Project PCAS at a glance

- 2013-16
- Funded by the European Commission, FP7
- Consortium:

1	INESC ID - INSTITUTO DE ENGENHARIA DE SISTEMAS E COMPUTADORES, INVESTIGACAO E DESENVOLVIMENTO EM LISBOA	INESC ID - INSTITUTO	Portugal
2	מ"עב שדח קפוא ס"וא	OS	Israel
3	UNIVERSIDAD POLITECNICA DE MADRID	UPM	Spain
4	NORSK REGNESENTRAL STIFTELSE	NORSK REGNESENTRAL S	Norway
5	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	CEA	France
6	MAXDATA-INFORMATICA LDA	Maxdata	Portugal
7	AFCON CONTROL & AUTOMATION LTD	AFCON CONTROL & AUTO	Israel

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Schedule

1. Secured Personal Device
2. Shuttle: cloud intrusion recovery

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1. SECURED PERSONAL DEVICE

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Motivation: smartphones

- Smartphones are convenient to store personal data & authentication
- but security is weak and storage capacity is limited

Secured Personal Device (SPD)

- The Secured Personal Device is the main outcome of PCAS
  - a smartphone add-on (or “sleeve”)
  - recognizes the user using biometric sensors
  - high storage capacity
  - physically isolated from smartphone (except USB conn.)
- Use:
  - allows users to authenticate themselves
  - allows users to securely store data

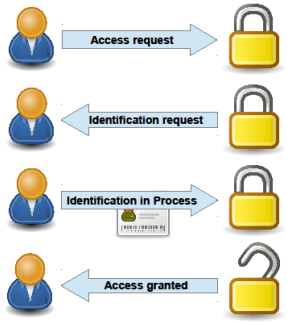
SPD sketches

Role of the smartphone

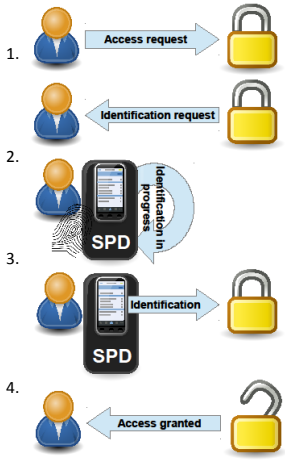
- SPD has to communicate with trusted (cloud) services
- Smartphone provides the SPD:
  - communications (e.g. Internet connection)
  - a user interface

Access control with SPD/biometrics

usual scheme



with SPD/biometrics



Scenarios

- Electronic health
  - SPD used for storing lifelong health information (exams...)
  - SPD as access point to Electronic Health Record (EHR)
  - Supports normal use (visit to doctor, surgery) and emergency
- University campus
  - SPD used for (physical) access control and
  - authentication into campus services (canteen, library, web site,...)

2. SHUTTLE: CLOUD INTRUSION RECOVERY

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Shuttle's objective

- Recover PaaS applications' state integrity when there are intrusions

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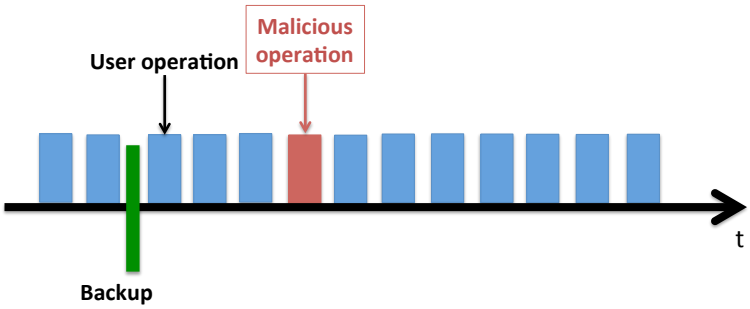
Backups?



- Works but removes both bad and good operations
- Shuttle: removes bad (tainted) operations but keeps good operations

Platform as a Service (PaaS)

- Cloud service = to run applications
- Consumer develops application to run in that environment, using
  - Supported languages, e.g., Java, Python, Go, PHP
  - Supported components, e.g., SQL/noSQL databases, load balancers

Shuttle intrusion recovery service

- Features:
  - Supported by the cloud: available without setup
  - Removes the intrusion effects in the applications' state
  - Supports applications deployed in various instances
  - Avoids application downtime
  - Cost effective
  - Recovers fast

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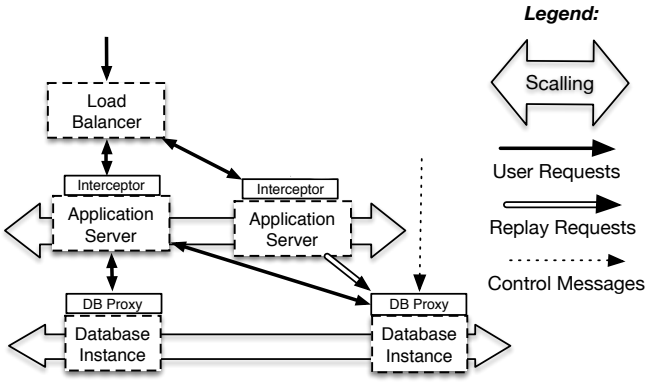
Shuttle architecture

User requests



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Replay Process

1. Identify the malicious operations (not part of Shuttle)
2. Start new application and database instances
3. Load a snapshot previous to intrusion instant
   Create a new branch; keeps the application running in previous branch
4. Replay requests in new branch
5. Block incoming requests; replay last requests
6. Change to new branch; shutdown unnecessary instances

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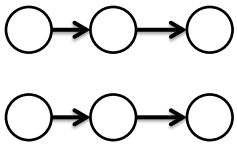
Replay Modes

- **Full-Replay:** Replay every operation after snapshot
- **Selective-Replay:** Replay only affected (tainted) operations

- **Serial:** Replay all dependency graph sequentially
- **Clustered:** Independent clusters can be replayed concurrently



	Full-Replay	Selective-Replay
1 Cluster (Serial)	✔	✔
Clustered	✔	✗

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Evaluation Environment

- Amazon EC2, c3.xlarge instances, Gb Ethernet
- WildFly (formely JBoss) application servers
- Voldemort database
- Ask Q&A application; data from Stack Exchange

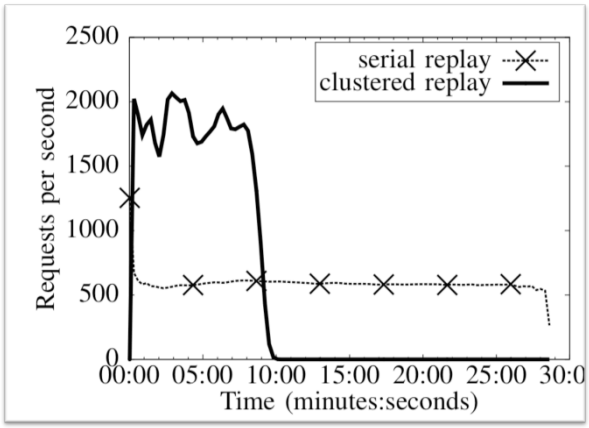
Performance overhead evaluation

- in normal execution

	Workload A	Workload B
Shuttle	6325 ops/sec [5.78 ms]	15346 ops/sec [3.62 ms]
No Shuttle	7148 ops/sec [5.07 ms]	17821 ops/sec [3.01 ms]
overhead	13% [14%]	16% [20%]

Recovery time

- for 1 million requests



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CONCLUSION

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Conclusion

- Intrusions may happen in mobile devices
  - SPD, a novel device for authentication and data protection
  - Data physically isolated, protected with biometrics
- Intrusions may happen in the cloud
  - Shuttle, a recovery service for PaaS offerings
  - Leverages the resource elasticity and pay-per-use model to reduce the recovery time and costs

THANK YOU

HTTPS://WWW.PCAS-PROJECT.EU

HTTPS://GITHUB.COM/DNASCIMENTO/SHUTTLE