
- Simple attack

  - replaced binaries: IE, FoxIT PDF Reader, Paint
  - detected after 1 hour

- Real world attack

  - Sality
  - detected after 3 days

Simple attack taint spread



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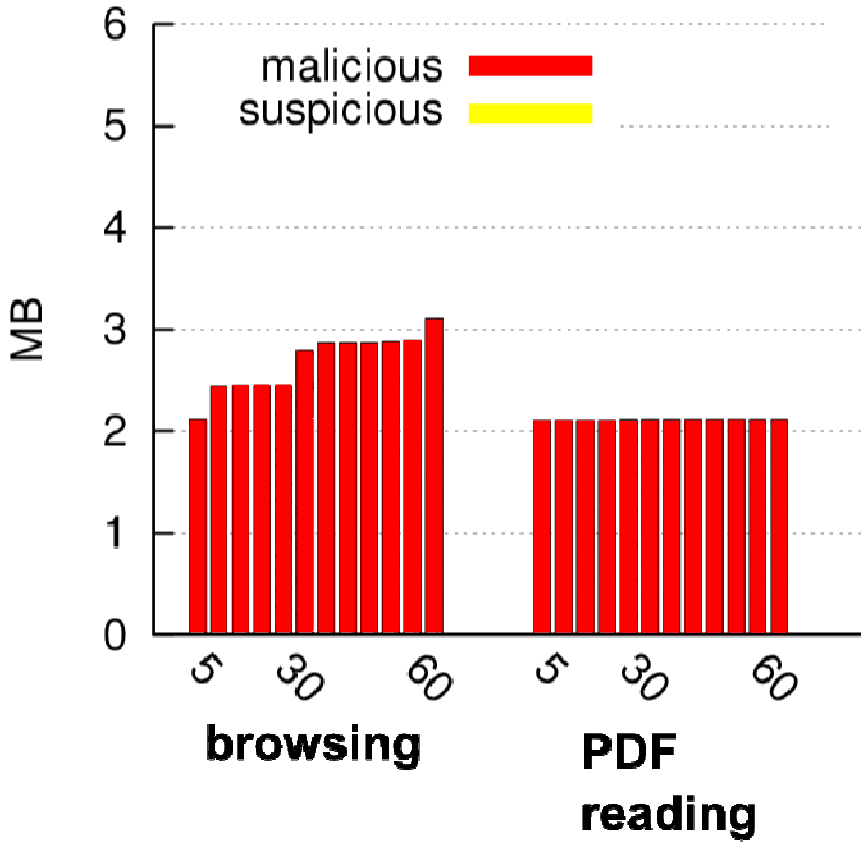

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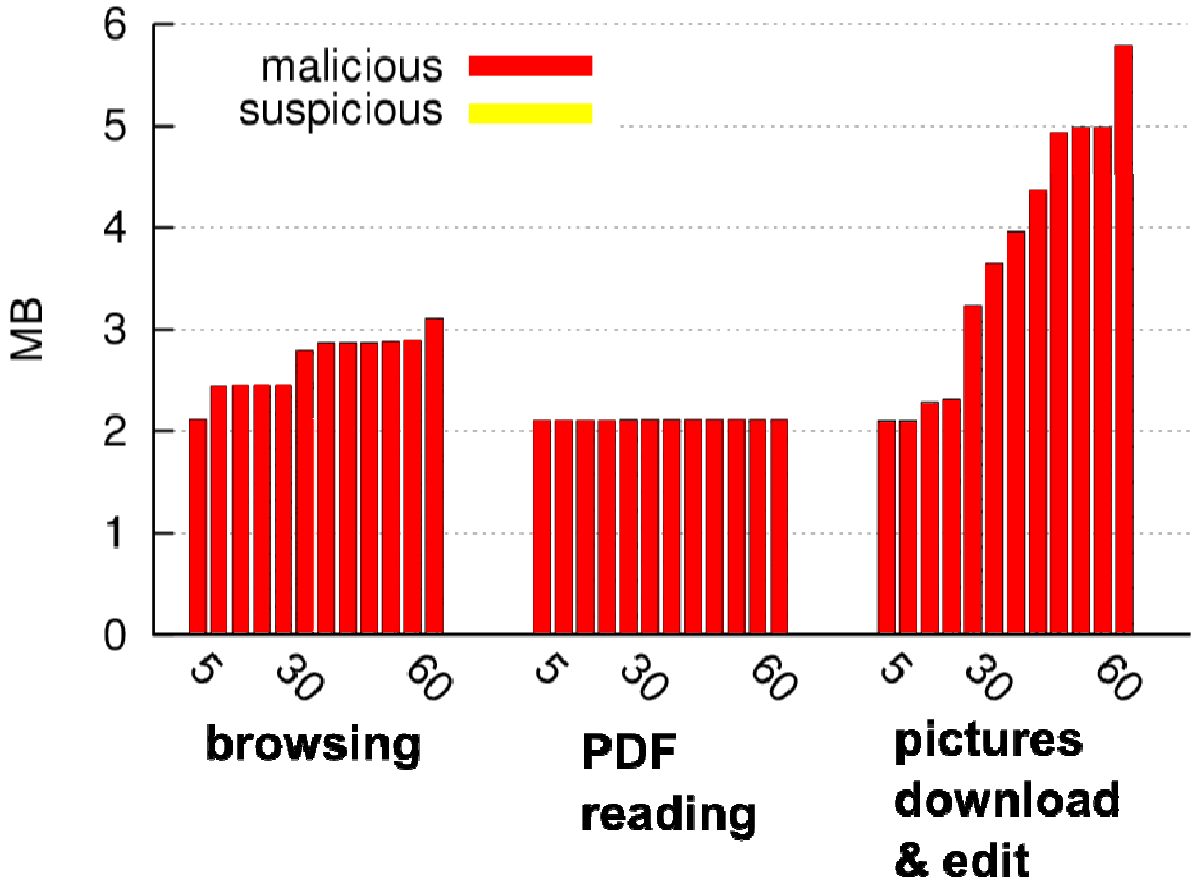
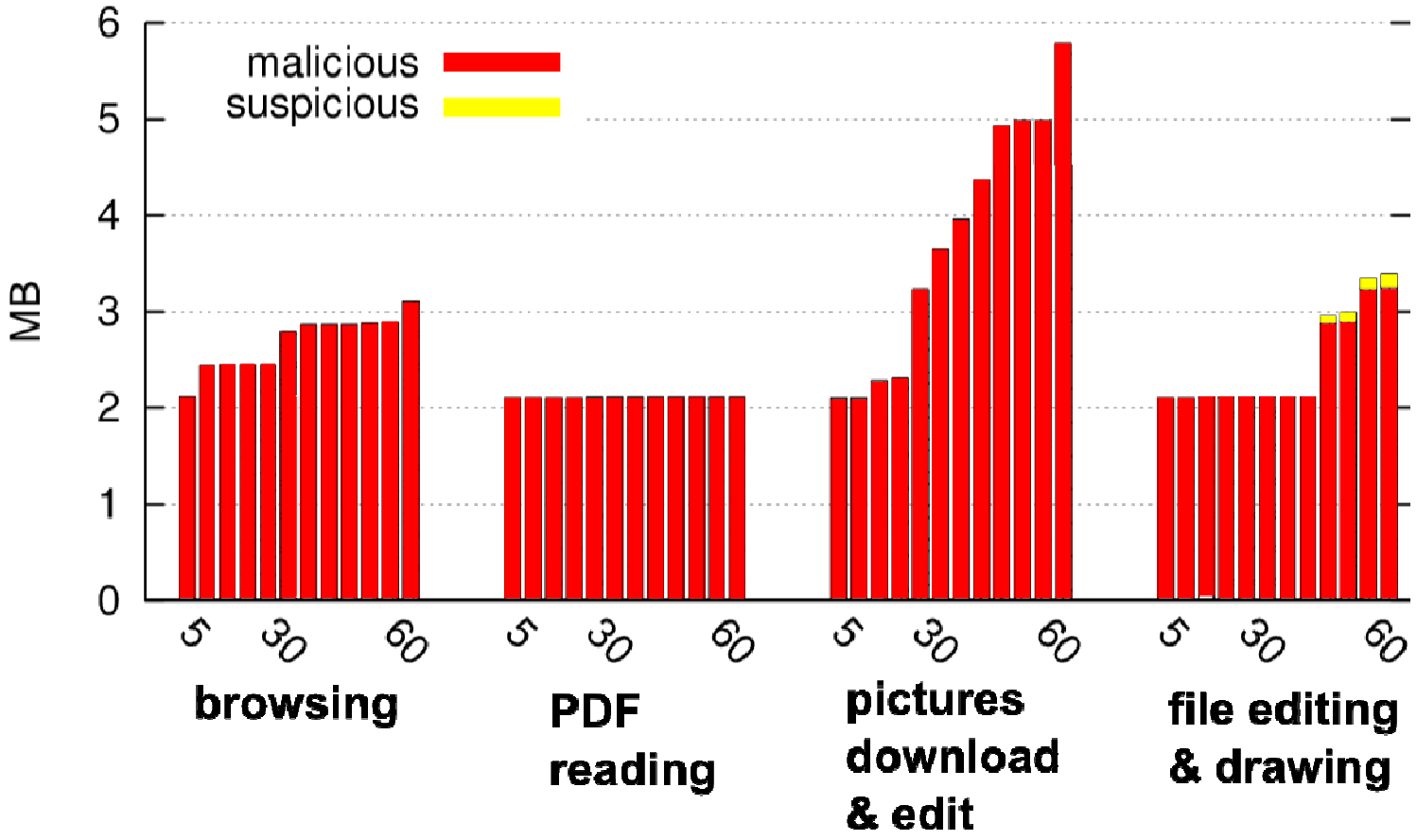
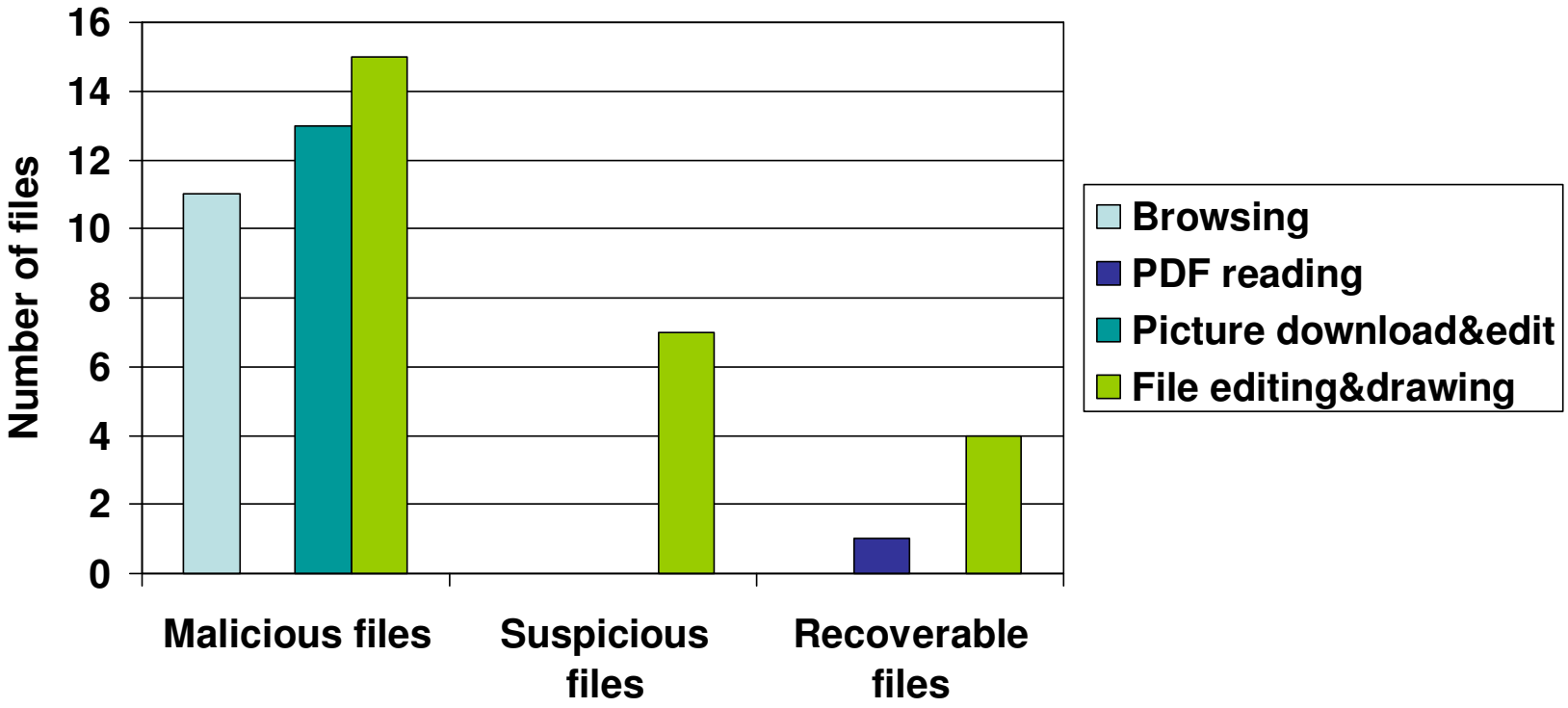


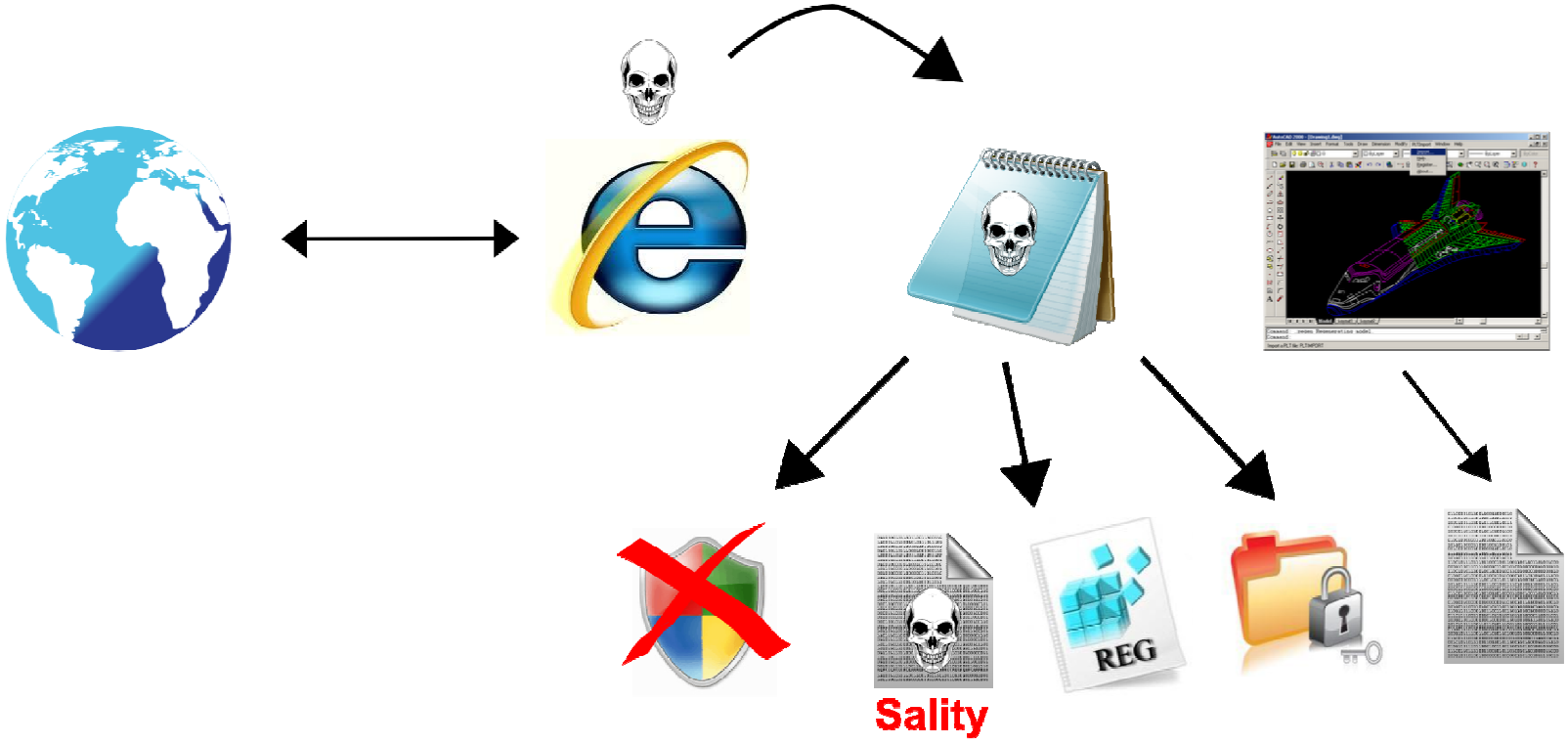
Simple attack taint spread on disk



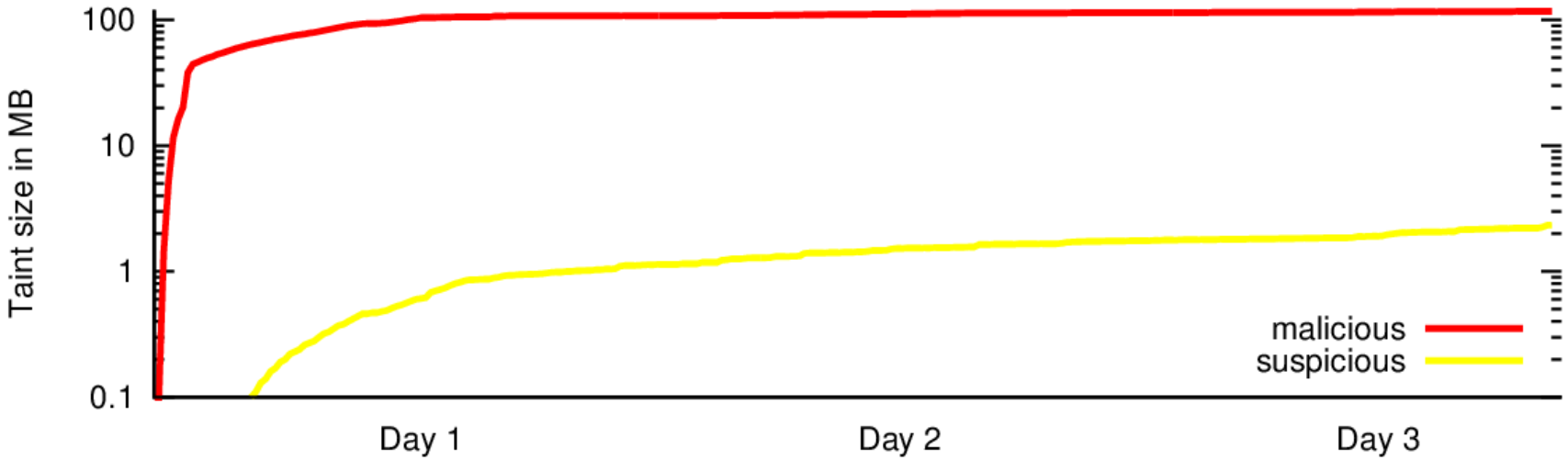
Simple attack recovery



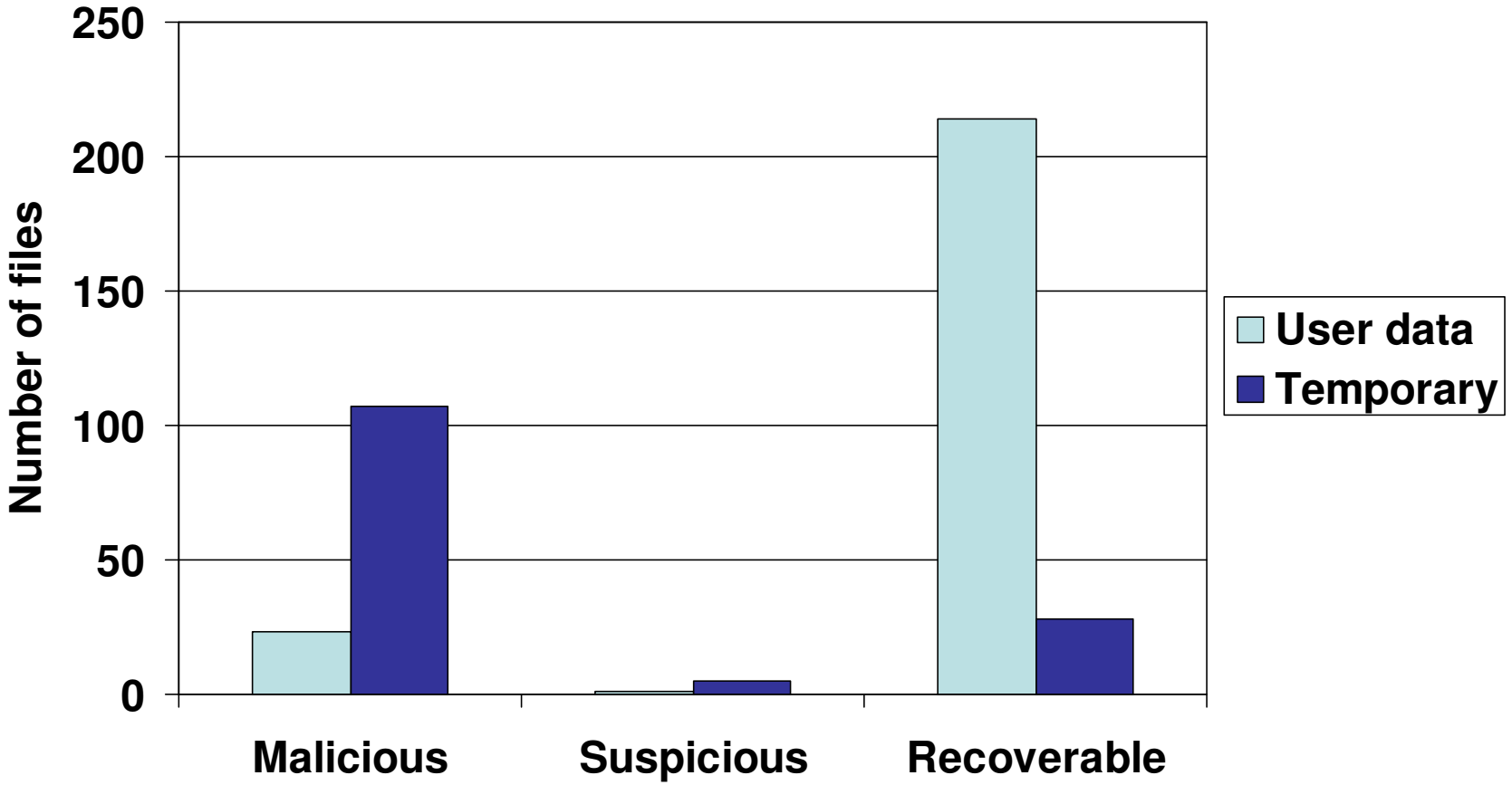
Attack: Sality/Win32



Sality/Win32 taint spread on disk



Sality/Win32 recovery



Conclusions

- Recover from complicated attacks to the state before the attack.
- Analyze the actions of malicious code and classify the bytes on the physical drive.
- Restore files up to the attack and recover the benign files edited or created after the attack.

Sality/Win32