An Approach to Automatically Detect Problems in Restructured Deployment Models based on Formalizing Architecture and Design Patterns

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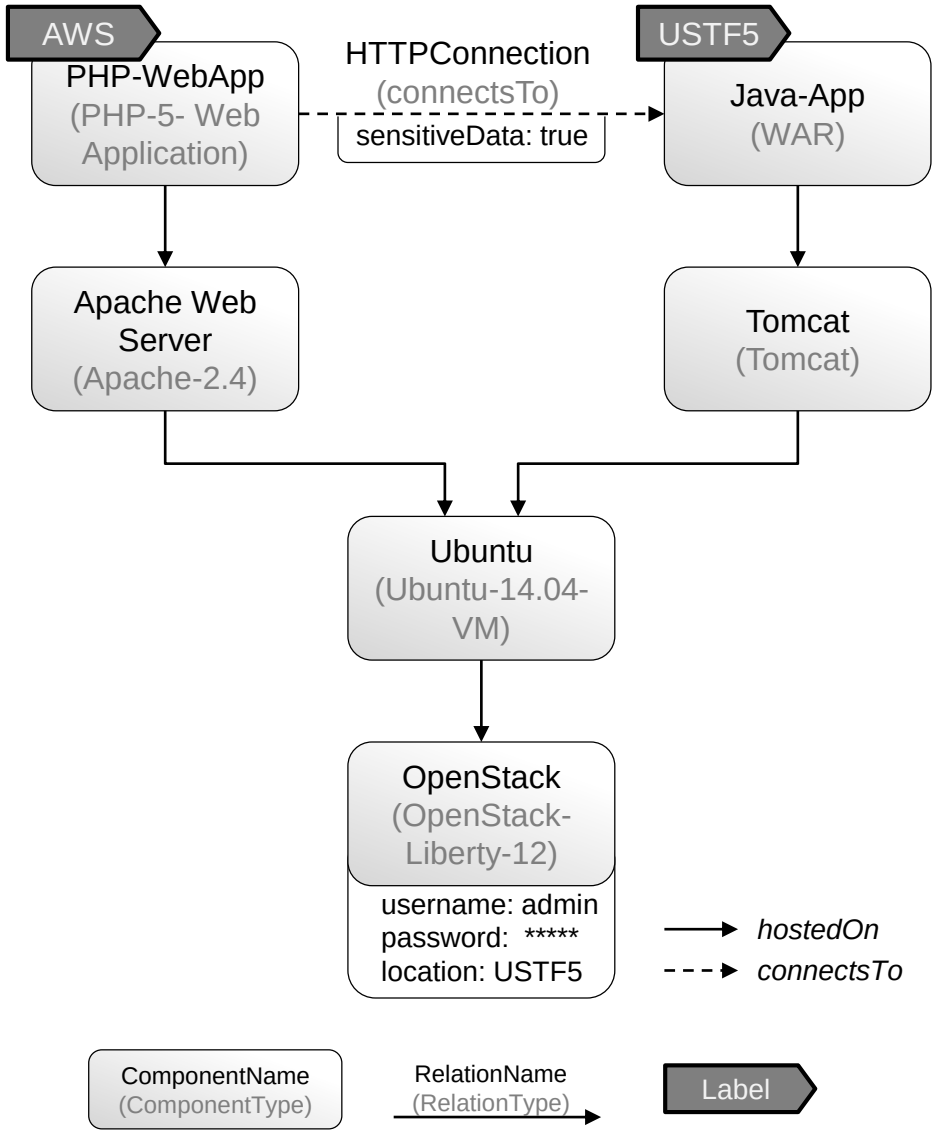
Outline

- Motivation
- Appyling Architecture & Design Knowledge to Deployment Models
- Automated Problem Detection by Formalized Patterns
- Application & Conclusion

Motivation

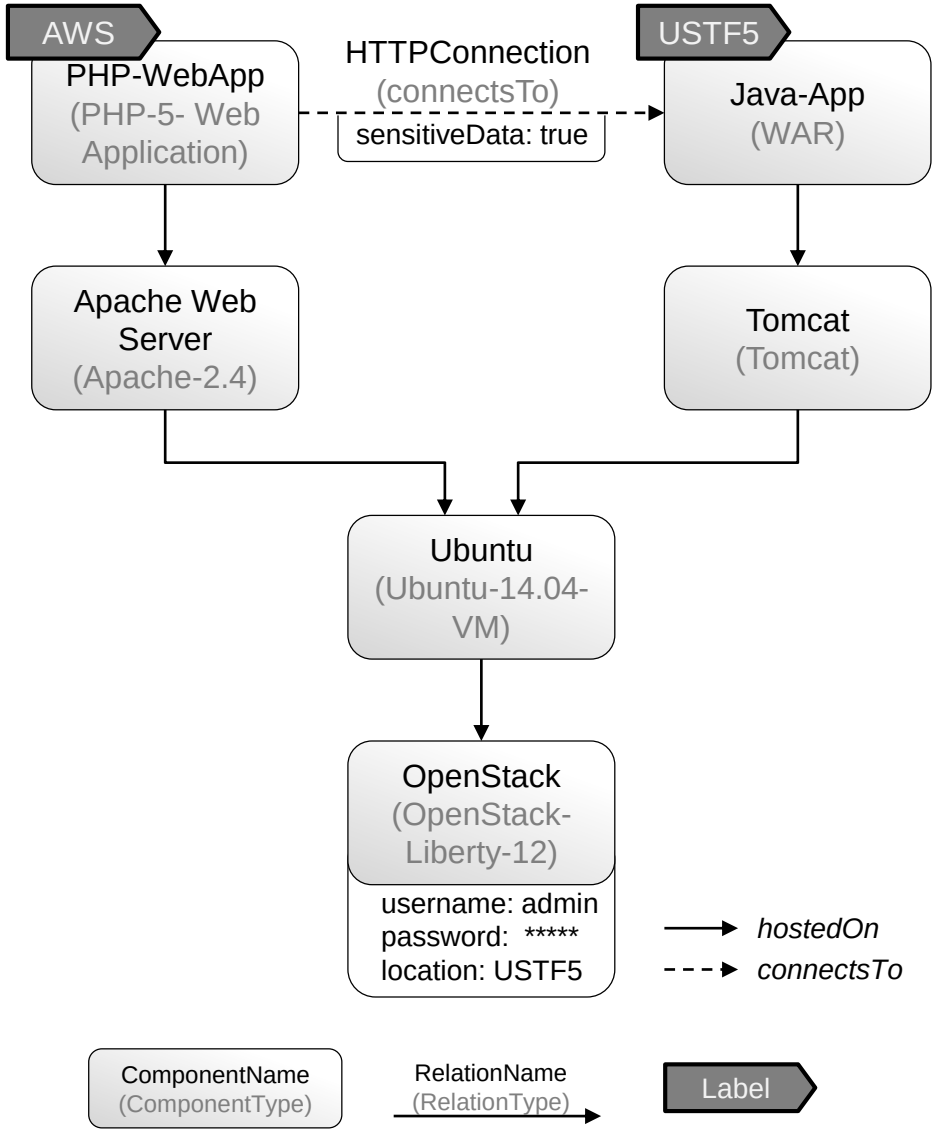
What is a restructured deployment model?

- Deployment Model => Topology-based Deployment Model
- Topology describing the structure of an application for the deployment:
  - Components
  - Relations
  - [Component/Relation] Types
  - Properties
- **Restructuring** means that the components are redistributed across different target locations
- How to model the desired restructuring? → Target Labels*



*K. Saatkamp, U. Breitenbücher, O. Kopp, F. Leymann (2017) Topology Splitting and Matching for Multi-Cloud Deployments. In: CLOSER 2017, pp 247-258

What is a restructured deployment model?



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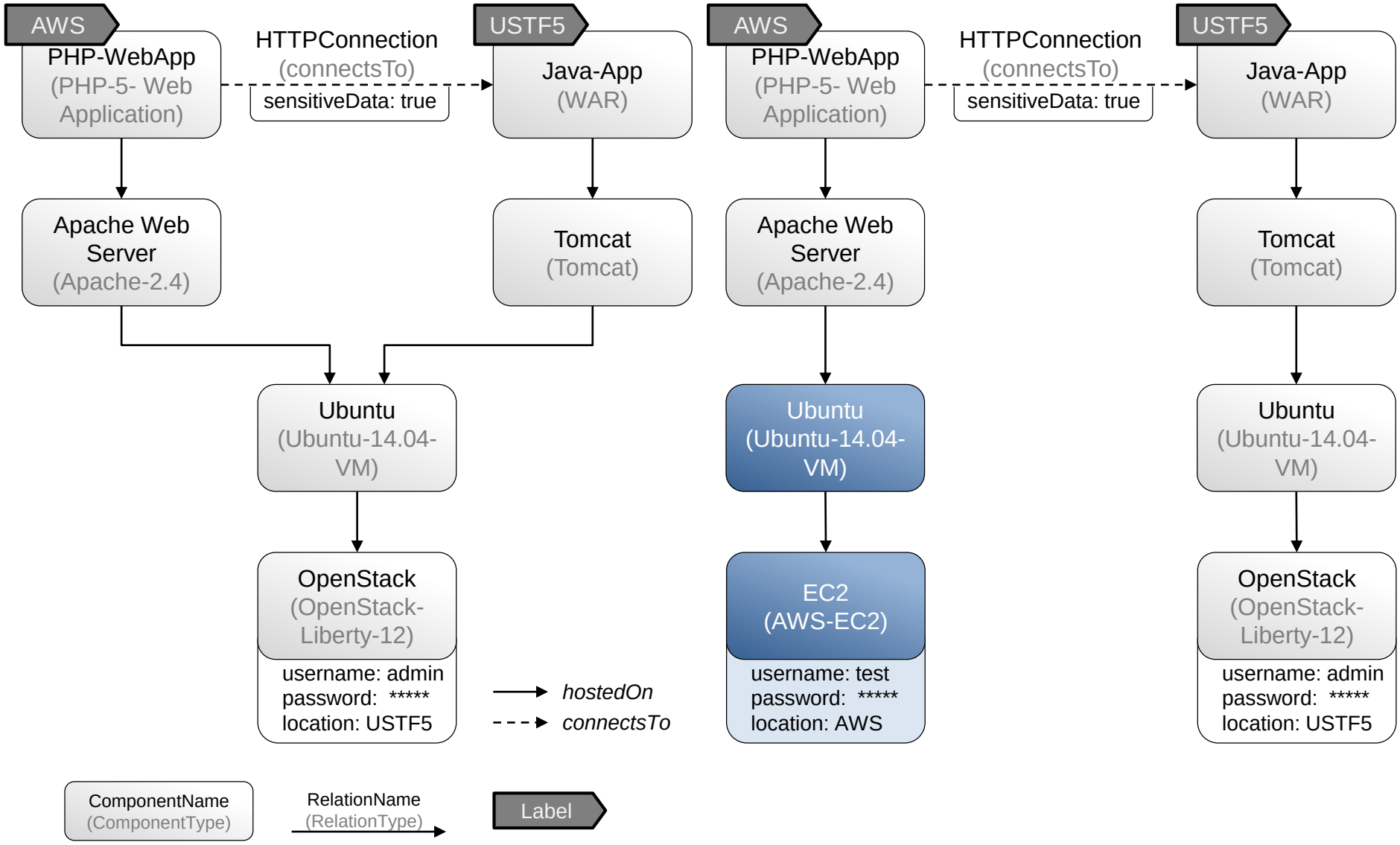
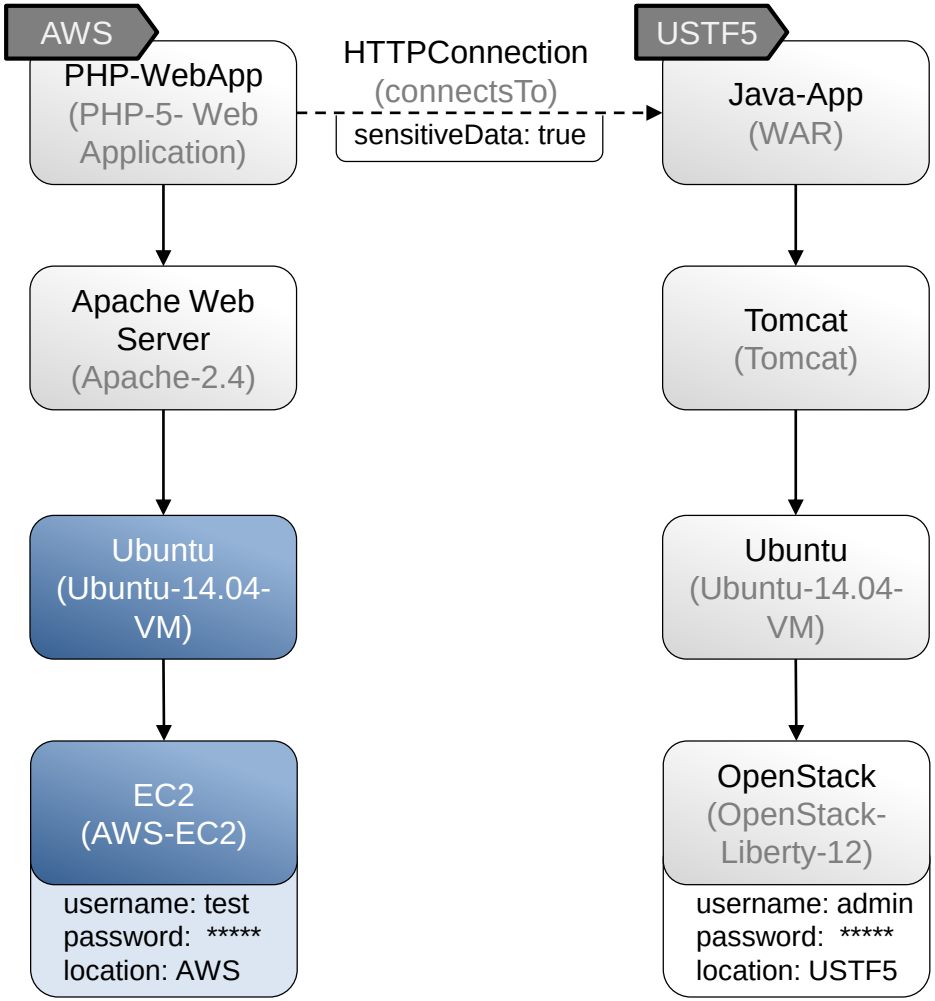


What are the consequences of a restructuring?

- Components formally hosted on the same host are located in different cloud environments
- The communication tel
  betwee
- [illegible] data are
  [illegible]xchanged over a public network
- Further consequences could be:
  - Firewalls
  - Different Communication Infrastructure
  - External Data Access
  - ...

Do we have a problem?



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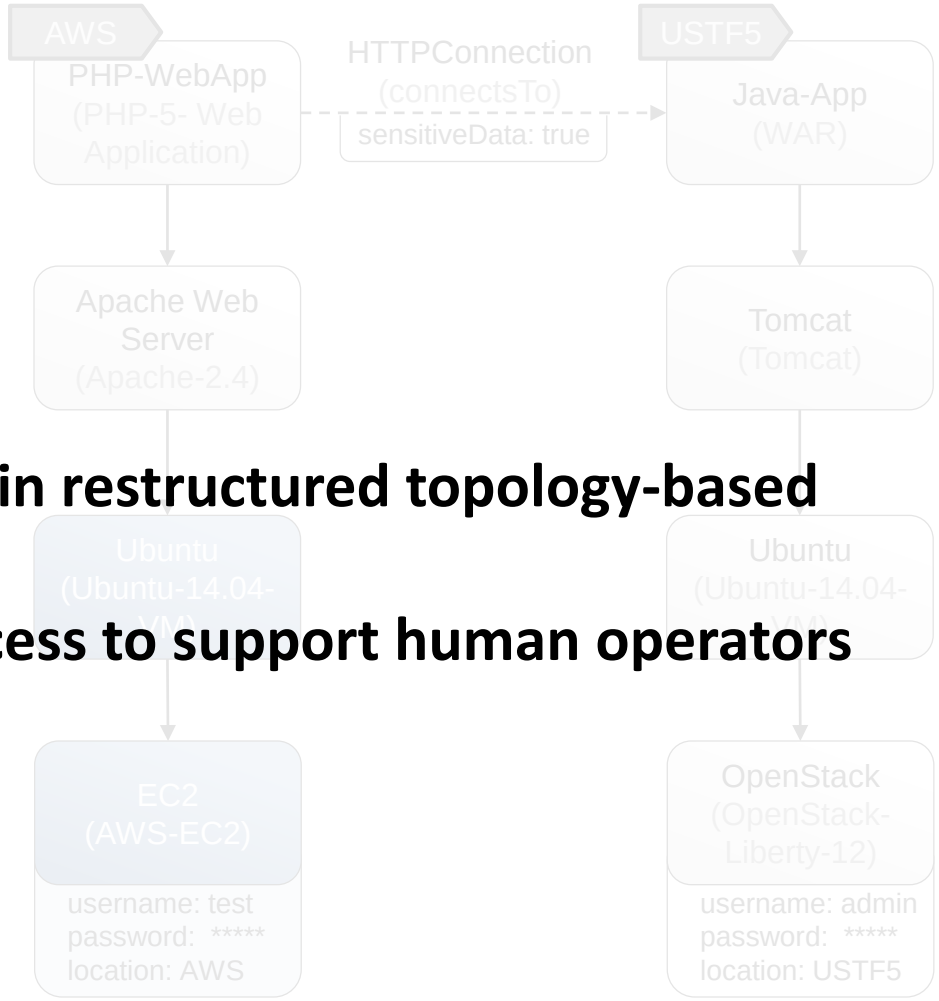


Thus, we want to …

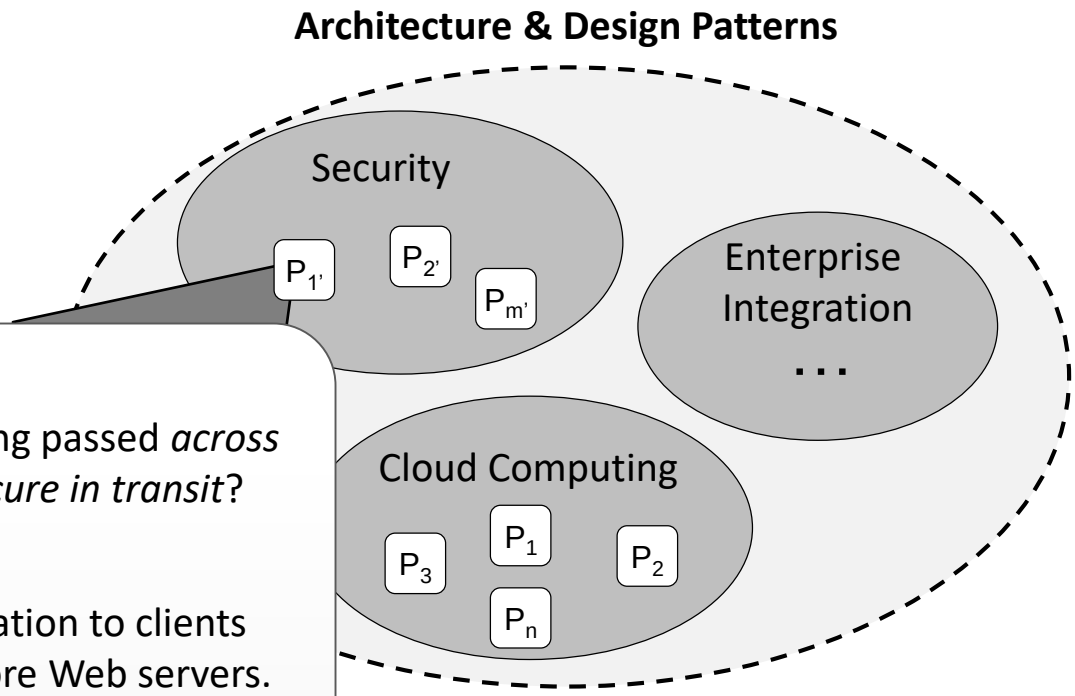
(i) Enable the problem detection in restructured topology-based deployment models and
(ii) Automated this detection process to support human operators

- Further consequences could be:
  - Firewalls
  - Different Communication Infrastructure
  - External Data Access
  - …

Applying Architecture & Design Knowledge to Deployment Models

Architecture & Design Knowledge as Patterns

- Patterns describe design & architectural knowledge as **best practices for recurring problems**



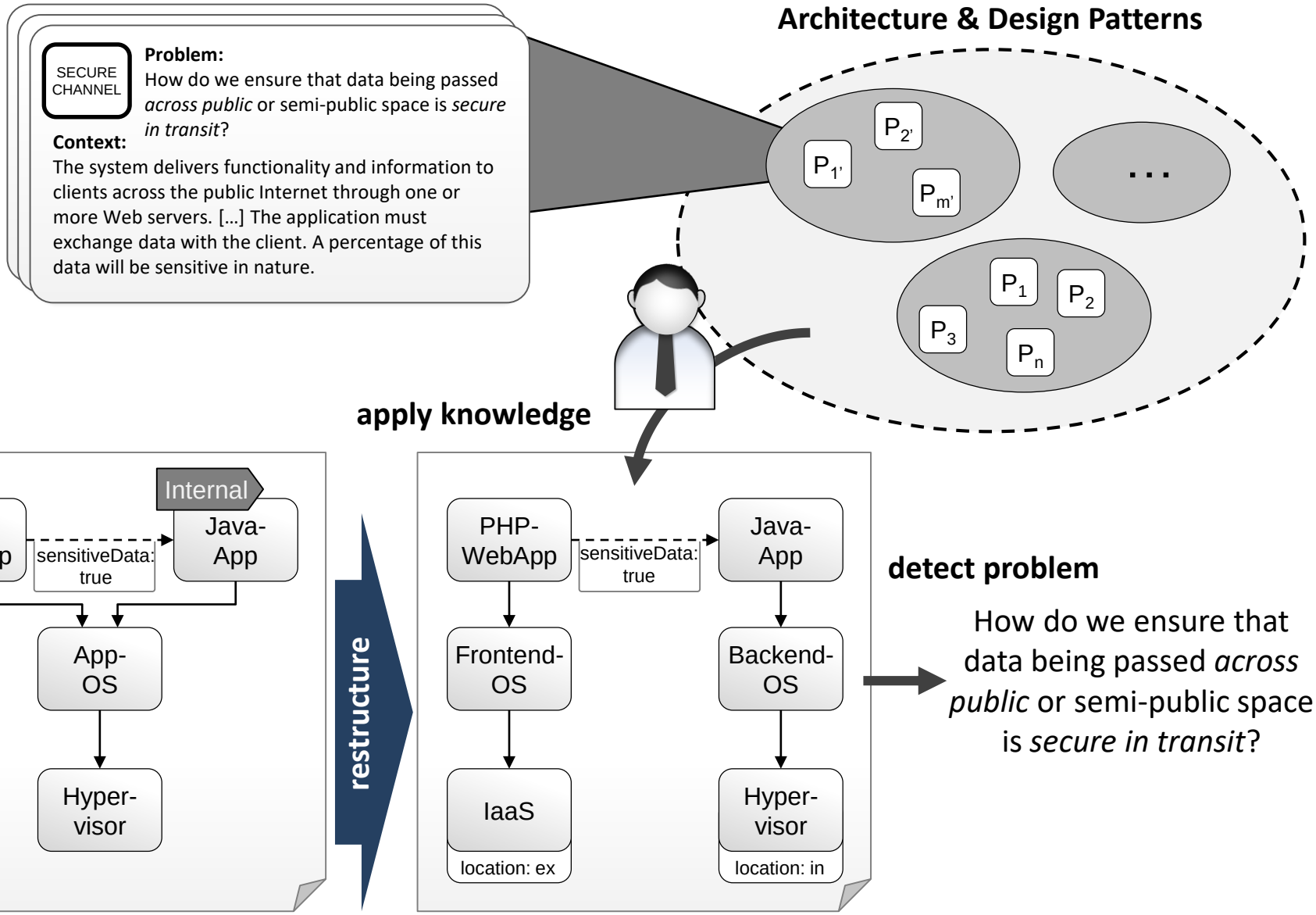
SECURE CHANNEL

Problem:
How do we ensure that data being passed *across public* or semi-public space is *secure in transit*?

Context:
The system delivers functionality and information to clients across the public Internet through one or more Web servers. […] The application must exchange data with the client. A percentage of this data will be sensitive in nature.

Solution: Create secure channels for sensitive data that obscure the data in transit. Exchange information between client and server to allow them to set up encrypted communication between themselves.[…]

Problem Detection Approach



Automated Problem Detection by Formalized Patterns

Pattern Formalization based on Logic Programming

- **Logic Programming:** domain knowledge can be expressed as **facts** and **rules** and it can be checked whether a fact satisfies the conditions of a rule.
  - **Facts** describe specific circumstances, i.e., objects and their relationships.
  - **Rules** simplify querying the facts
- Approach based on the widely used logic programming language **Prolog**

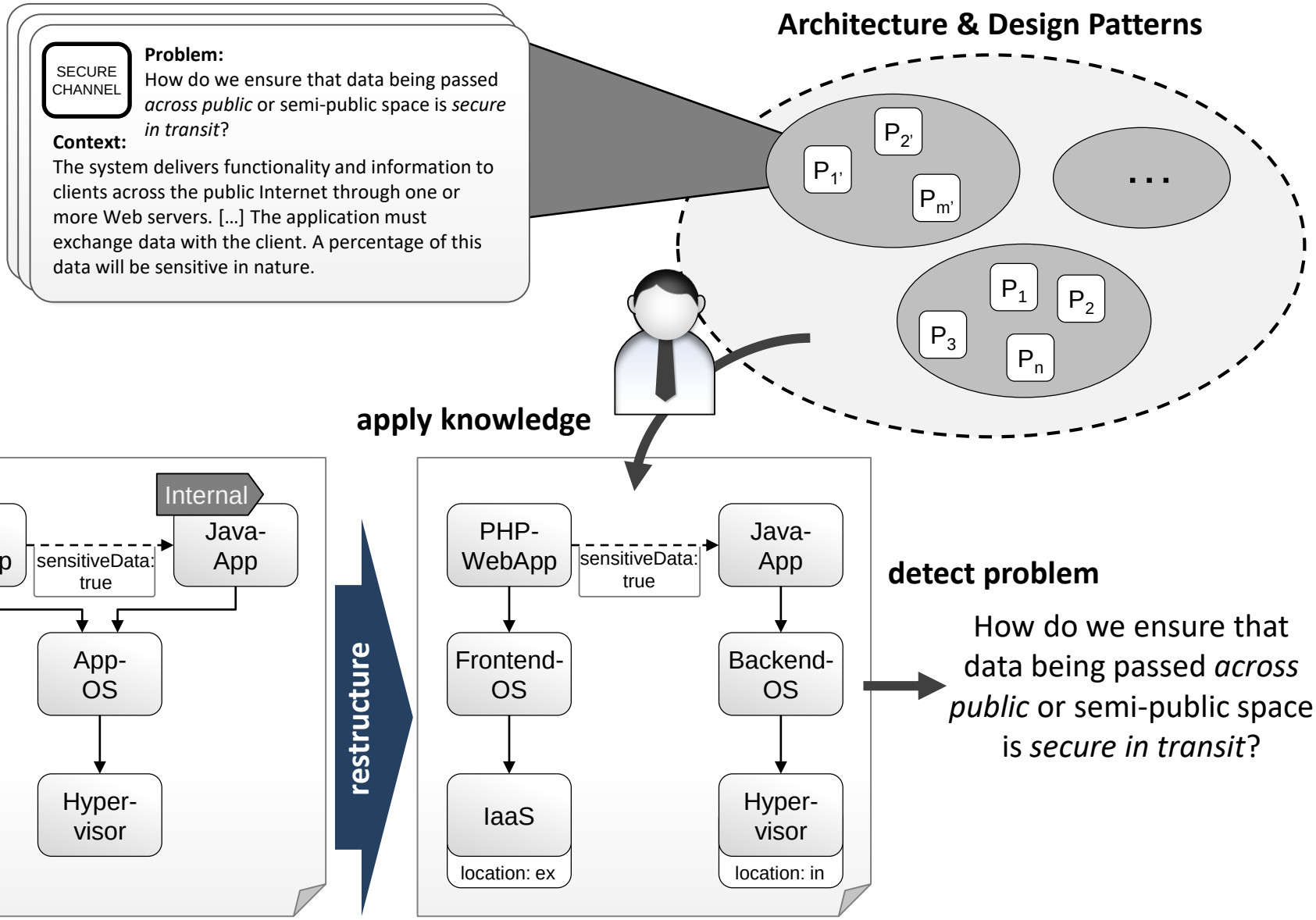
```
father(ben,john).
male(ben).
male(john).
```

```
son(X,Y) :-
  father(Y,X),
  male(Y),
  male(X).
```

Is John the son of Ben? → YES

Do objects exists for which son(X,Y) is fulfilled? → X= john, Y= ben

Problem Detection Approach



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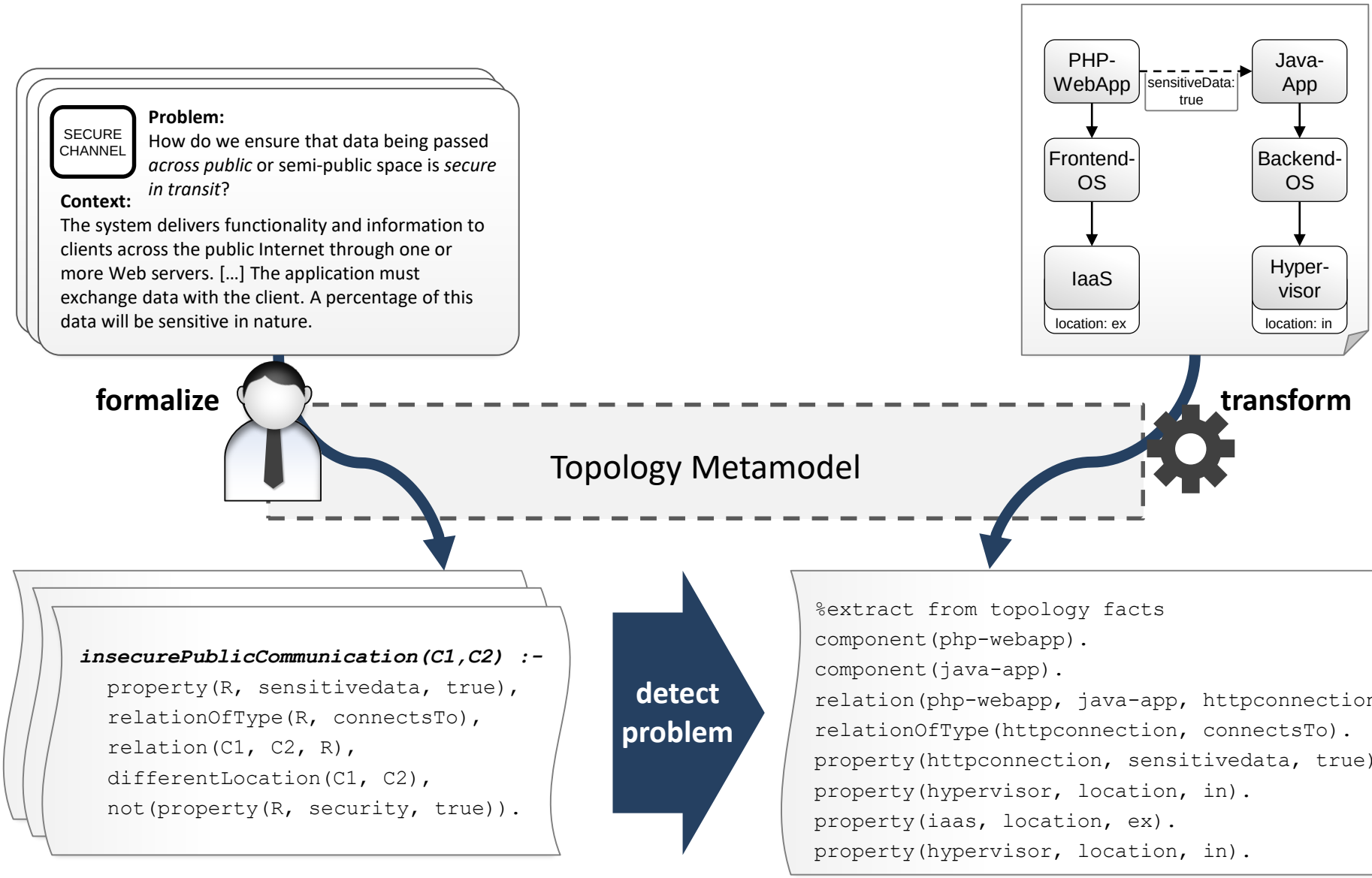

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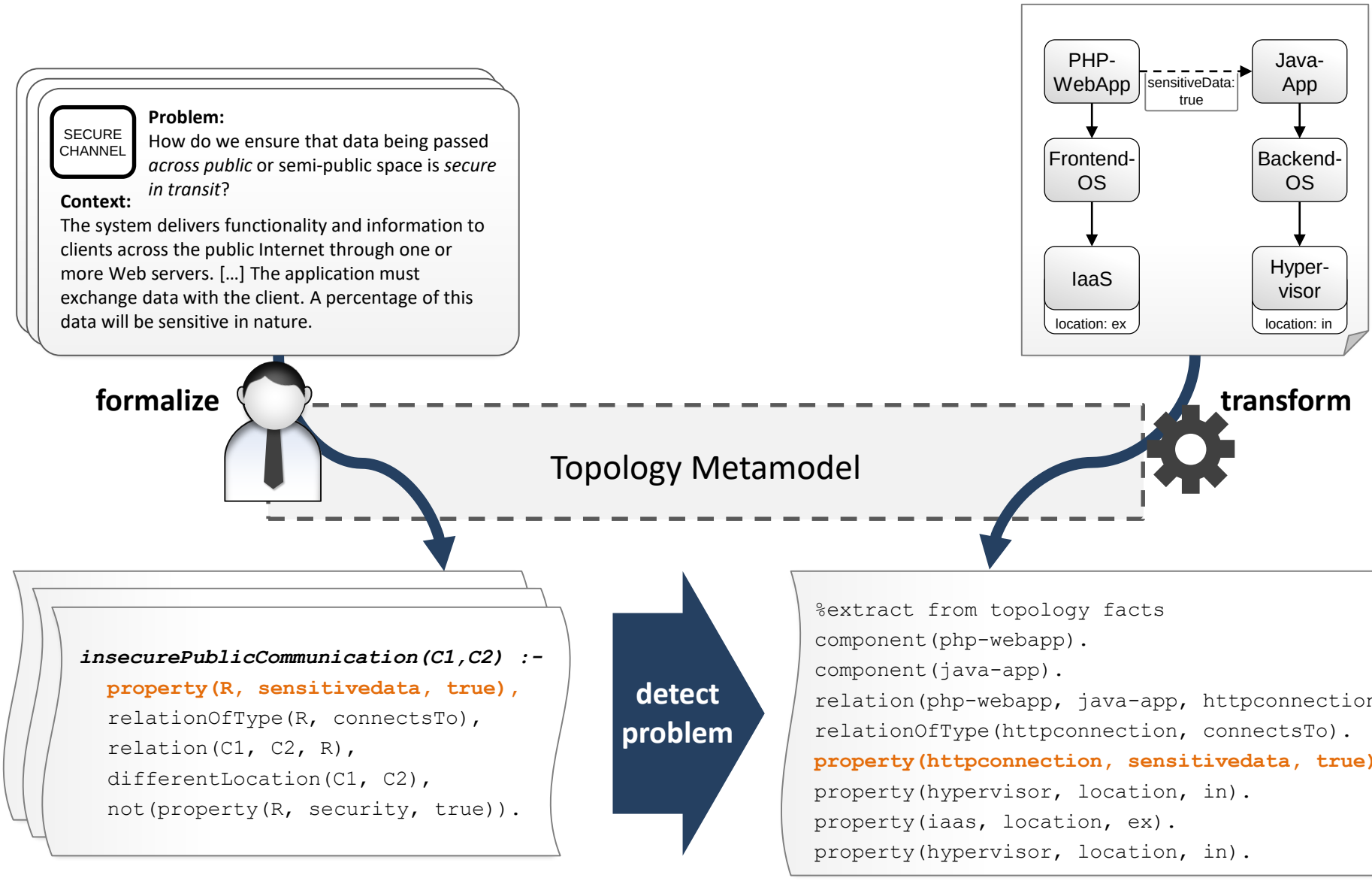

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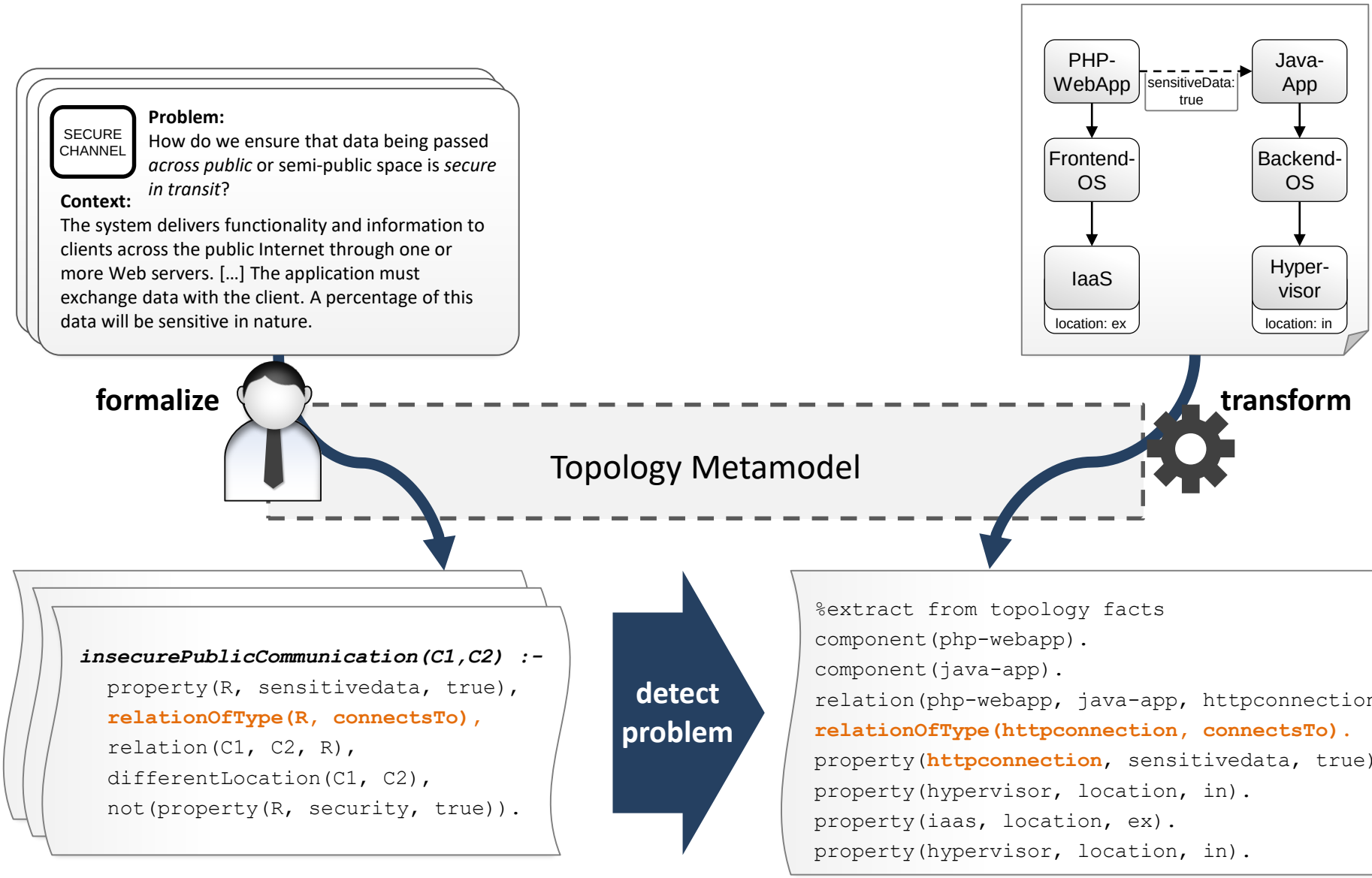

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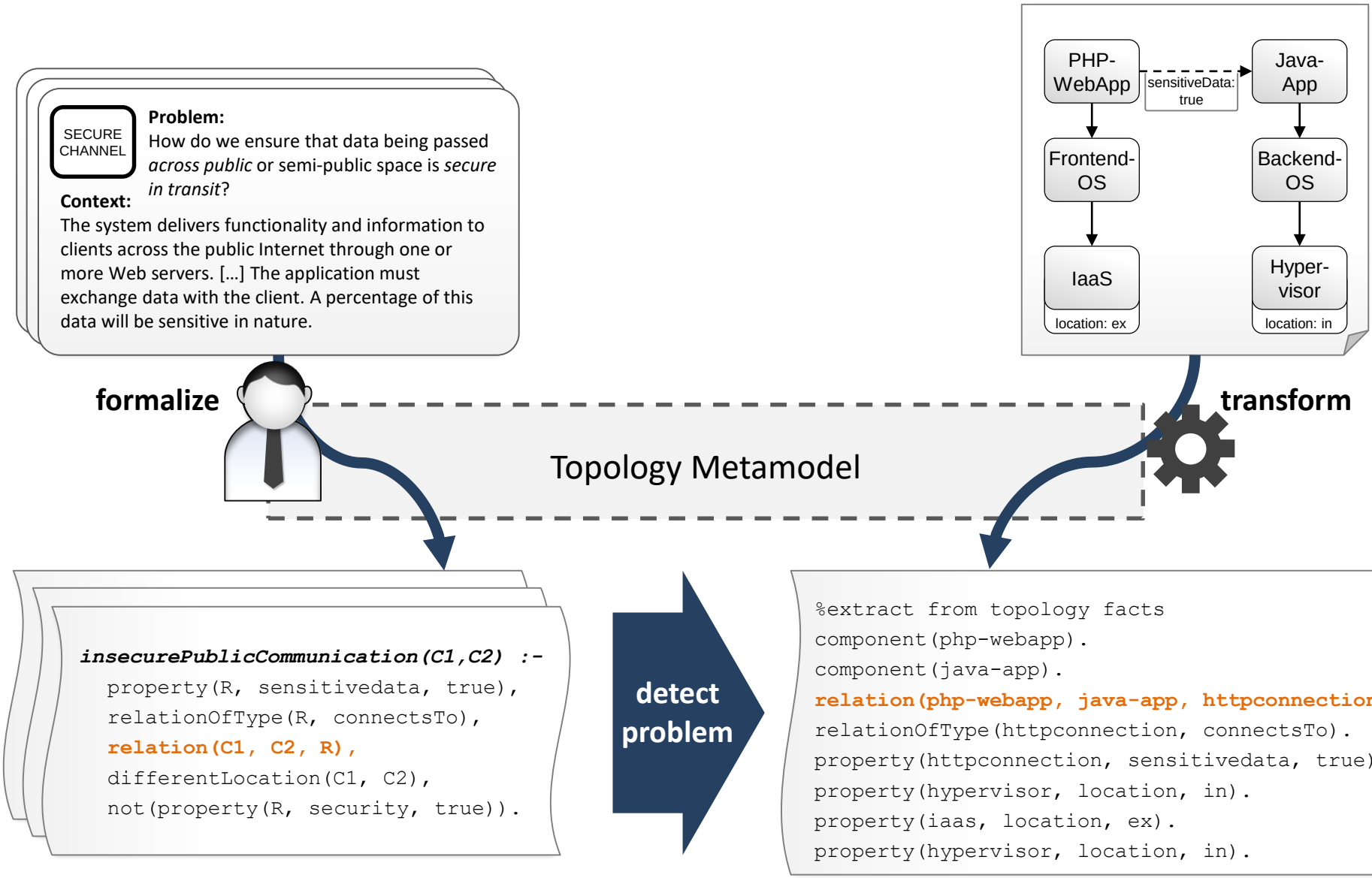

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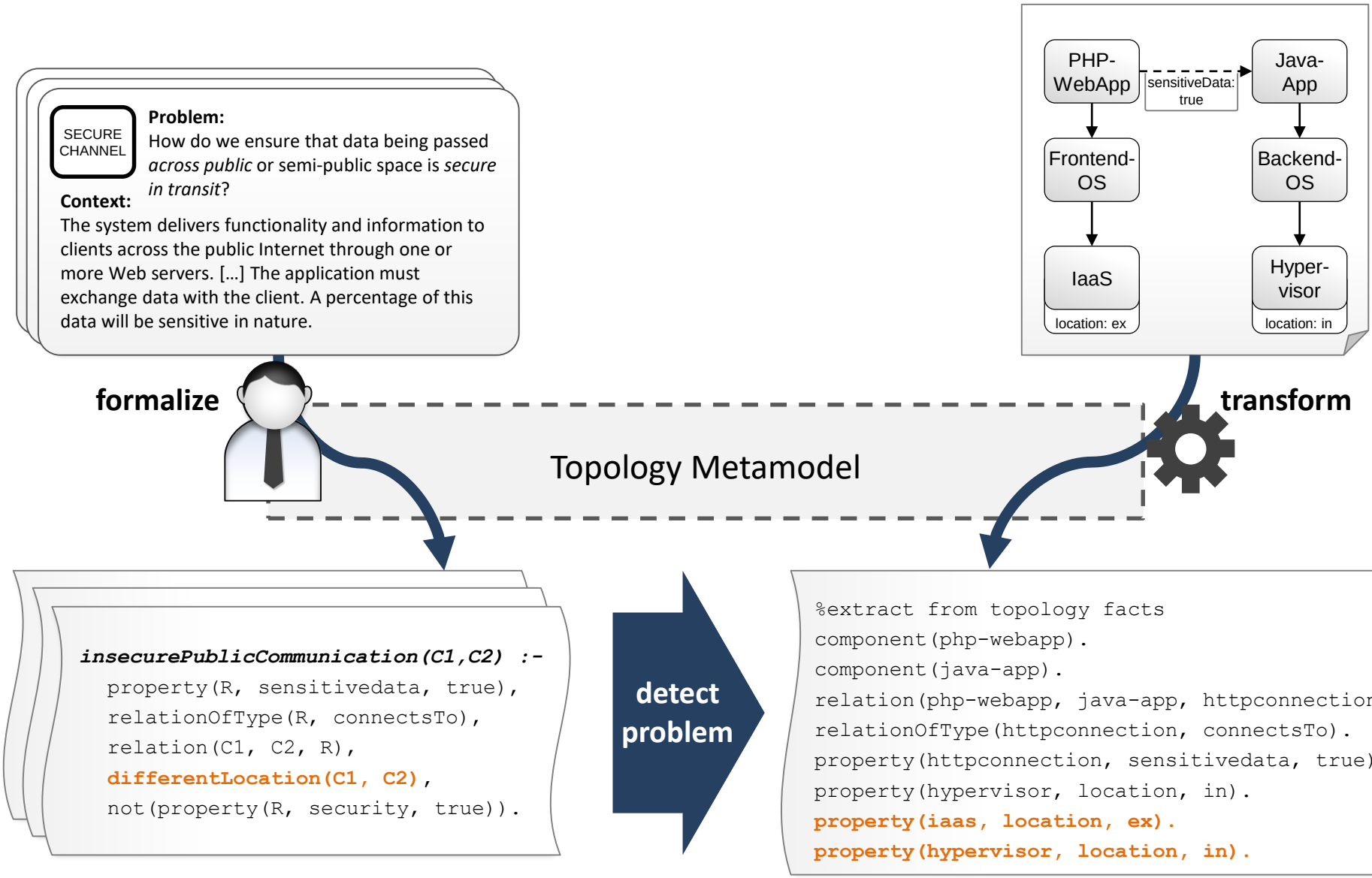

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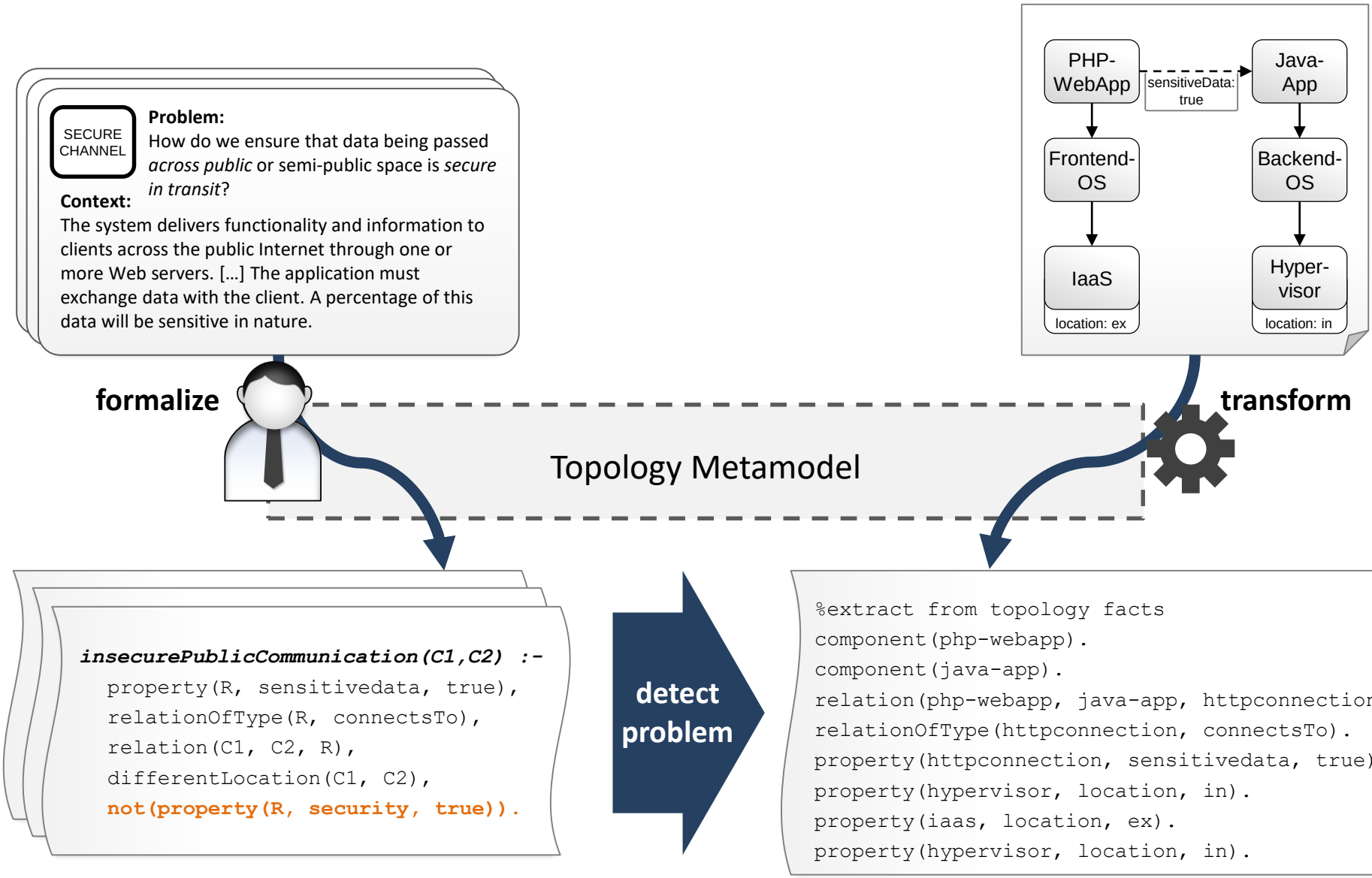

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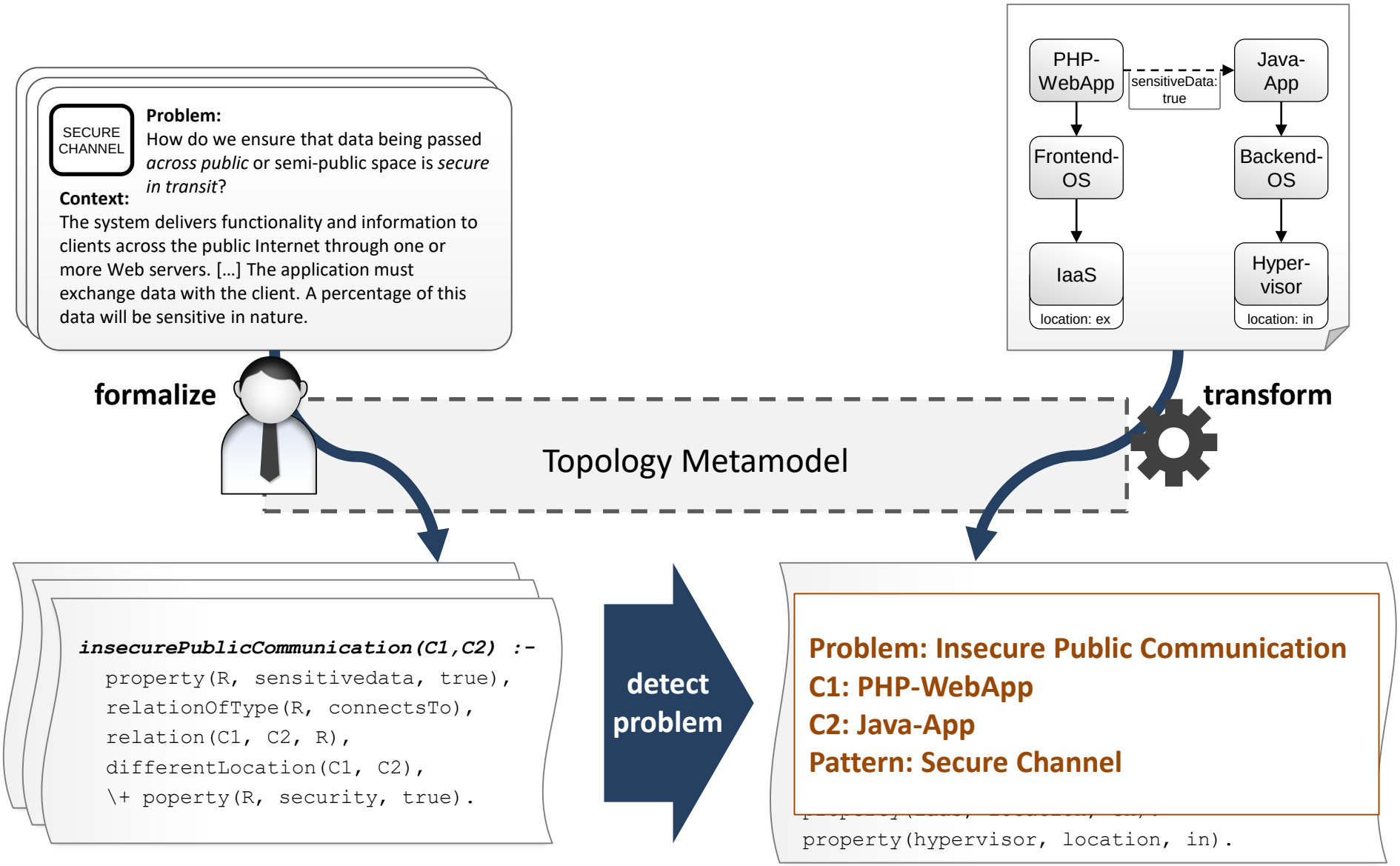


Prototypical Implementation Topology-ProDec*

- Based on TOSCA using the modeling tool Winery
- SWI Prolog

Secure Channel

Problem

Insecure Communication Channel

Problem Rule

```
insecure_public_communication(Component_1, Component_2) :-
        property(Relation_ID, sensitivedata, true),
        relation_of_type(Relation_ID, connectsto),
        relation(Component_1, Component_2, Relation_ID),
        components_in_different_locations(Component_1, Component_2),
        not(property(Relation_ID, security, true)).
```

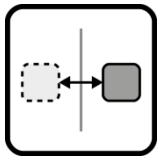
Solution Description

Create secure channels for sensitive data that obscure the data in transit. Exchange information between client and server to allow them to set up encrypted communication between themselves. [...]

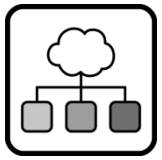
*https://github.com/saatkamp/topology-prodec

Application & Conclusion

- Prototypical validation based on 3 Cloud Computing and 1 Security Pattern



Application Component Proxy



Integration Provider

Message Mover

Secure Channel

- Future work:
  - Semantic model for the formalization and transformation process
  - Realization of solutions for the detected problems in topologies

Thank you for your attention and I hope I will see you at the poster session for interesting discussions ☺