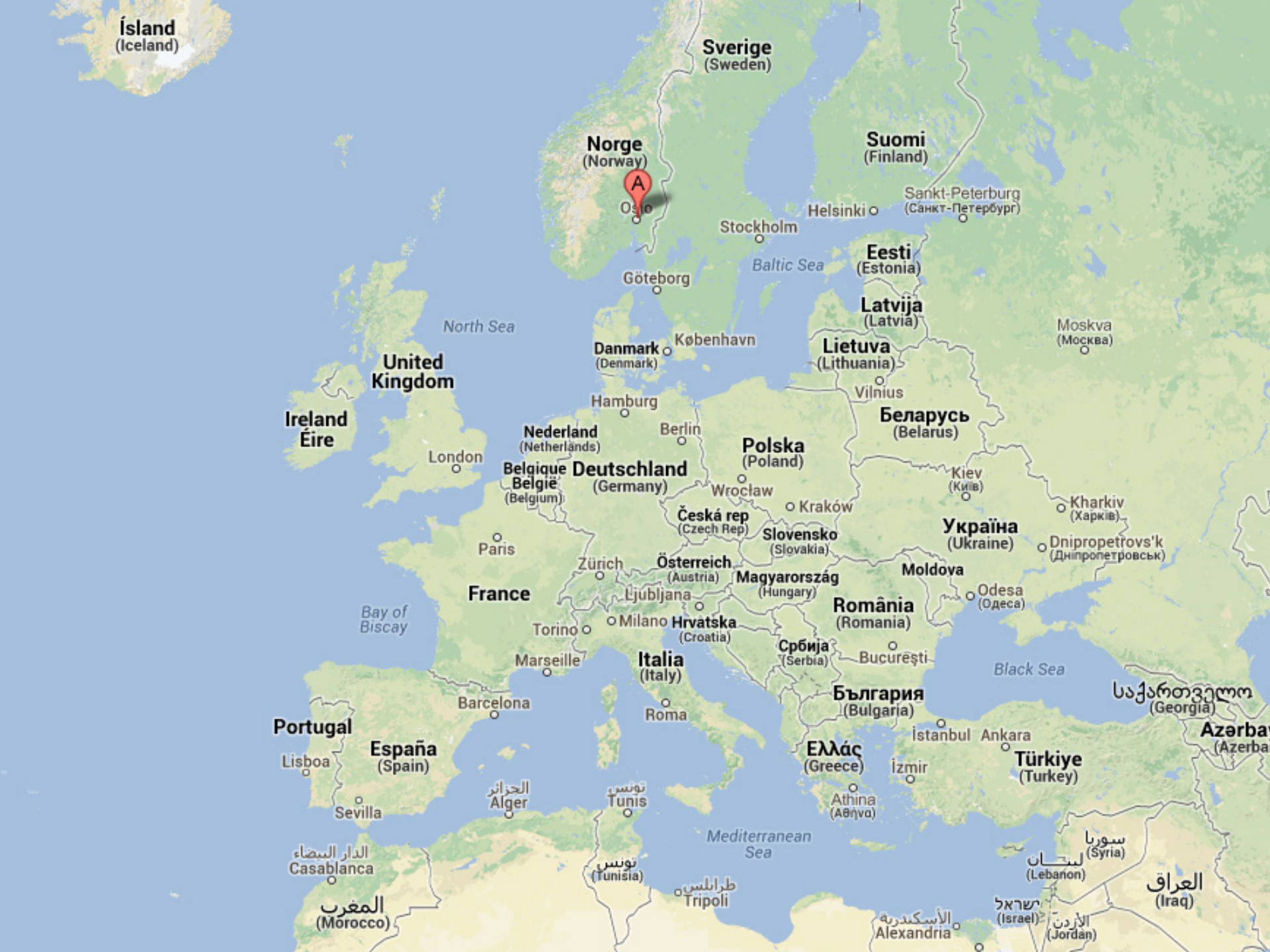# Towards model-driven provisioning, deployment, monitoring, and adaptation of multi-cloud systems

Alessandro Rossini

Advanced School on SOC, Hersonissos

4 July 2013

SINTEF

- Largest research organisation in Scandinavia

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- Technology, Medicine, Social Science

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- 1000 employees holding a Ph.D.

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- 2100 employees from 70 countries
- 1000 employees holding a Ph.D.
- 350 million euros annual turnover

Alessandro Rossini

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Education

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- 2004-2006   M.Sc.,   University of L'Aquila, Italy
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- 2012   Lecturer, Bergen University College
- 2012-   Research scientist, SINTEF, Oslo

Cloud computing

Cloud computing

A computing model enabling ubiquitous network access to a shared and virtualised pool of computing capabilities (e.g., network, storage, processing, and memory) that can be rapidly provisioned with minimal management effort
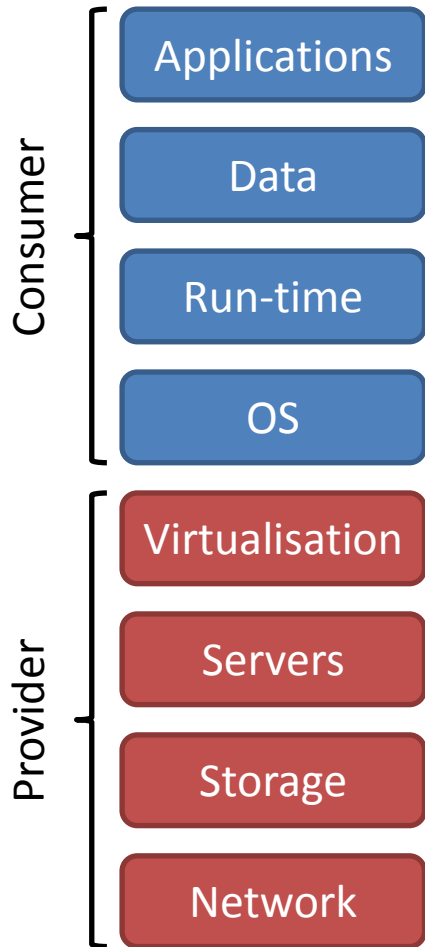
source: NIST

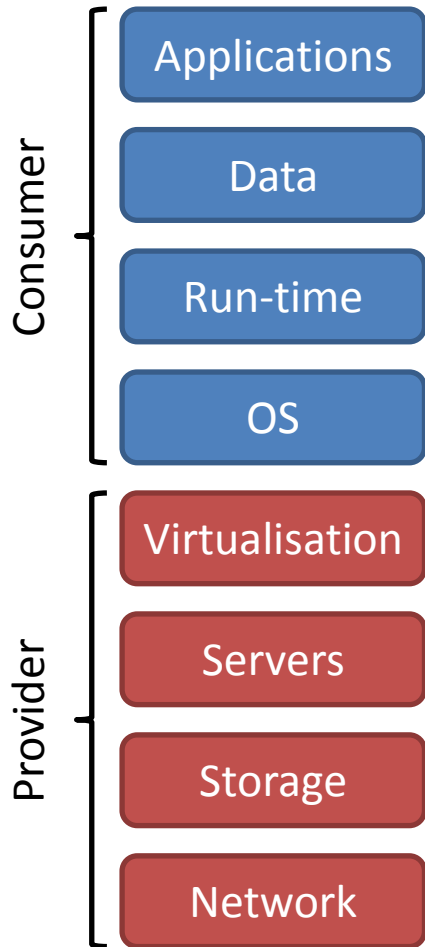Technology for a better society

source: Graviant

IaaS   PaaS   SaaS

IaaS

PaaS

SaaS

Applications

Data

Run-time

OS

Virtualisation

Servers

Storage

Network

IaaS   PaaS   SaaS

Consumer

Applications

Data

Run-time

OS

Provider

Virtualisation

Servers

Storage

Network

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IaaS

Consumer

| Applications |
| Data |
| Run-time |
| OS |

Provider

| Virtualisation |
| Servers |
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| Network |

PaaS

Consumer

| Applications |
| Data |

Provider

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SaaS

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IaaS

Applications
Data
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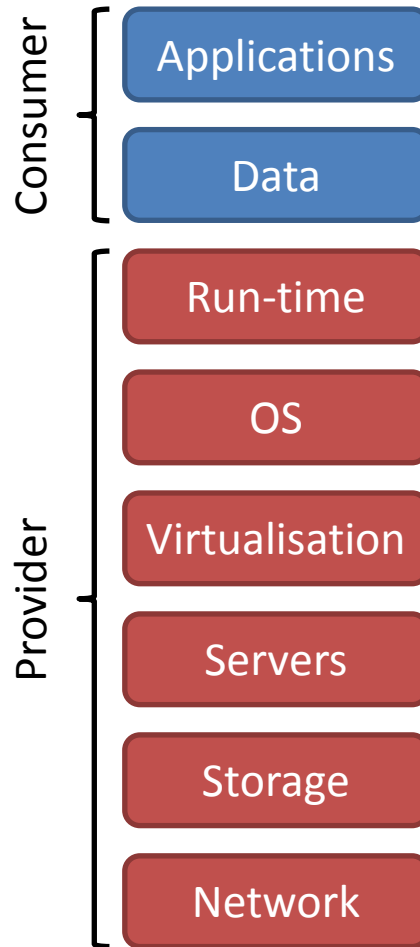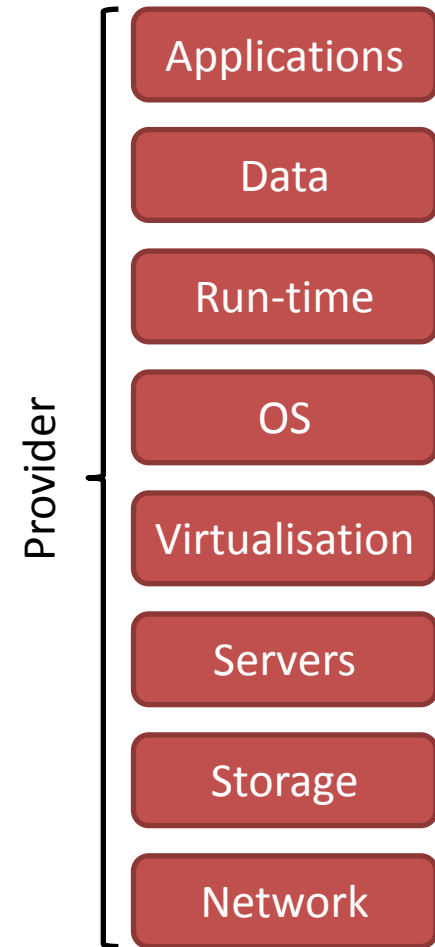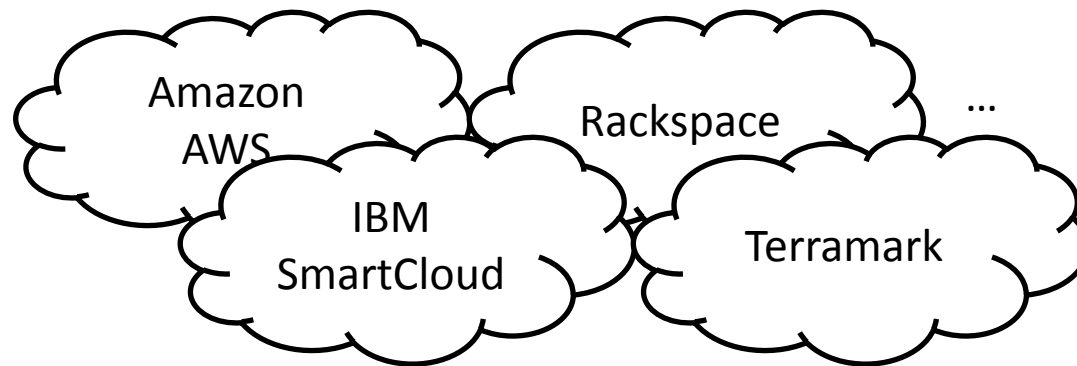
Benefits

- Scalability

- Performance

- Availability

- Cost

Challenges

- Heterogeneity

- Incompatibility

- Lack of standards

- Lack of methodologies

Amazon AWS

Rackspace

...

IBM SmartCloud

Terramark

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jclouds   Simple Cloud   Deltacloud   ...   Libraries

Amazon AWS   OpenStack   vCloud   ...   Stacks

Amazon AWS

IBM SmartCloud

Rackspace   ...

Terramark

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Technology for a better society
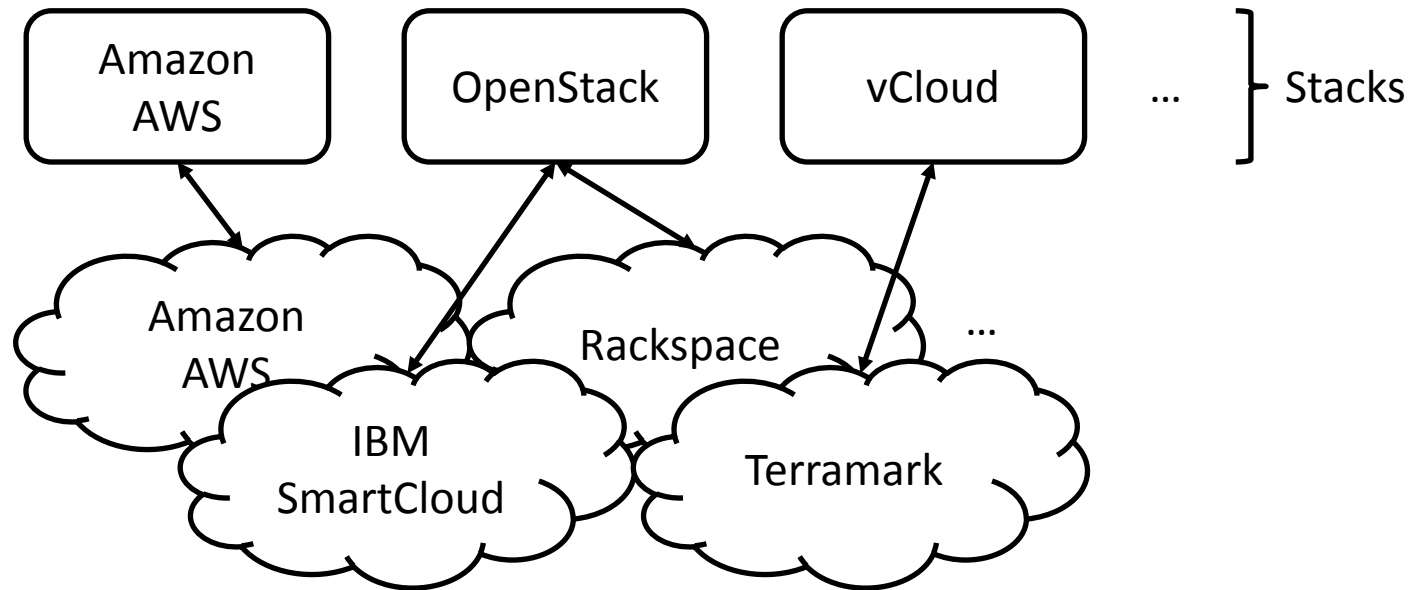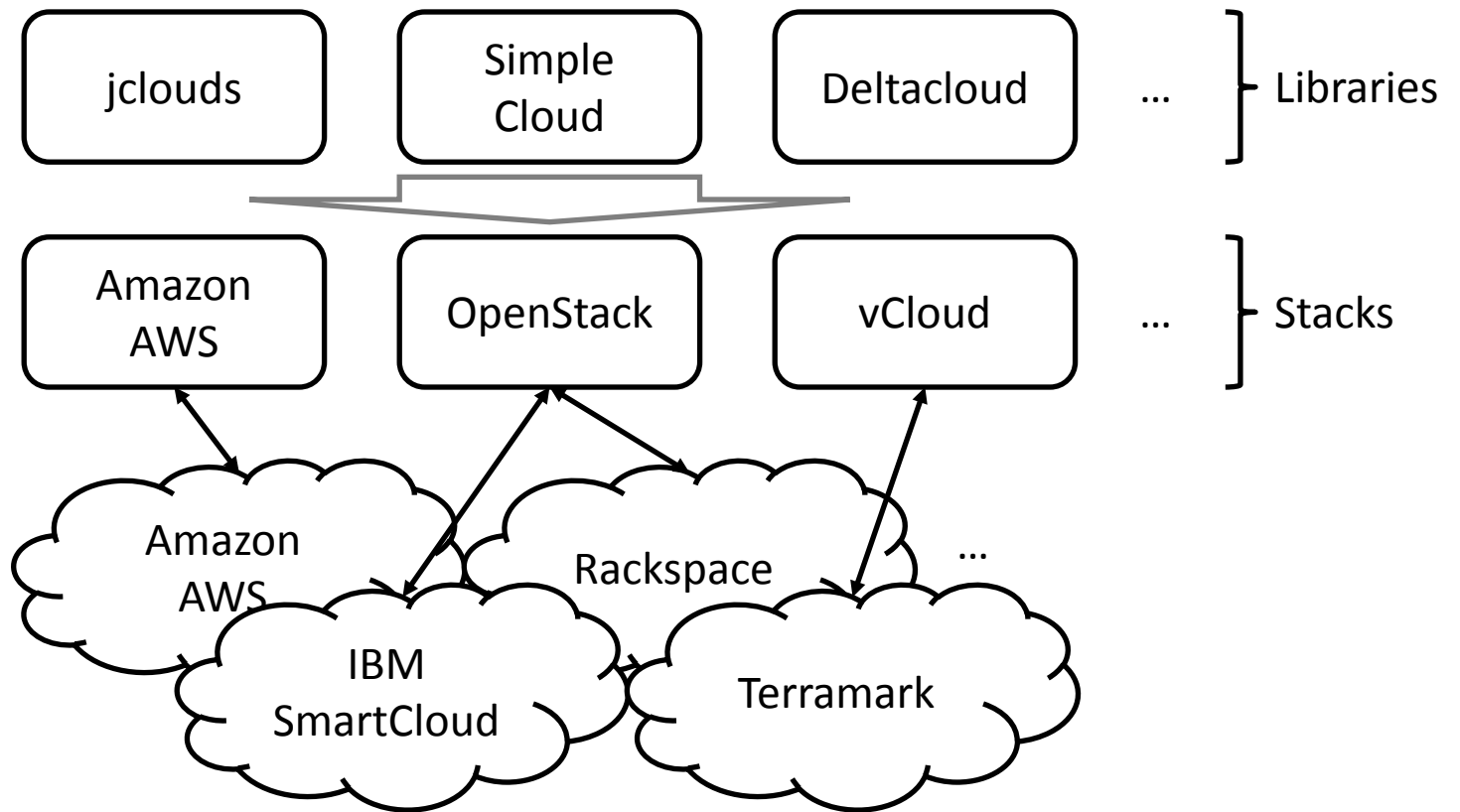
CloudML

CloudML

- Domain-specific language (DSL) for modelling the provisioning and deployment of multi-cloud systems at design-time

CloudML

- Domain-specific language (DSL) for modelling the provisioning and deployment of multi-cloud systems at design-time

- Models@run-time environment for enacting the provisioning and deployment of these systems at run-time

Design-time

Cloud Provider-Independent Model

JSON · XMI · ...

Node type

- Generic virtual machine
  - a virtual machine running GNU/Linux

Node type

- Provisioning requirements
    - 2 cores $\leq$ compute $\leq$ 4 cores
    - 2 GiB $\leq$ memory $\leq$ 4 GiB
    - storage $\geq$ 10 GiB
    - location = Europe

Node type example (JSON)

```json
"nodeTypes": [
    {
        "id": "SmallGNULinux",
        "os": "GNULinux",
        "compute": [ 2, 4 ],
        "memory": [ 2048, 4096 ],
        "storage": [ 10240 ],
        "location": "eu",
        "provides": [
            { "id": "SSHCapability" }
        ]
    }
]
```

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Artefact types

- Generic component of the application
  - a Java servlet of an application for document collaboration
  - a Jetty container
  - a MongoDB database

Artefact types

- Deployment commands
  - retrieve the Java servlet from cloudml.org
  - configure it
  - run it

Artefact types

- Deployment dependencies
  - the Jetty container and the MongoDB database have to be deployed before the Java servlet

Artefact types

- Communication channels
  - a Java servlet communicates with another Java servlet through Hypertext Transfer Protocol Secure (HTTPS) on port 443

Artefact type example (JSON)

```json
"artefactTypes": [
    {
        "id": "MongoDB",
        "retrieval": "wget http://cloudml.org/services/mongodb",
        "deployment": "sudo mongodb",
        "provides": [
            { "id": "MongoDBCapability" }
        ]
    },
…
```
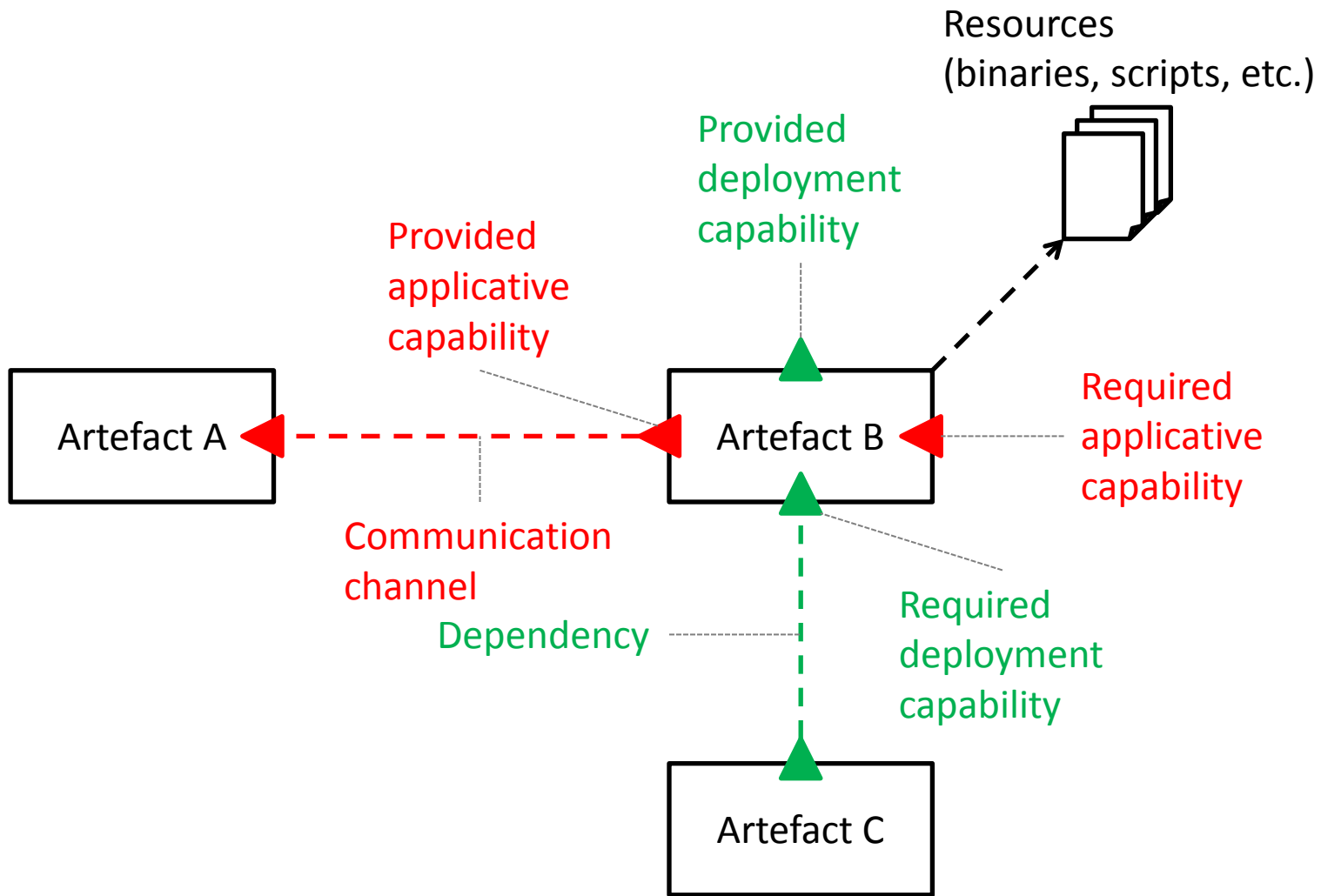
Artefact type example (JSON)

…

```json
{
    "id": "Jetty",
    "retrieval": "wget http://cloudml.org/services/jetty",
    "deployment": "sudo jetty",
    "provides": [
        { "id": "JettyCapability" }
    ]
},
```

…

Artefact type example (JSON)

```
…
        {
            "id": "Docs",
            "retrieval": "wget http://cloudml.org/apps/docs.war; wget
http://cloudml.org/apps/docs_configure; wget
http://cloudml.org/apps/docs_deploy",
            "configuration": "sudo docs_configure",
            "deployment": "sudo docs_deploy",
            "requires": [
                { "id": "JettyCapability" },
                { "id": "MongoDBCapability" }
            ]
        }
    ]
```
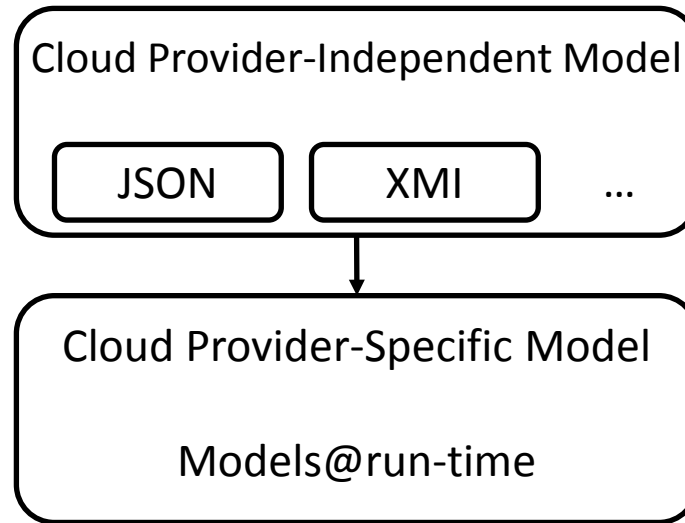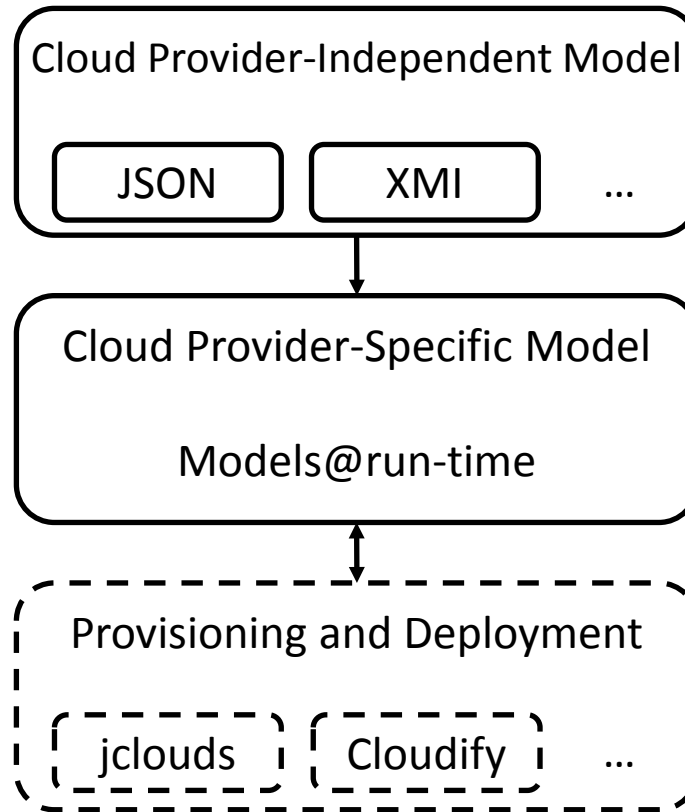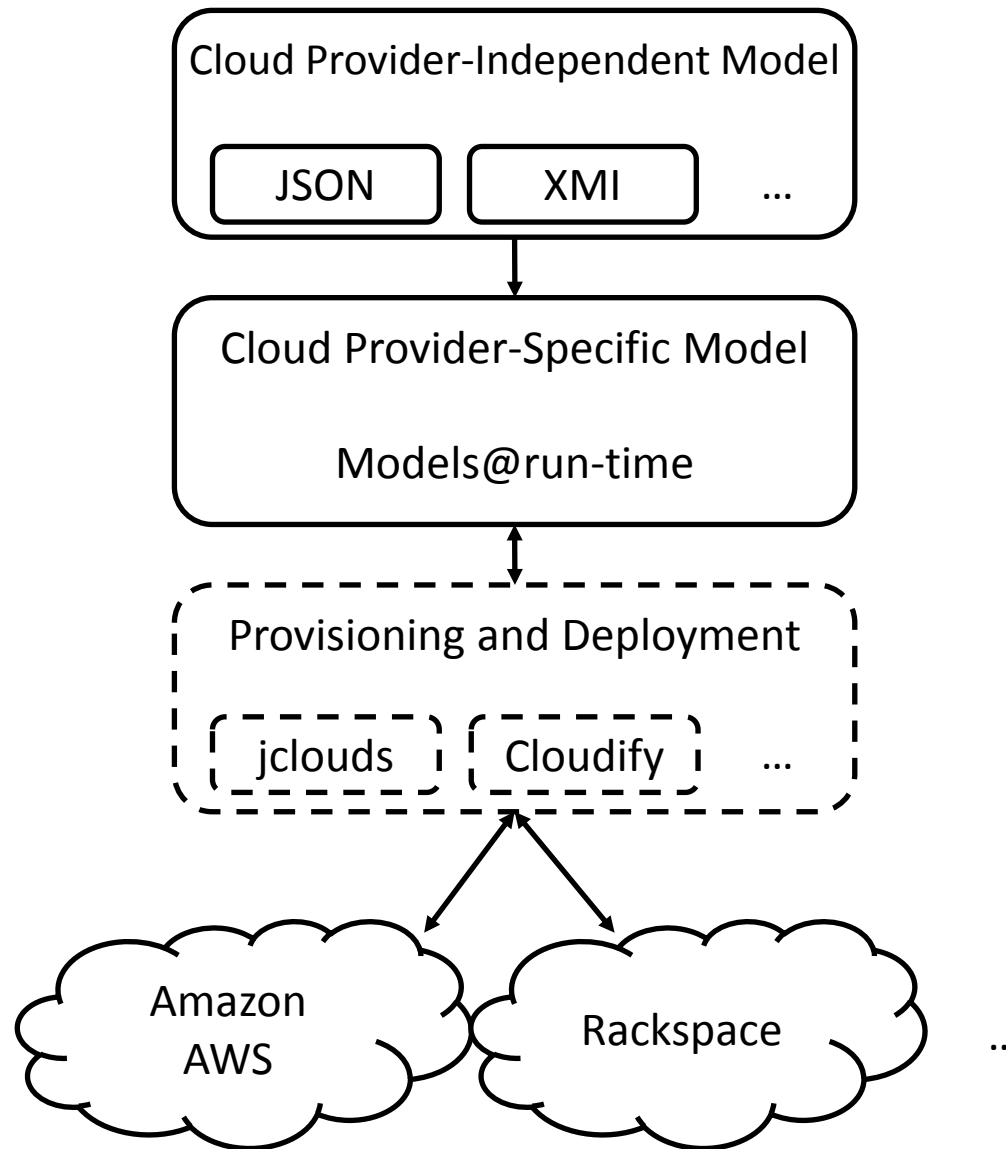
Resources
(binaries, scripts, etc.)

Provided
deployment
capability

Provided
applicative
capability

Required
applicative
capability

Artefact A

Artefact B

Communication
channel

Dependency

Required
deployment
capability

Artefact C

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Run-time

Cloud Provider-Independent Model

JSON   XMI   ...

Cloud Provider-Independent Model

JSON   XMI   …

Cloud Provider-Specific Model

Models@run-time

Provisioning and Deployment

jclouds   Cloudify   …

Models@run-time

Models@run-time
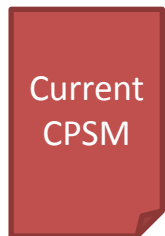
- CPSM causally connected to the running system

Models@run-time

- CPSM causally connected to the running system
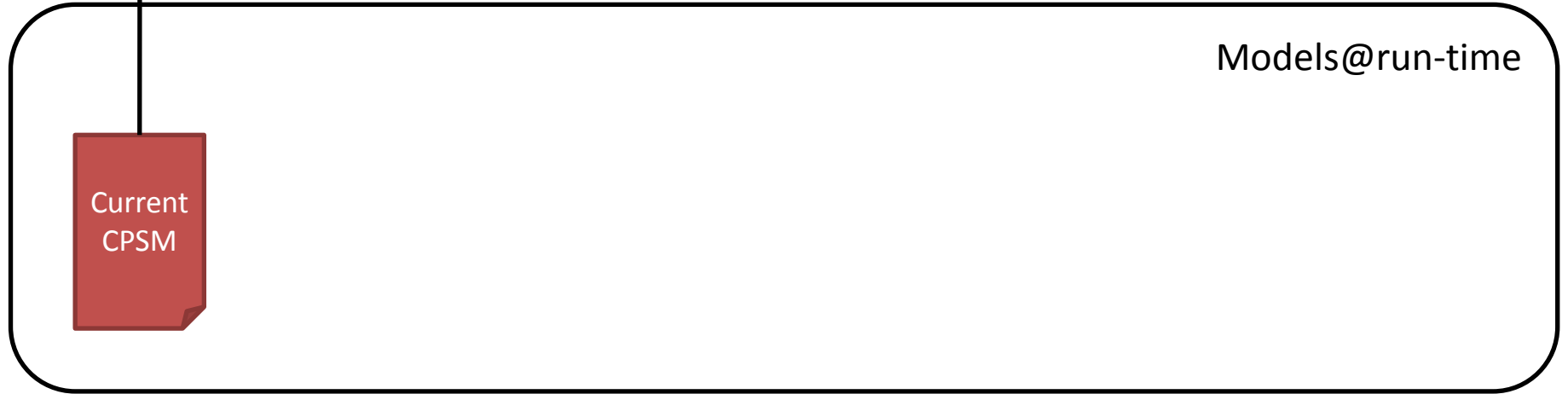- A change in the CPSM is reflected on-demand in the running system

Models@run-time

- CPSM causally connected to the running system

- A change in the CPSM is reflected on-demand in the running system

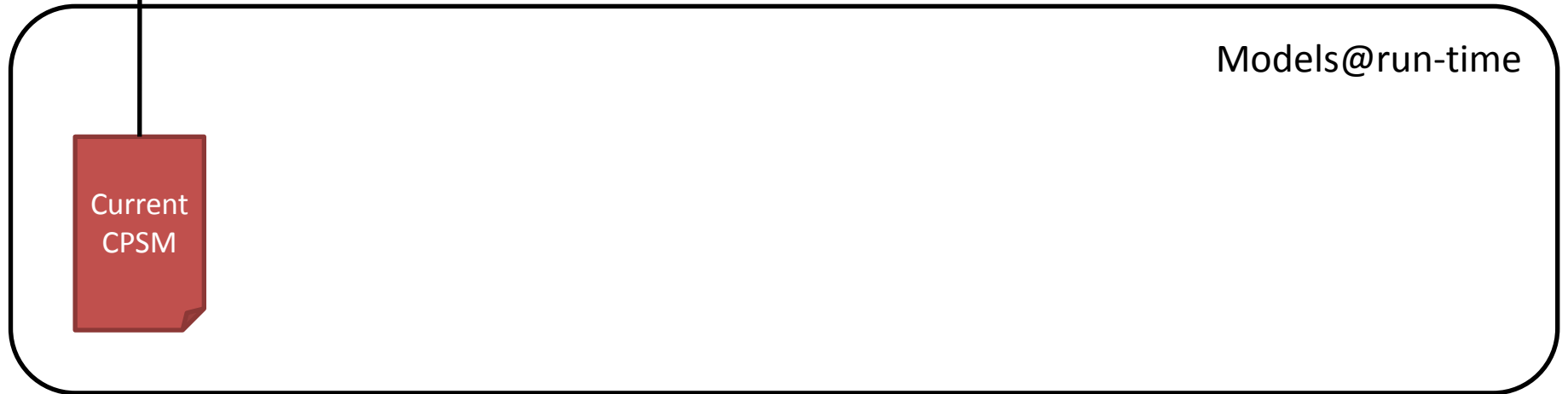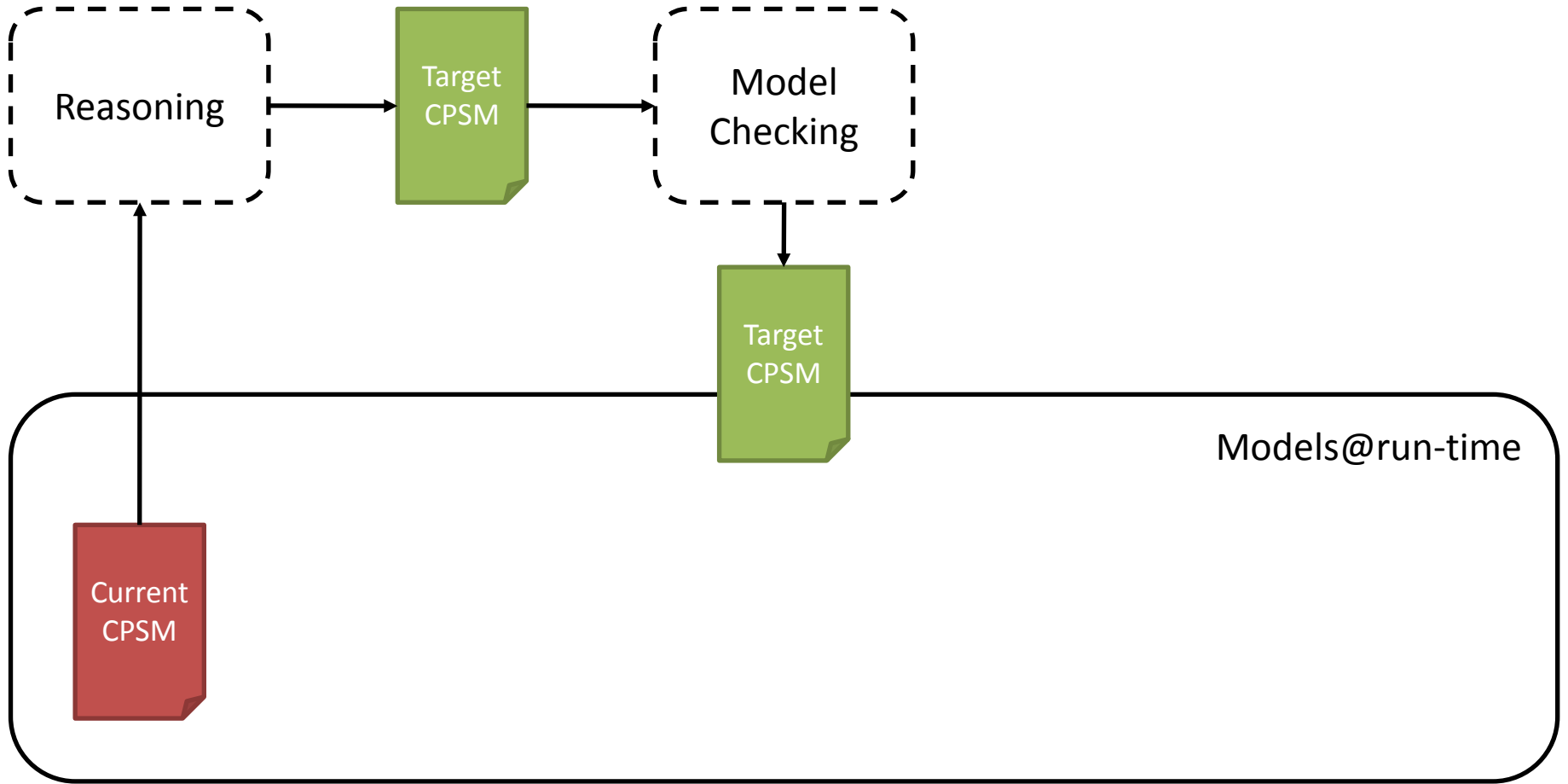- A change in the running system is automatically reflected in the CPSM
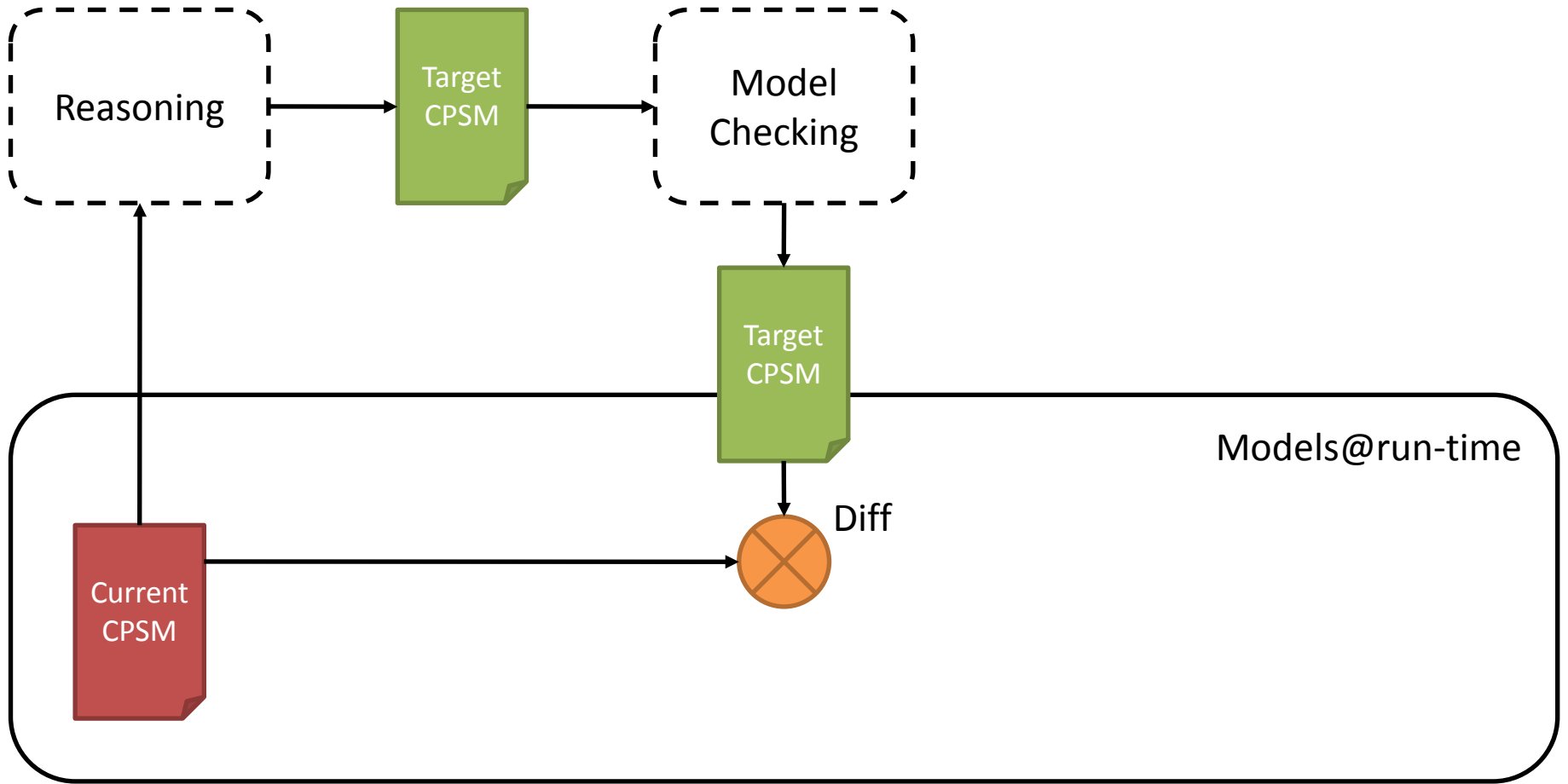
Models@run-time

Current
CPSM

Reasoning

Models@run-time

Current
CPSM

Reasoning

Target CPSM

Models@run-time

Current CPSM

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Reasoning → Target CPSM → Model Checking

Models@run-time

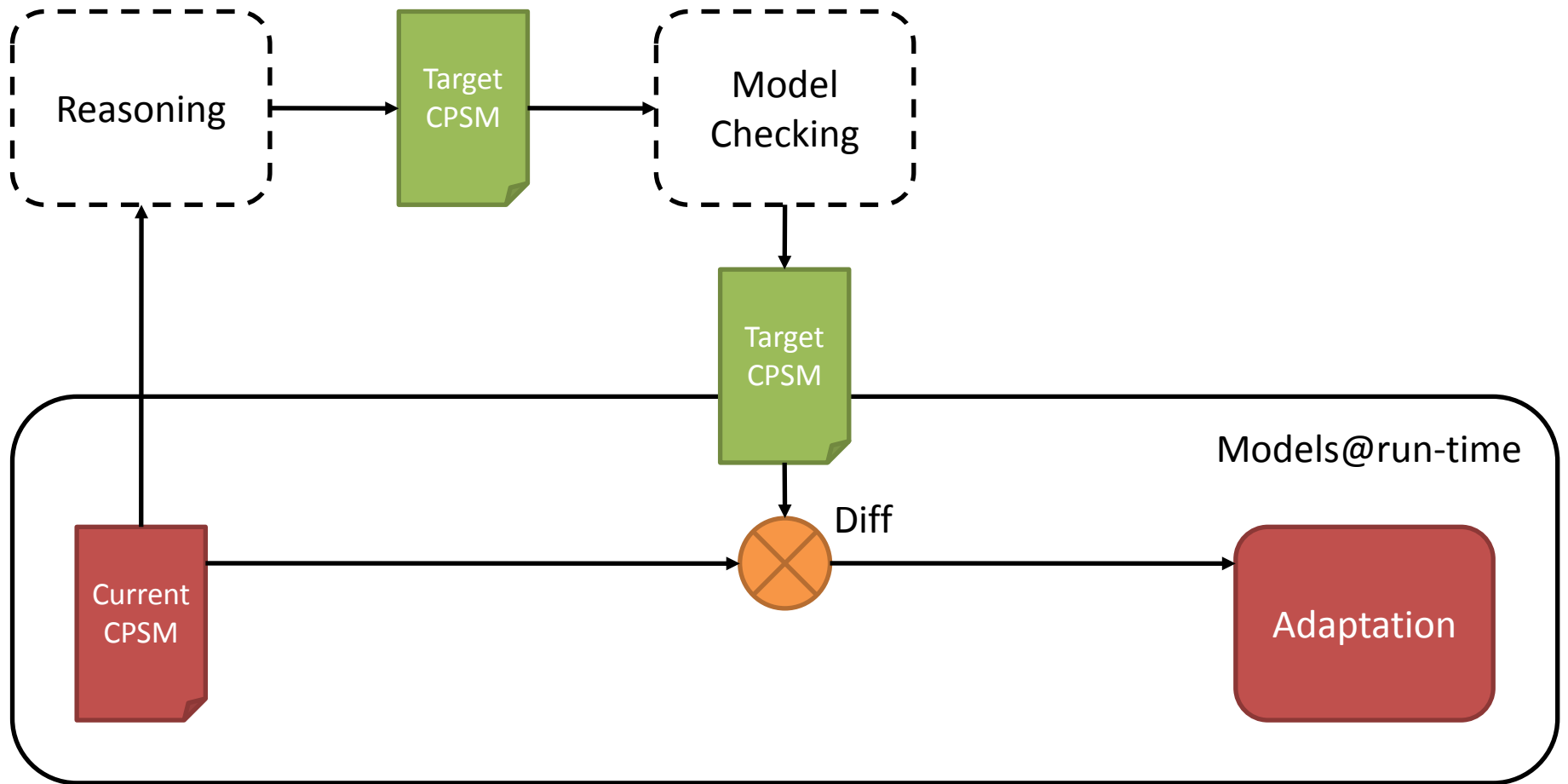Current CPSM

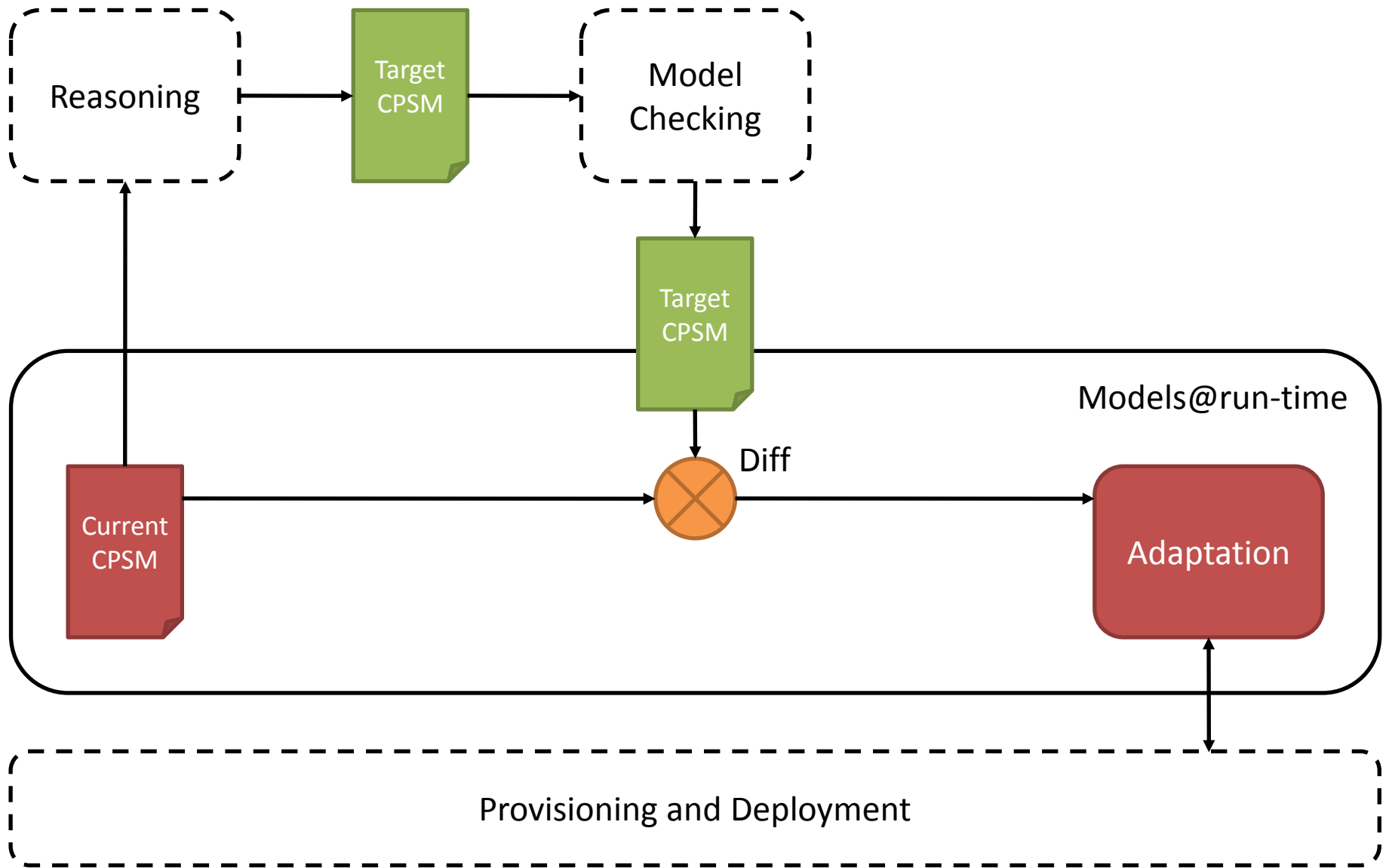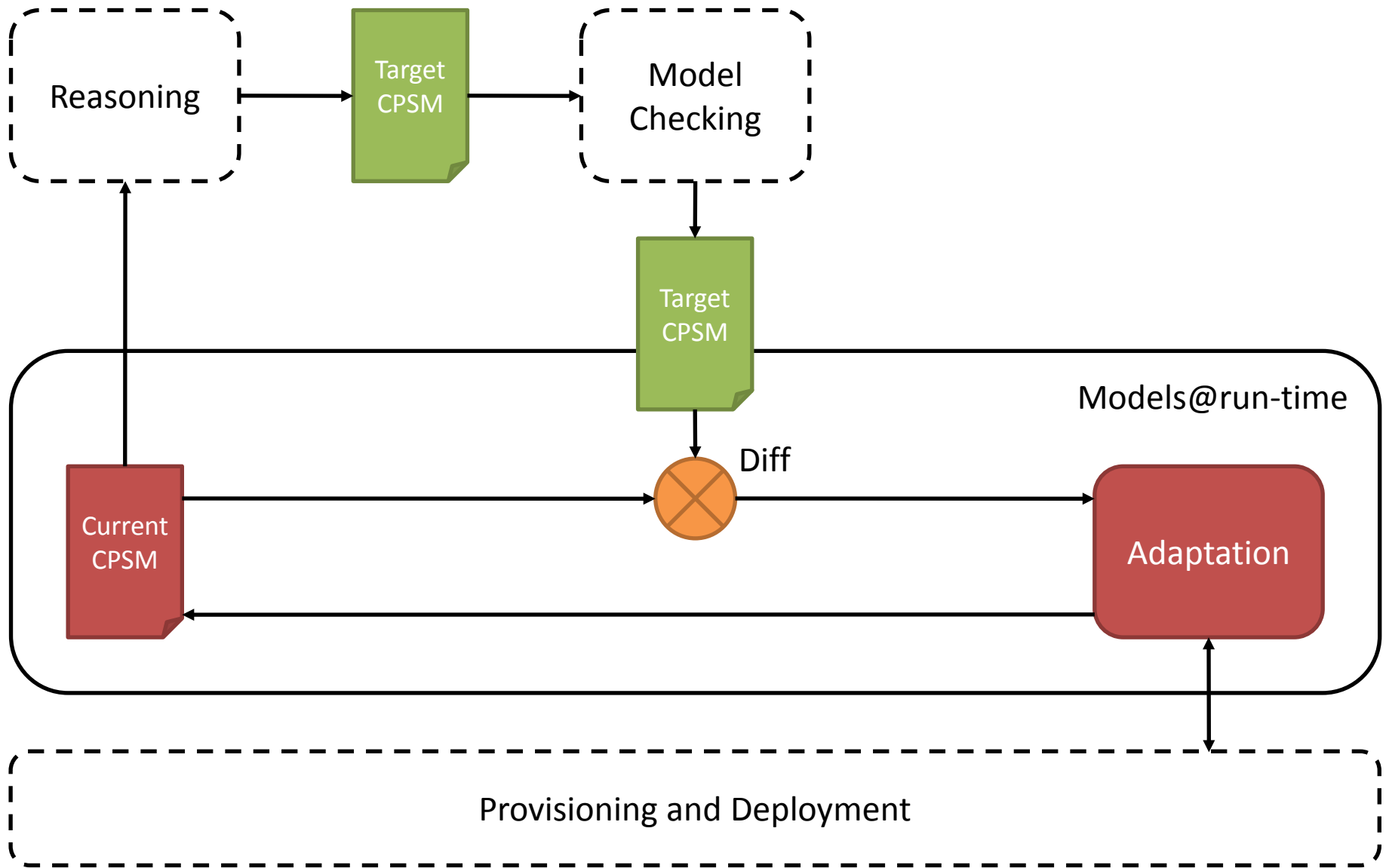SINTEF — Technology for a better society

Demo

Related work

Related work

- TOSCA
- Cloudify
- Chef
- Puppet

Summary

CloudML

- Domain-specific language (DSL) for modelling the provisioning and deployment of multi-cloud systems at design-time

- Models@run-time environment for enacting the provisioning and deployment of these systems at run-time

Technology for a better society

Resources

- http://cloudml.org

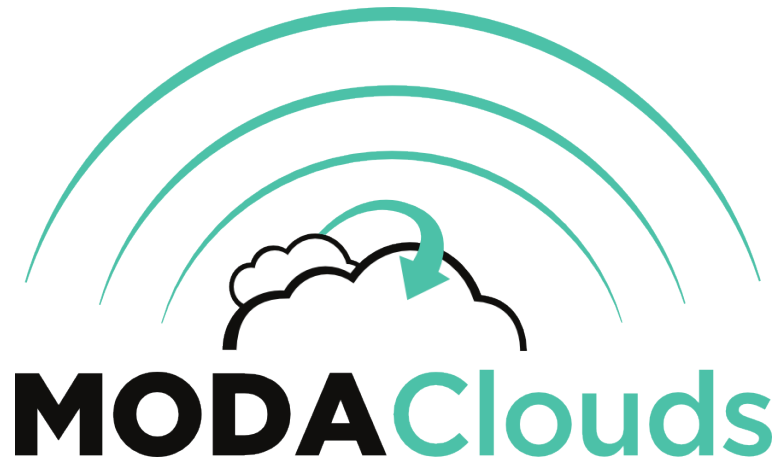- https://github.com/SINTEF-9012/cloudml/

Literature

Nicolas Ferry, Alessandro Rossini, Franck Chauvel, Brice Morin, Arnor Solberg

Towards model-driven provisioning, deployment, monitoring, and adaptation of multi-cloud systems

In *IEEE CLOUD 2013*

IEEE Computer Society, 2013

Acknowledgements

Thank you!

?

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