

# Automated Provisioning of Customized Cloud Service Stacks using Domain-Specific Languages

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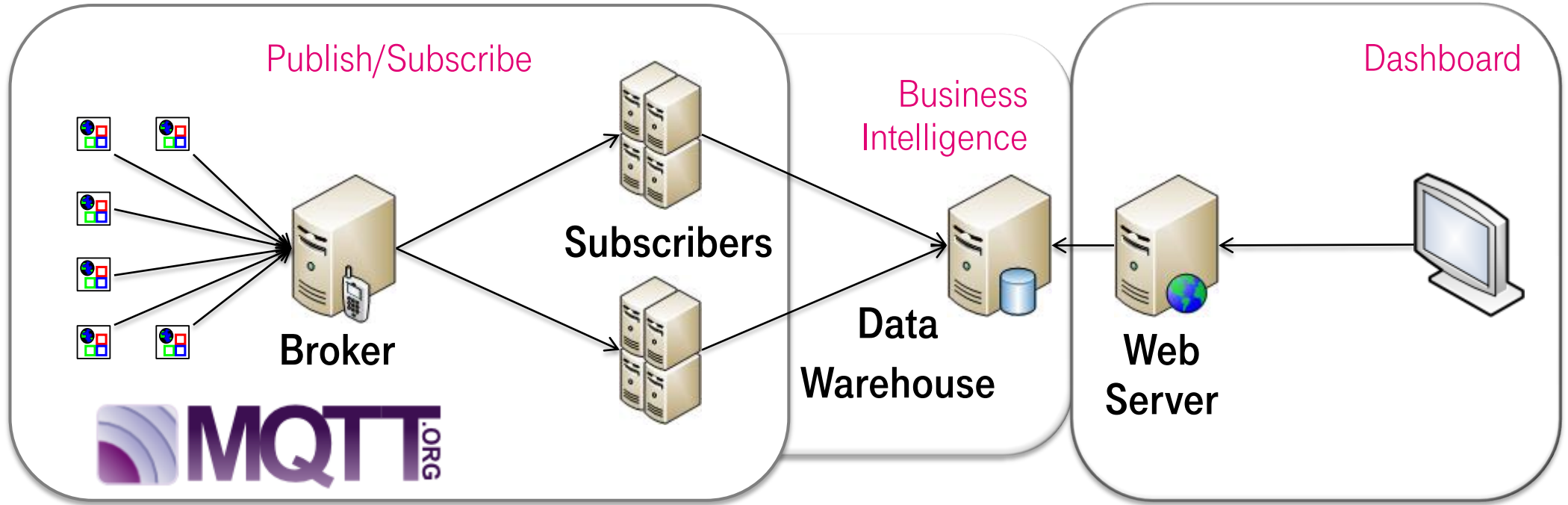
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# Vision: Rapid Prototyping of Cloud-Based Applications

How to instantiate entire cloud stacks?



# Practical Burdens and Tasks

- defining service topology: **complex**
- setup of infrastructure: **cumbersome**
- (basic) provisioning: **time-consuming**

repeat for, e.g.,

- **test**
- **preproduction**
- **production**

Finally:

- Development and Deployment of a Proof-of-Concept



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 CloudMDE

# Relating to the Workshop Calls

## Call for Papers

“CloudMDE is an international workshop that aims to bring together researchers and practitioners working in MDE or cloud computing [...]”

“We aim to identify opportunities for using MDE to support the development of cloud-based applications (MDE for the cloud) [...]”

“We also are interested in novel results of adoption of MDE in cloud-related domains, that provide insight into early adoption of MDE for building cloud-based applications [...]”

# Targeted Topics of Interest

## Call for Papers

- Metamodels and novel domain-specific languages to support development of cloud-based applications.
- Model transformation for cloud-based applications.
- Model-to-text transformations for specific cloud platforms.
- Cloud-specific development scenarios enabled by or enriched by use of MDE.
- Case studies and experience reports.



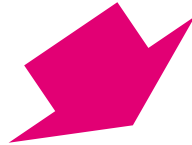
# Principle Approach: Model-Driven Engineering!

- proofed to be effective in managing **complexity**;
- establishes a high-degree of **automation** while
- incorporating different **stakeholders**,
- capturing expert **knowledge**,
- realizing **best-practices**, and
- building on **conventions** (over configurations)



# Research Questions

- How to enable end-users in specifying entire cloud stacks?
- How to accelerate their provisioning?
- How to facilitate development of comprised cloud services?



[EDOCW 2014, pp. 422-425]

# Motivation

## and requirements

- automate **provisioning**
- **simplify** specification of cloud stacks
- no-compromise regarding **flexibility**
- **conformance** with intended service topology
- facilitate **agile** development
- permit to “fail fast / fail cheap”





# Concrete Approach: Domain-Specific Languages!

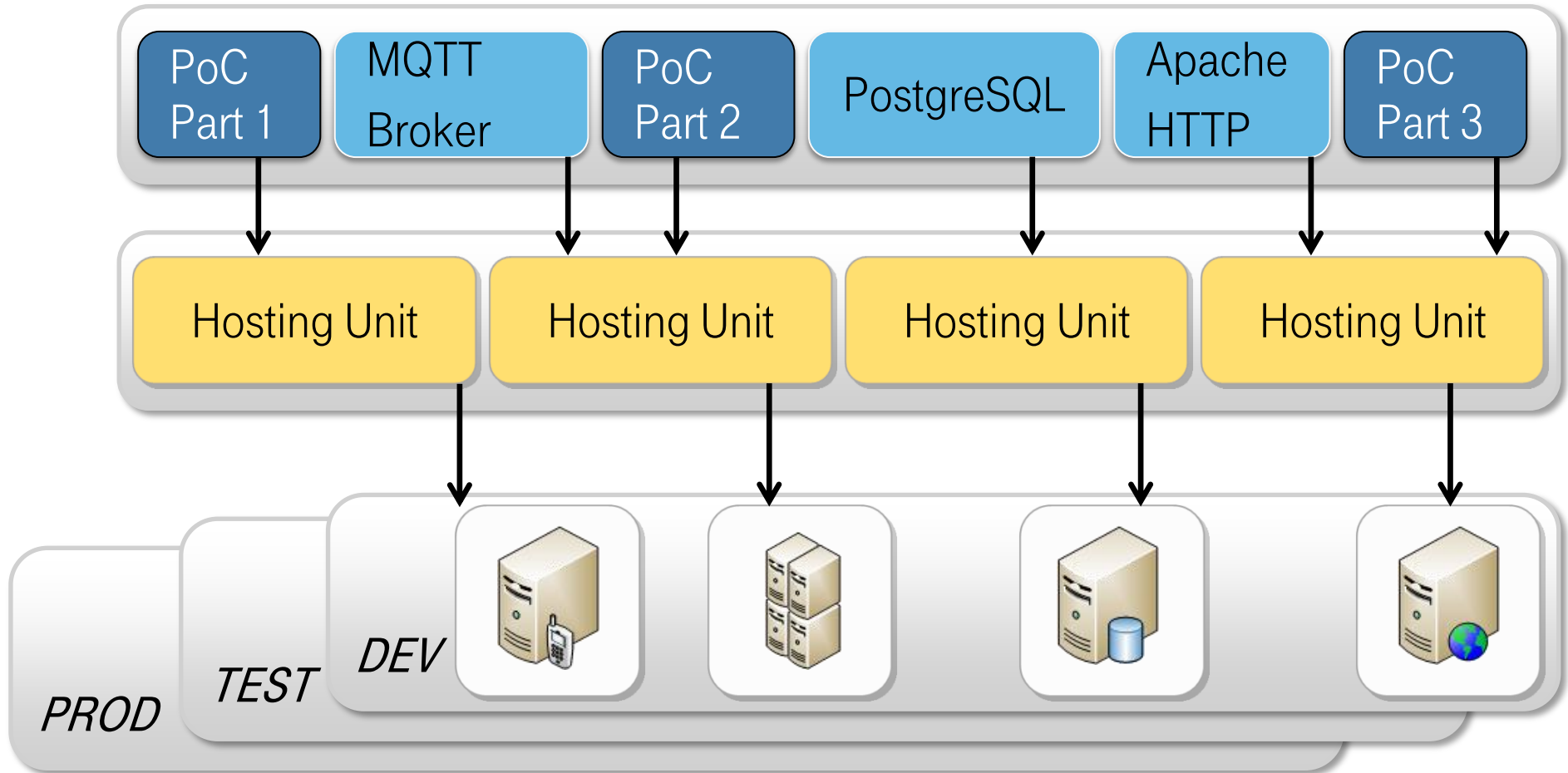
syntax highlighting, code-completion, validators, transformations

- tailored towards end-users (domain-experts)
- precise levels of abstraction
- automated transformation of programs



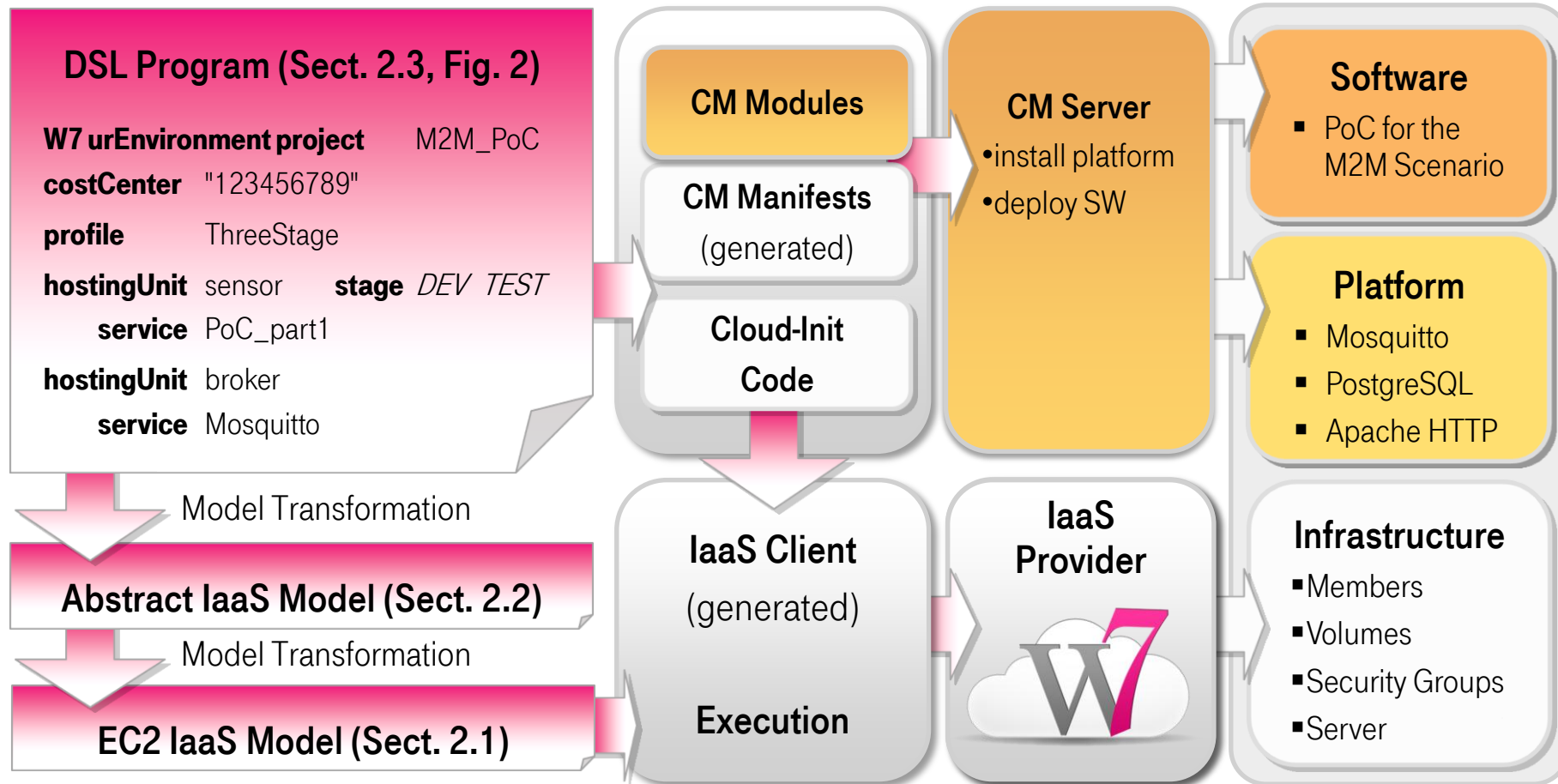
Völter, M., Benz, S., Dietrich, C., Engelmann, B., Helander, M., Kats, L.C.L., Visser, E., Wachsmuth, G.  
*DSL Engineering - Designing, Implementing and Using Domain-Specific Languages*. [dslbook.org](http://dslbook.org) (2013)

# Relating Software Building Blocks to Infrastructure





# Approach – Overview

using the motivation example



# Results

## basic concepts and transformation chain

- Users may specify a **Cloud Stack** in terms of a tailored **DSL**. 
  - For this they select a **profile** and specify **hosting units** with **services**.
- The model is **transformed** to an abstract IaaS model (PIM). 
  - subsequent transformation to an IaaS model (PSM)
  - subsequent generation of a shell script (IaaS consumer)
    - execution creates the cloud services

# Profiles and ServiceType Definitions

standard library

W7 urEnvironment globals

```
profile ThreeStage stages DEV TEST PROD
```

```
serviceType LAMP implies {
```

```
  service Apache
```

```
  internal service MySQL
```

```
}
```

```
serviceType SIP TCP 5060,5061 UDP 5060,5061
```

```
serviceType Git
```

```
serviceType Apache TCP 80,443
```

```
serviceType MySQL TCP 3306 UDP 3306
```

three security groups will be created  
when selecting the profile

## ThreeStage

a technology stack

the service will not be exposed to  
public

listening ports



# Binding of Stages to different Cloud Regions

standard library

W7 urEnvironment globals

region **DE99**

EC2 http://10.11.13.4:8773/services/Cloud

Nova http://10.11.13.123:5000/v2.0

S3 http://s3.t-online.example.org

region **DE01**

EC2 http://10.12.26.9:8773/services/Cloud

profile ThreeStage

DEV @ **DE99**

TEST @ **DE99**

PROD @ **DE01**

Production is hosted at a different location in a different cloud.



# Results

## further concepts and some mappings

- **ServiceTypes** specify listening **ports** and dependencies
  - The ports are considered when generating firewall rules.
  - Dependencies are resolved for provisioning.
- **Services** can be specified as **internal**; i.e., will not be exposed to public.
- Security groups are created according to the selected profile (e.g., development, testing, production)
  - Services can be bound to (only) certain of these **stages**.

# Mapping to a Cloud Infrastructure

## Model-Transformation to Security Groups and Rules

### DSL Program (extract)

```
profile TwoStage
hostingUnit db
  service MySQL
hostingUnit broker
  service Mosquitto
hostingUnit subscriber1
  service MosquittoClient
```

### Abstract IaaS Program (extract)

```
securityGroup DEV
  TCP src net "0.0.0.0/0" dst 1883,8883,3306
  server db
  server broker
  server subscriber1
securityGroup PROD
  TCP src net "0.0.0.0/0" dst 1883,8883,3306
  server db
  server broker
  server subscriber1
```





# Contributions & Conclusions

- reported on industrial adoption of MDE in a cloud context

## scientific contributions

- DSLs are suitable for defining entire cloud stacks
- enables end-users to specify customized cloud stacks
- full automation; no manual task required
- best of two worlds: configuration management & MDE



# Acknowledgements



# THANK YOU!

# QUESTIONS?

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