# Self-Adaptive Security Systems

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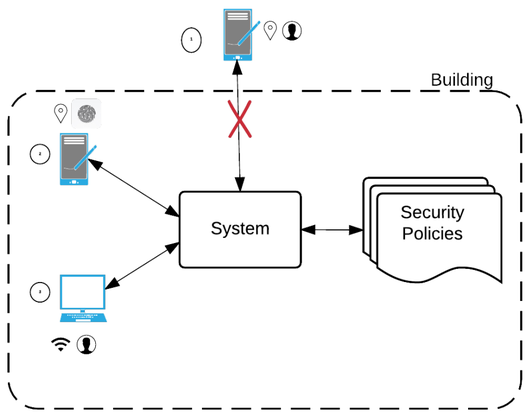
## Motivational Example




User must be
1. in building &
2. Authenticated

to Access files

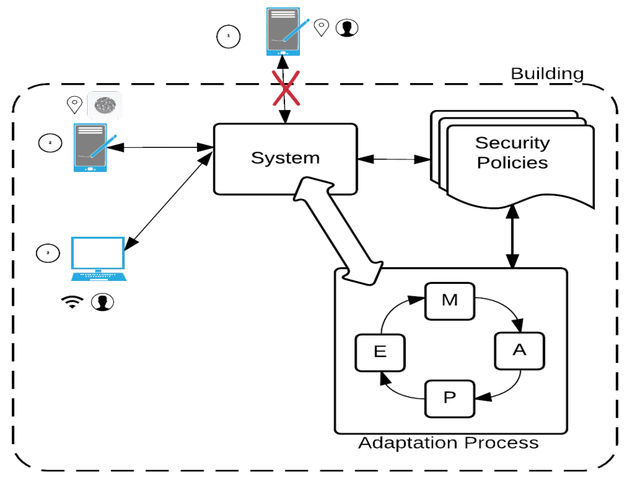
Access depends on the **context**. For example in the figure above :

1. Access Denied - from GPS, the user is not in the building
2. Access Allowed - location and identity are verified through GPS & fingerprint functionalities in the phone
3. Access Allowed - location and identity are verified through the IP Address and credentials.

Policy Enforcement needs to adapt to Context changes at runtime

## Self-Adaptive Security Systems (SASS)

SASS is a prominent approach to address some of the limitations of traditional security systems. SASS can adjust itself to changes during runtime without human intervention [1]. A popular adaptation framework is the **MAPE-K Feedback loop** [2]:




- ❏ Monitor - The Adaptation System ***monitors the system*** to detect change
- ❏ Analyse - through ***look-ahead heuristics*** determine ***pro-actively*** whether a future violation is possible
- ❏ Plan - find action plan to avoid future violations
- ❏ Execute - apply the action plan to the system

SASS address policy Enforcement in Evolving Systems

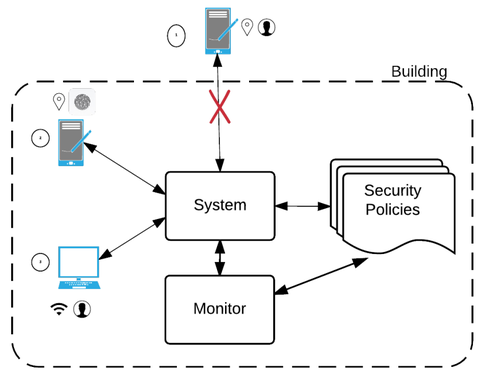
## Research Questions

- ❏ When is an SASS **correct**? Can we break down correctness to each sub-system?
  - ❏ For the Monitor phase, it may imply that every change is detectable.
  - ❏ For the Analysis, it may mean that all potential violations in the next *k*-steps are discovered
  - ❏ For Planning, it may mean that planned actions indeed guard against all violations
  - ❏ For Execution, it may mean that planning is implemented faithfully
- ❏ What **verification techniques** are suitable for SASS?
  - ❏ We envisage a combination of Static Analysis, Model Checking and Runtime Monitoring for different phases
- ❏ How can we tackle **complexity** of verifying SASS Systems?
  - ❏ Is the approach modular?

We need the right formal model of SASS to be able to verify correctness effectively

## Approach

A popular approach for modelling standard security systems is runtime-monitoring [3]:




- ❏ Violations are detected by looking at the ***history***
- ❏ Countermeasures include suppressing operation or imposing alternative sequence of operations
- ❏ Similar to SASS except SASS takes into account the context

How can we extend these to model SASS? Will they be useful for modular verification?

### References

1. Salehie, M. et al. "Self-adaptive software: Landscape and research challenges." *ACM Transactions on Autonomous and Adaptive Systems (TAAS) 2009.*
2. Pasquale, L. et al. "Topology aware adaptive security." *in Proc. of the 9th International Symposium on Software Engineering for Adaptive and Self-Managing Systems 2014*
3. Bauer, L. et al. "More enforceable security policies." *in Proc. of the Workshop on Foundations of Computer Security (FCS)* 2002.

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