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Cloudiator: A Cross-Cloud, Multi-tenant Deployment and Runtime Engine (for IaaS)

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Disclaimer

Acknowledgements
The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement number 317715 (PaaSage).

Motivation

- Cloud hype is at its peak (or has even passed it)
- Still several huge probles around
  - Vendor lock-in
  - Uncomparable offerings (vCPU != vCPU)
  - Incompatible APIs, unadopted standards
  - Cloud providers do not fit

- Need to adopt application and deployment to changing conditions
- Adaptation and re-deployment
- Awareness of application state and failures

Motivation (ii)

What is needed is a platform

- to provide multi- and cross-cloud capabilities
- to enable re-use of software components
- to provide an abstraction layer over different cloud APIs
- to support multi-tenancy
- to enact powerful adaptation rules

Cloudiator is such a tool

Scopes

Deployment

Runtime Handling

Deployment

Understanding of „application“

Understanding of „cloud“

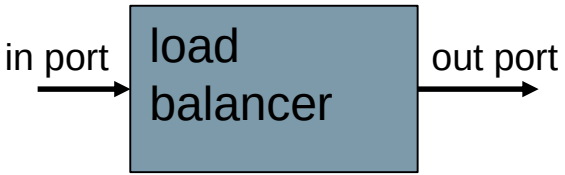
Understanding of „lifecycle“

Understanding Applications

Component

- Self-contained chunk of software
- Unit of failure
- Unit of scale

- May interact with other components through *channels*



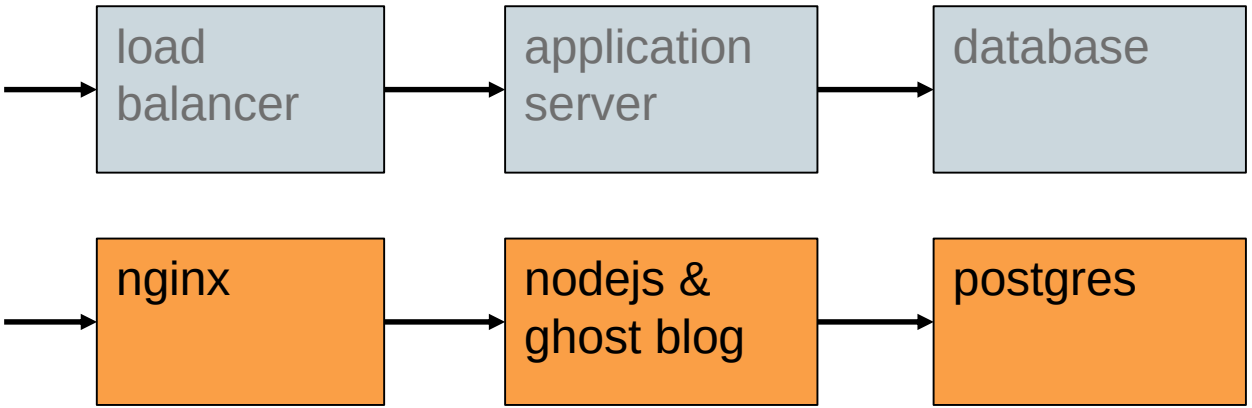
Examples

- Database
- Load balancer
- Web server/application server (in comb. with business logic)

Understanding Applications (ii)

Application

- Set of interdependent components
- Wired through channels

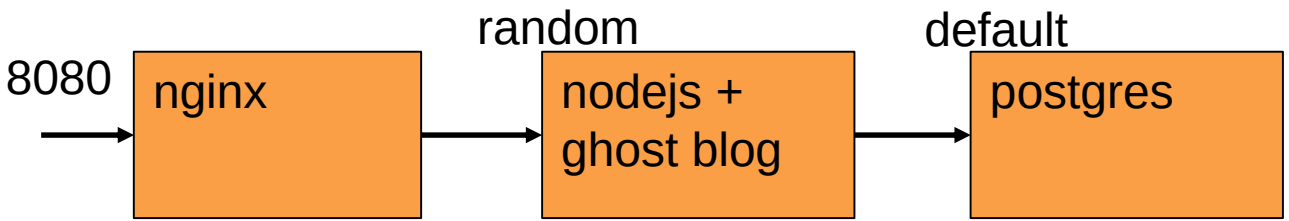


Understanding Applications (iii)

Application Instance

- Enactment of an application in the „cloud“
- At least one component instance per component

- Definition of ports (if needed)
- Definition of locations (clouds and virtual machines)



Deployment

Understanding of „application“

Understanding of „cloud“

Understanding of „lifecycle“

Understanding cloud terminology

cloud platform
- software stack
- version for
- management of (IaaS) resources

→ defines API

- OpenStack Juno

cloud provider
- offers access to resources by running cloud platform

→ defines endpoint (URI)

- Redstack, Uni Ulm cloud, bwCloud

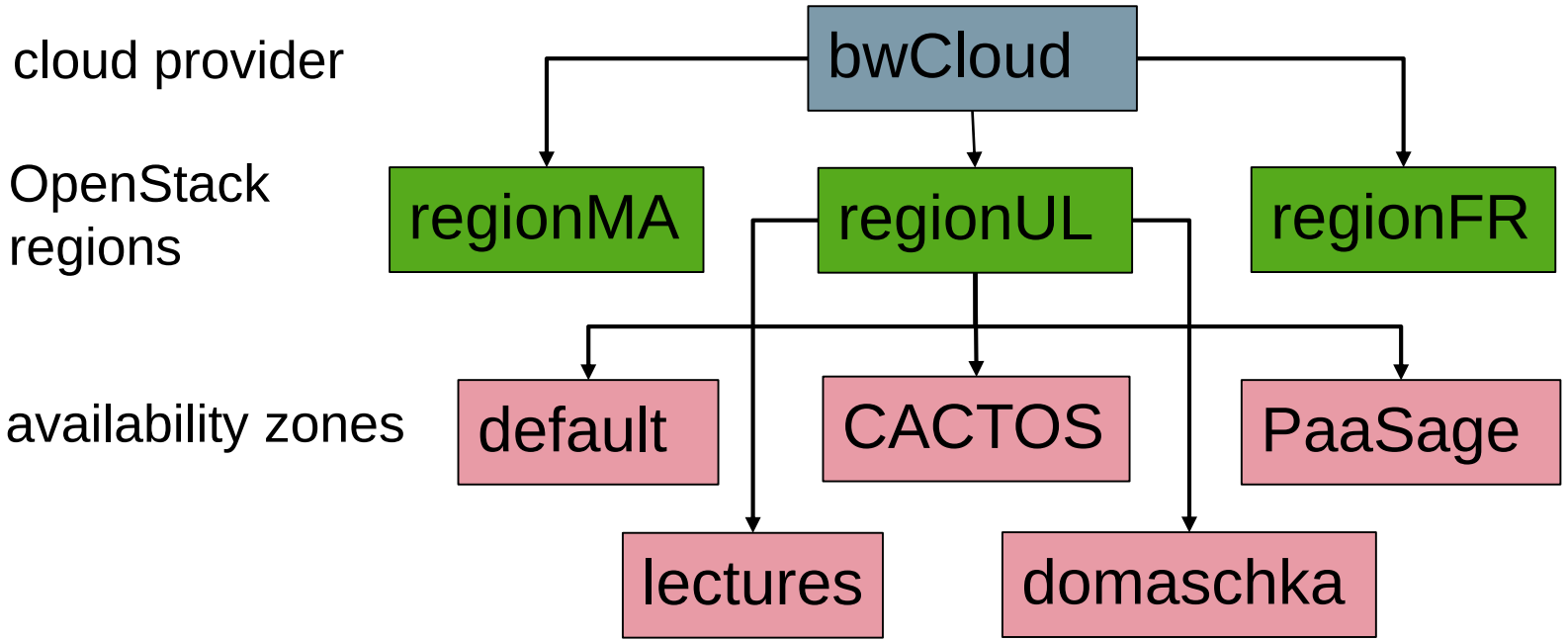
cloud
- provider as seen by user

→ user name
→ access credentials

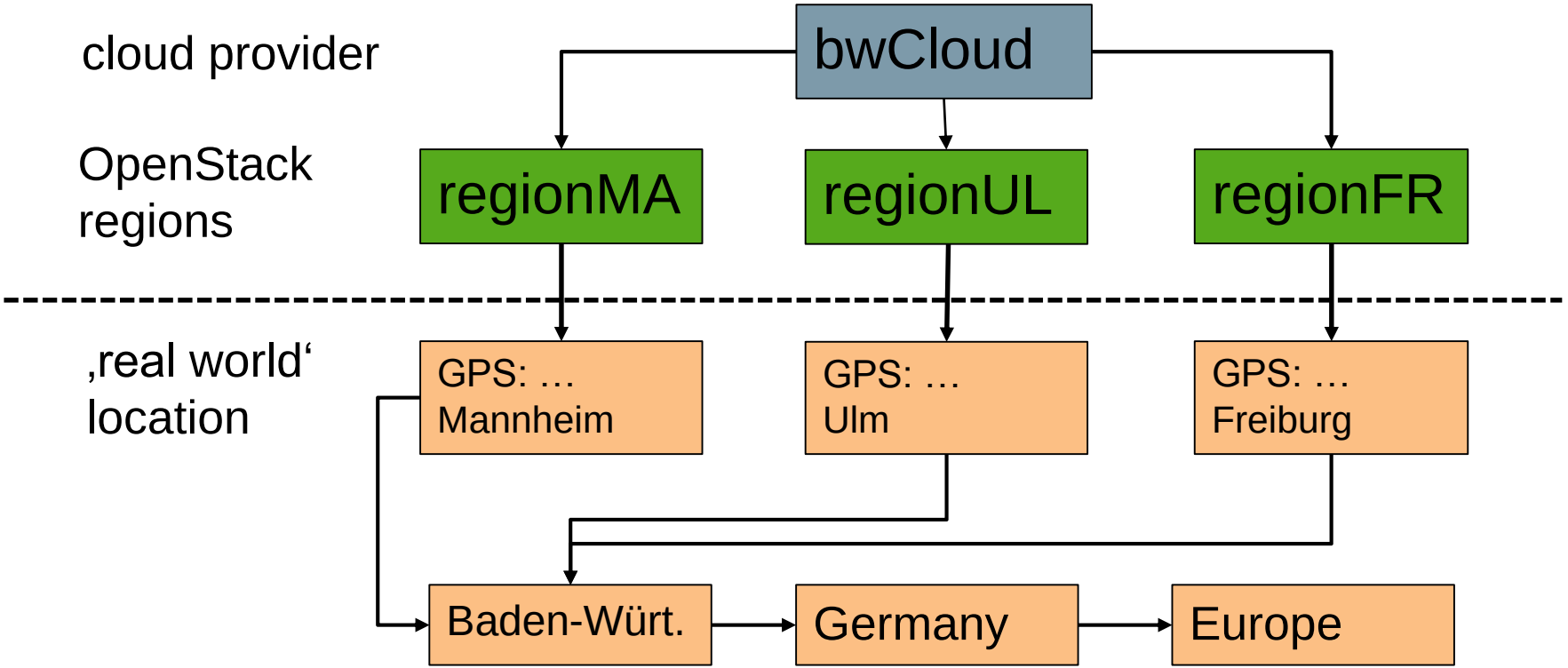
Dealing with Different Provider APIs

- Need for hiding the differences
- Cloudiator mostly relies on Apache jclouds
- … but has custom implementations as well

Technical Locations of bwCloud



Geographical Locations of bwCloud

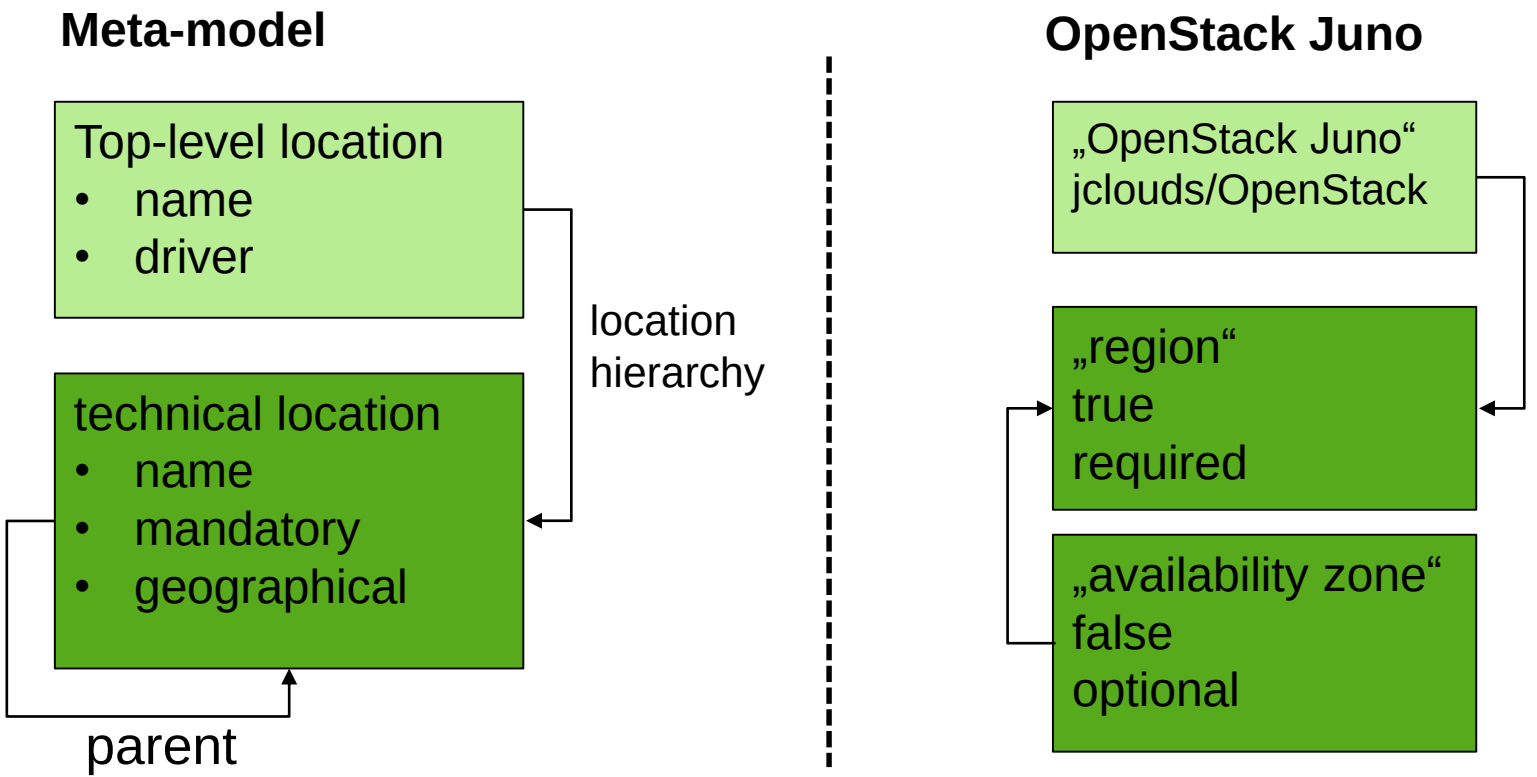


Locations of Cloud Providers

But …

- availabilty zones may reside in different geographical locations
- other cloud platforms may use different schemas
- Not all locations are required for deployment
  (e.g. availability zone is optional)

Locations of Cloud Providers (ii)

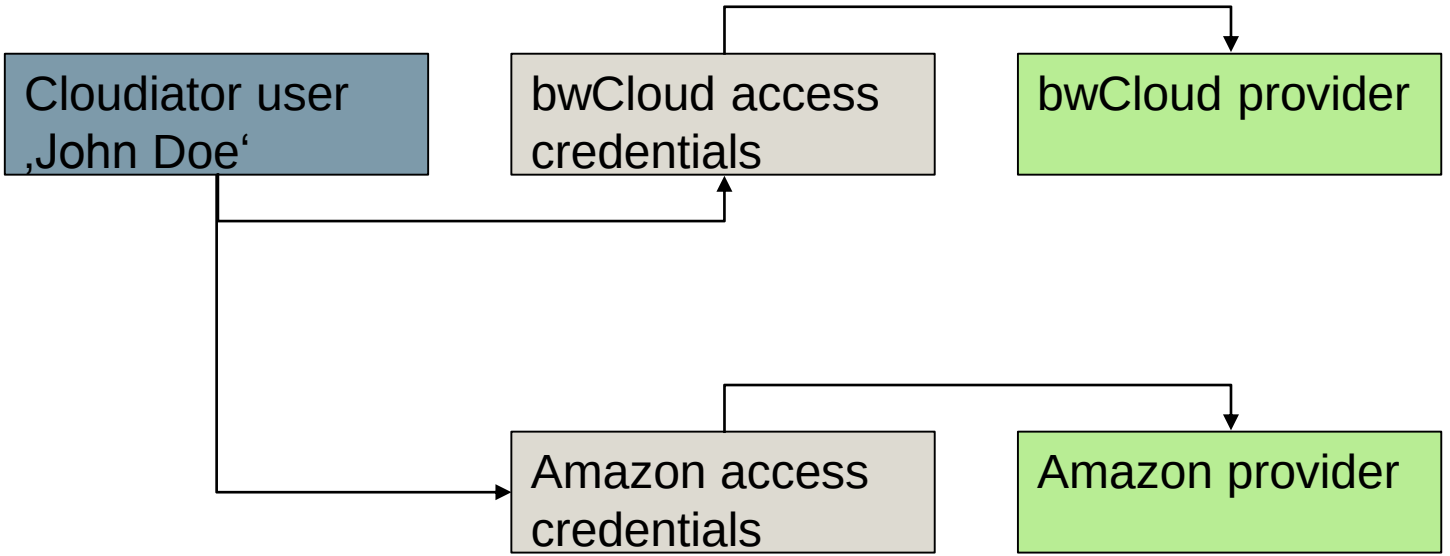


Other Properties

- locations, driver, and endpoints are cloud provider specific
- images and flavours are cloud-specific
  - different users may see different images/flavours

- same holds for virtual networks, security groups and the like

Cloudiator Users vs Cloud Users



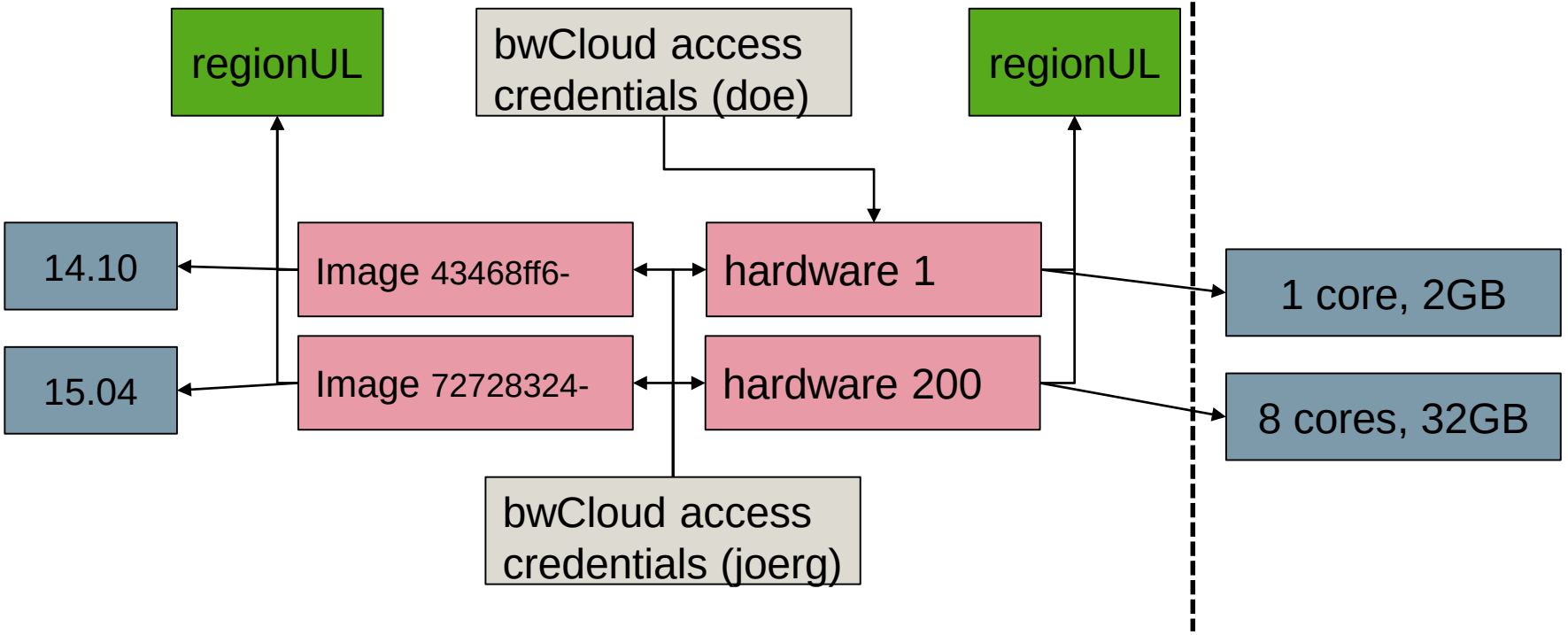
Adding a Cloud for a Cloudiator User

Triggers harvesting

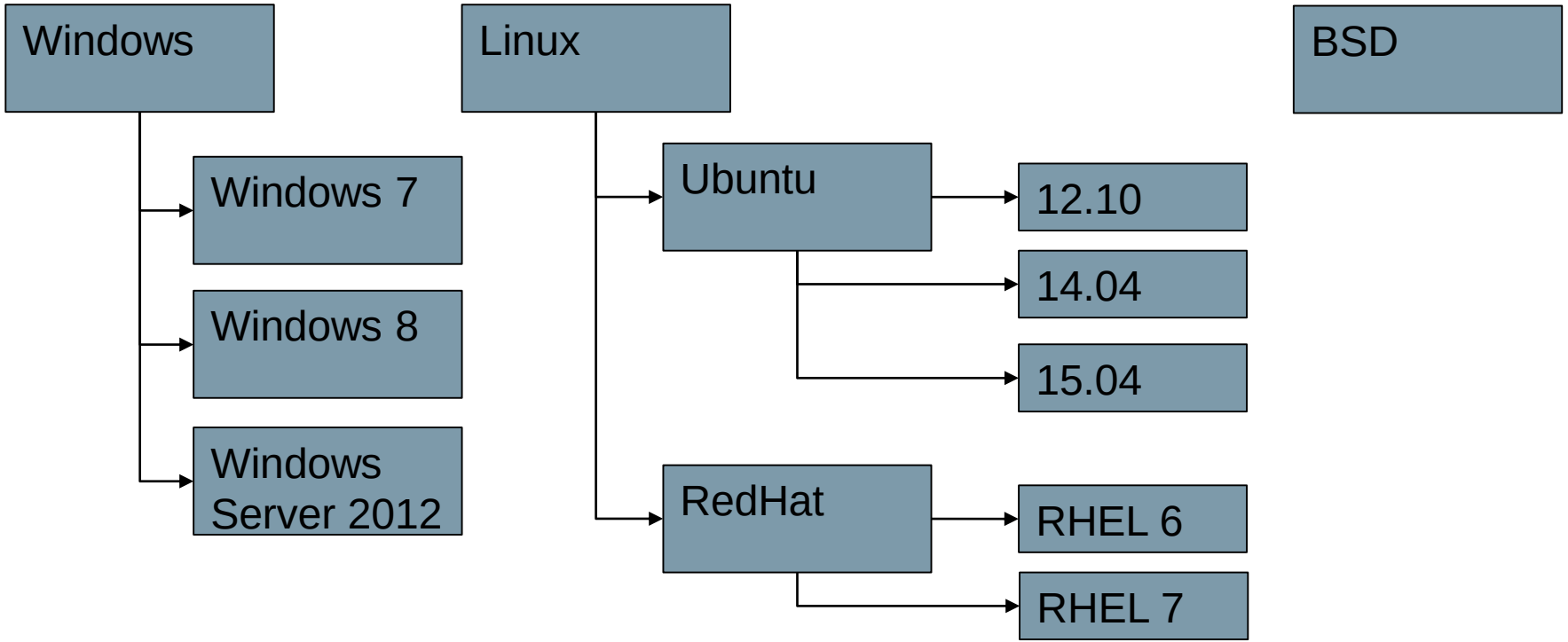
- Available locations (regions and availability zones)
- Available images
- Available hardware configurations (flavours)

- Periodically updated

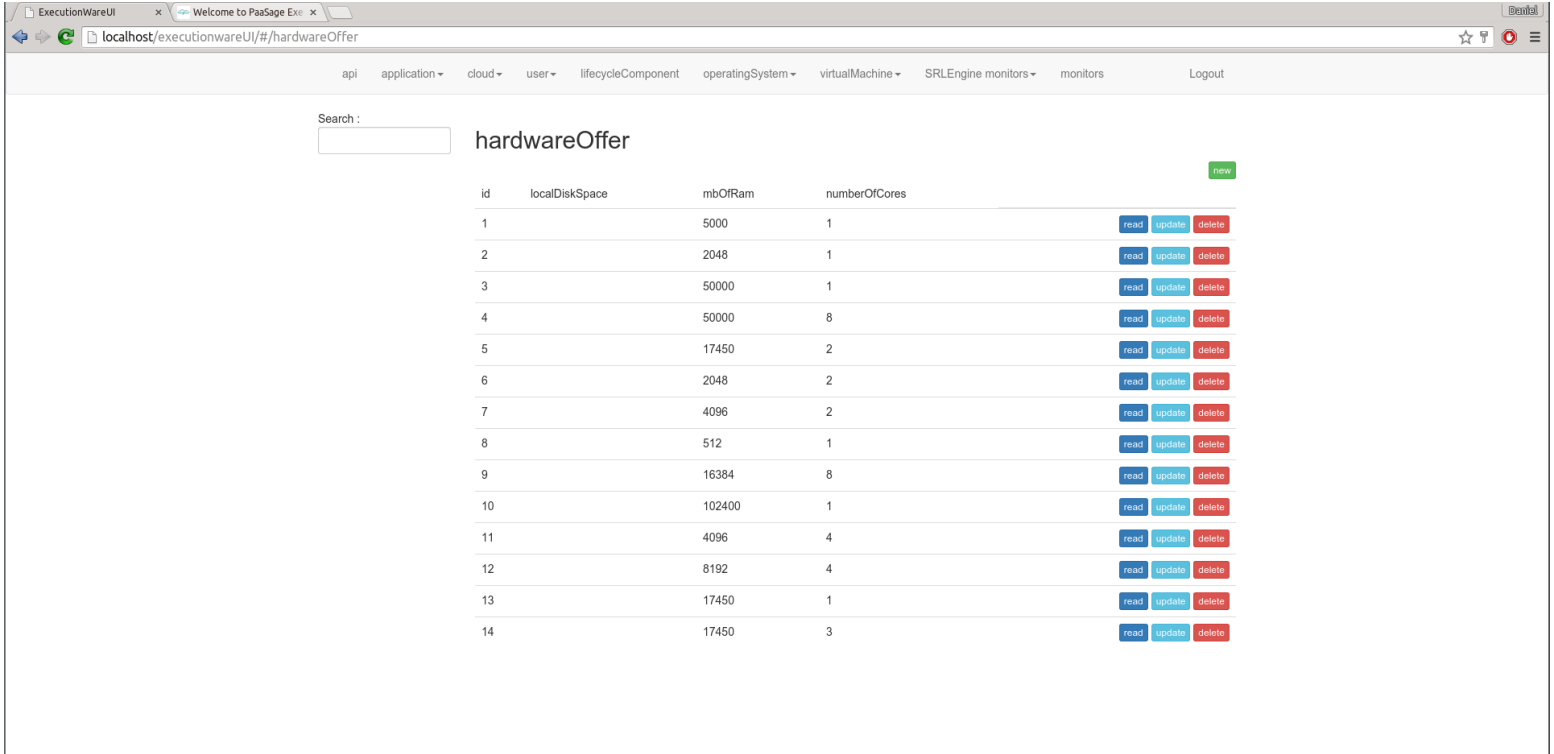
Images and Hardware Flavours



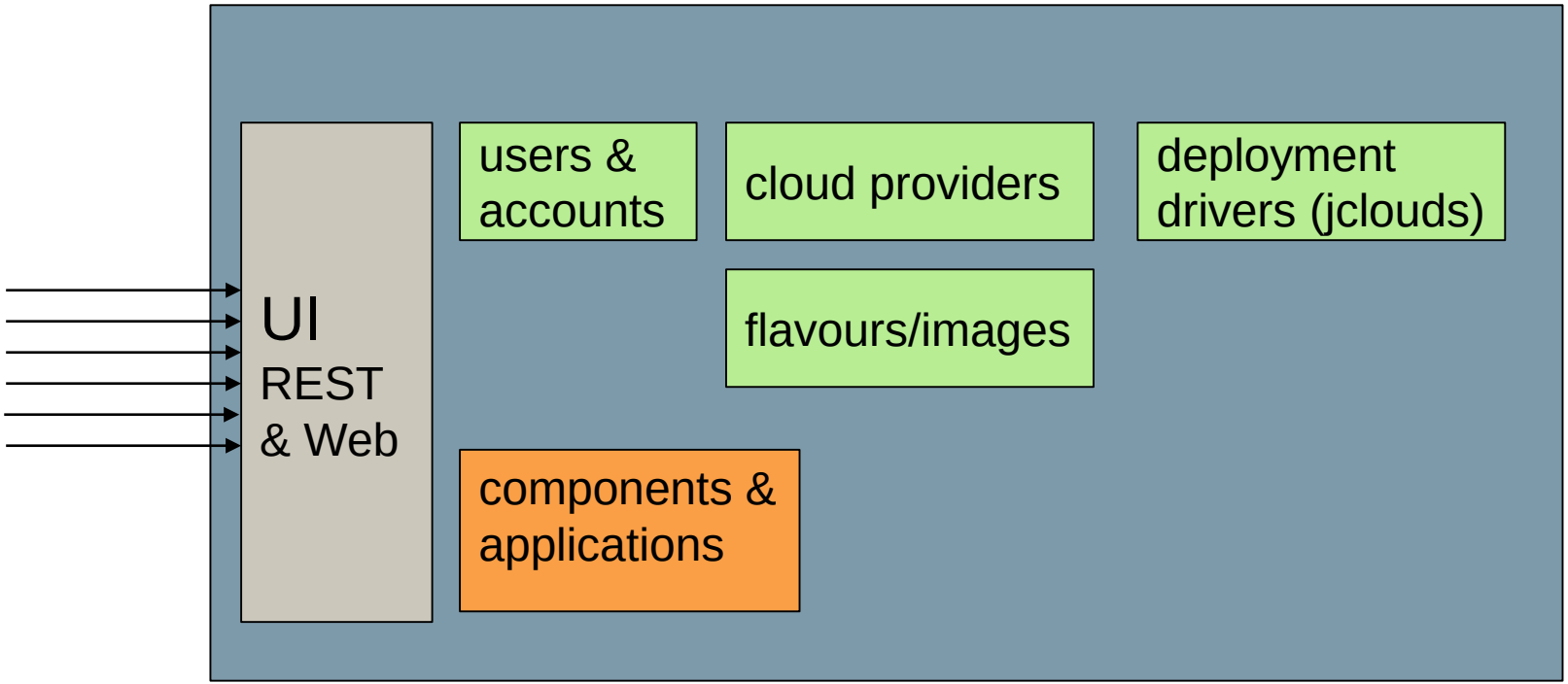
Operating System Hierarchy



Hardware Flavours



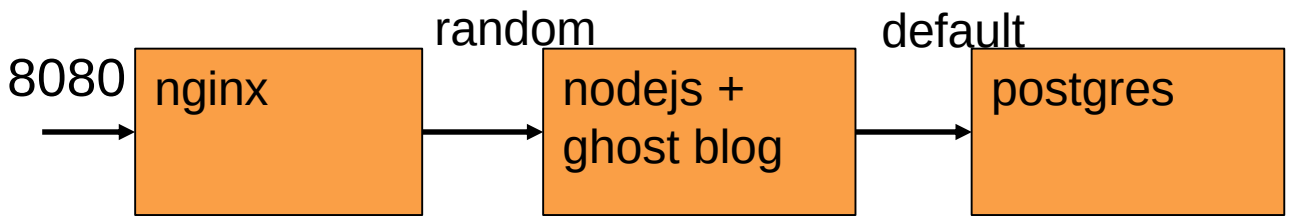
Cloudiator components



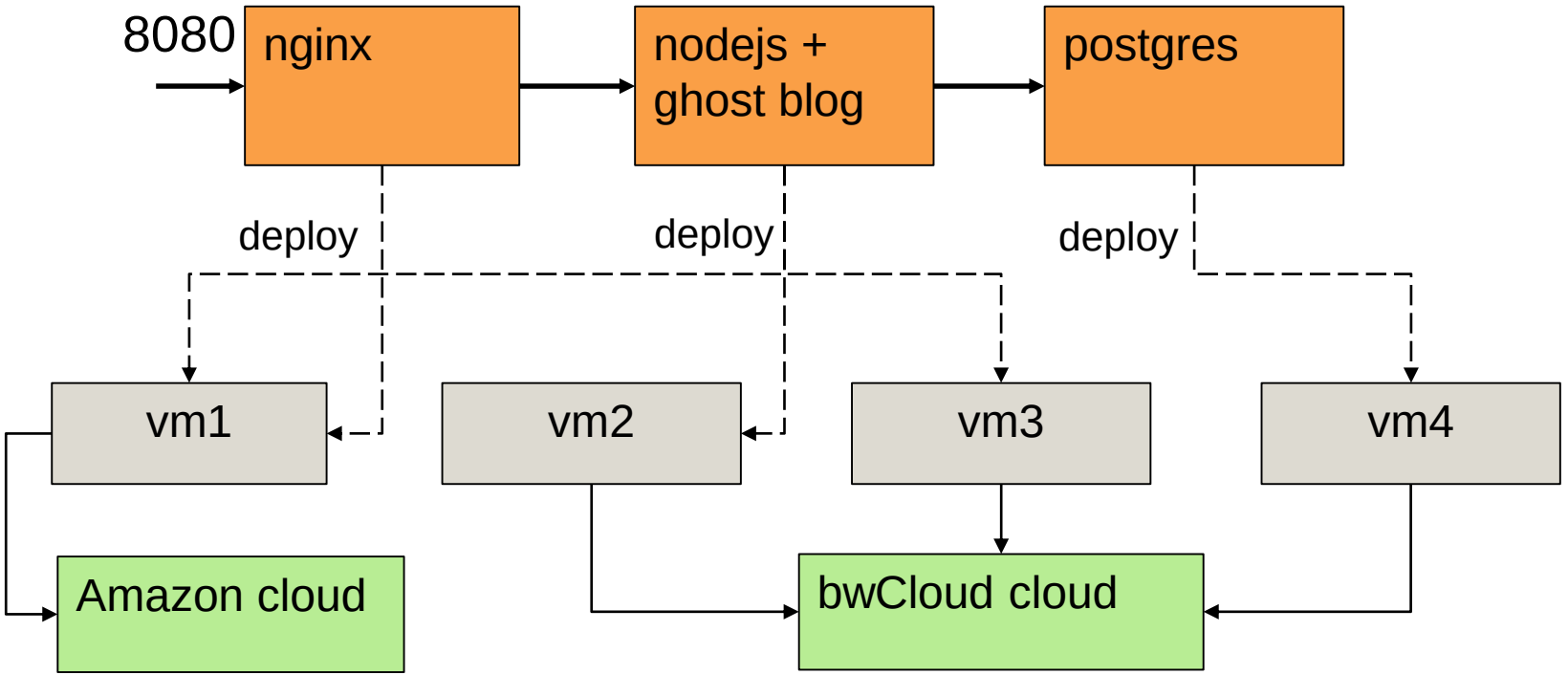
Creation of Application Instances

- Creation of virtual machines
- ‚Put' components on these virtual machines

- **no magic**



Creation of Application Instances (ii)



Deployment

Understanding of „application“

Understanding of „cloud“

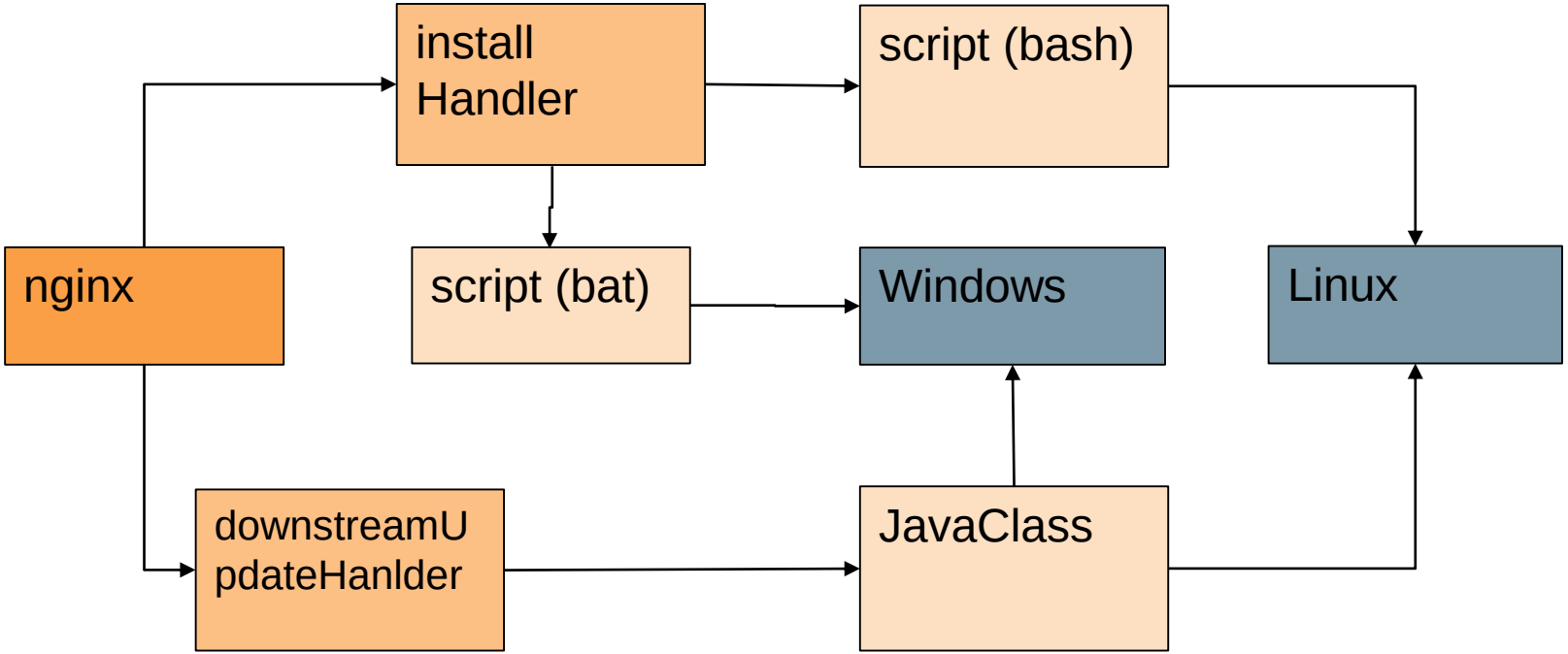
Understanding of „lifecycle“

Lifecycle Handling

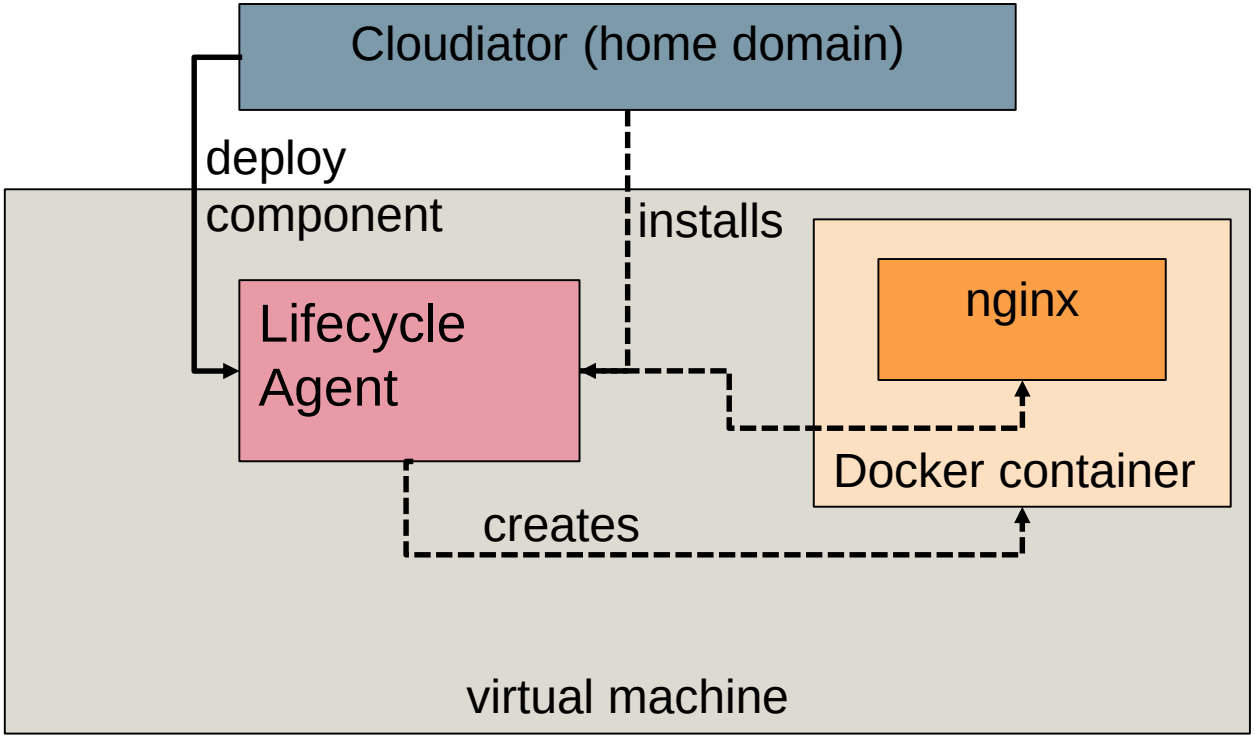
Lifecycle: defines actions to steer application component

- Fixed set of common handlers
  - install (download)
  - configure
  - start, stop
- Surveillance
  - start detector
  - stop detector
- Ports
  - downstreamUpdates

Clouditor Lifecycle Handlers (Example)



Technically Speaking …



Scopes

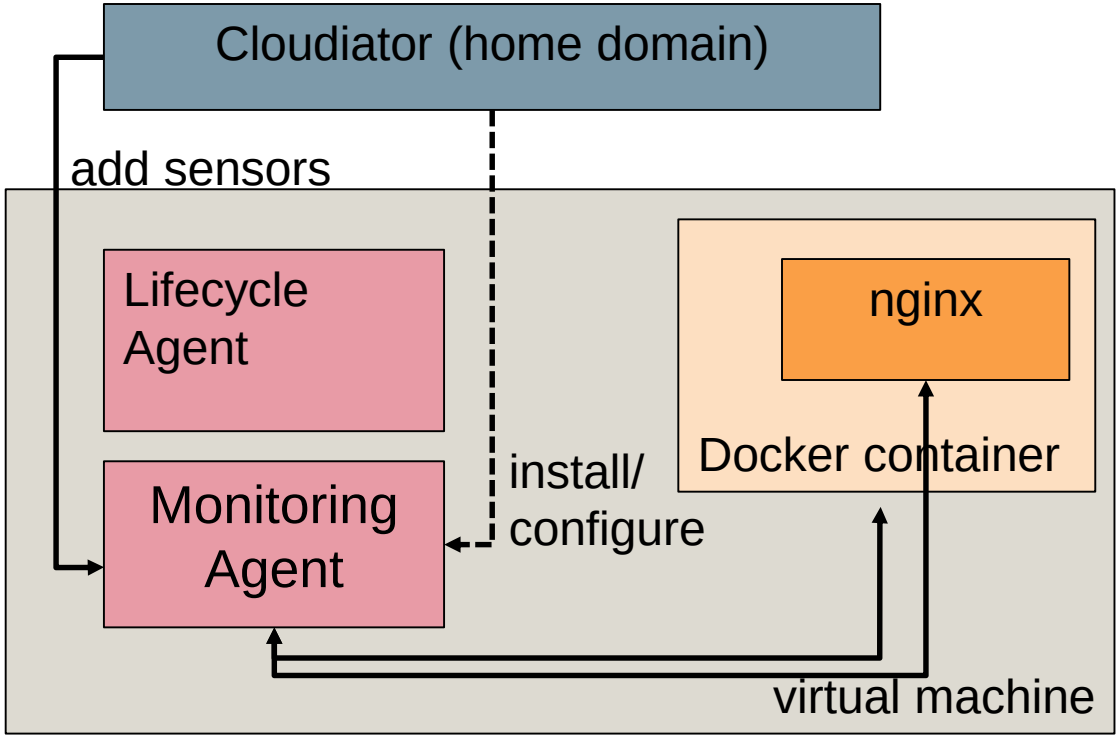
Deployment

Runtime Handling

Knowing what is going on …

- Judging your current deployment requires insight into the behaviour of
  - virtual machines
  - component instances
  - groups of component instances
  - …
- Monitoring is the key to this

Monitoring architecture (pt i)



Monitoring Agent

- monitors VM
- monitors container
- monitors application

- default probes
- custom probes
- pull/push based

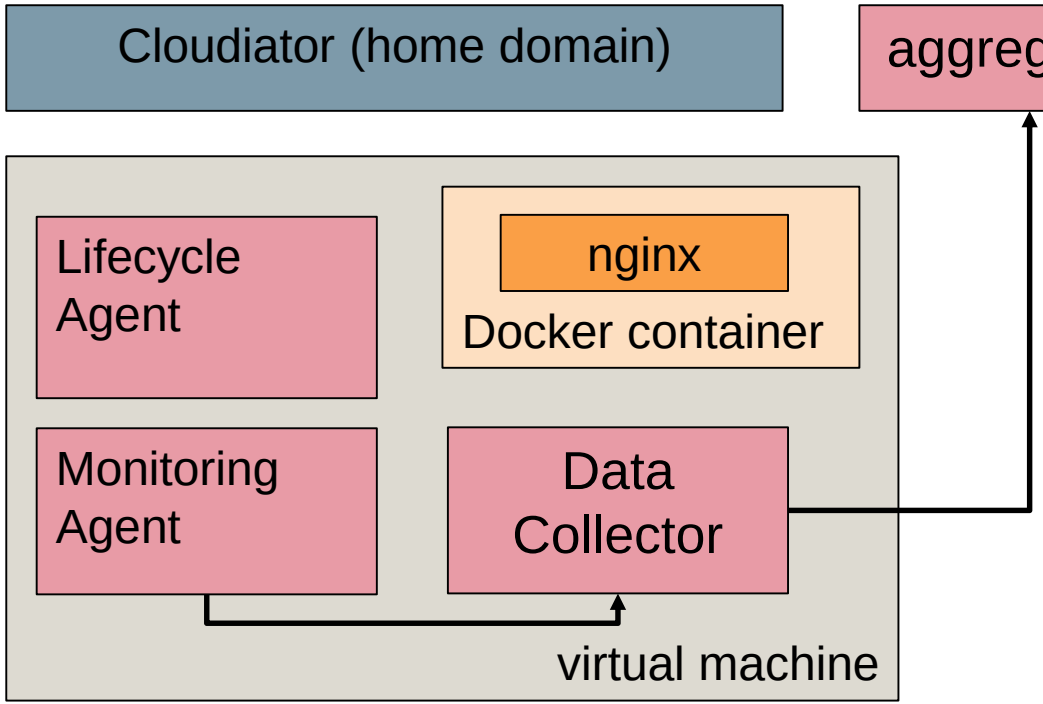
- variable intervals

Dealing with Raw Data

- raw data is often useless
- at least aggregation is needed

→ collect data such that aggregation is possible

Monitoring architecture (pt ii)



Data Collector

- make data available to aggregators
- relay data if needed
- currently two implementations

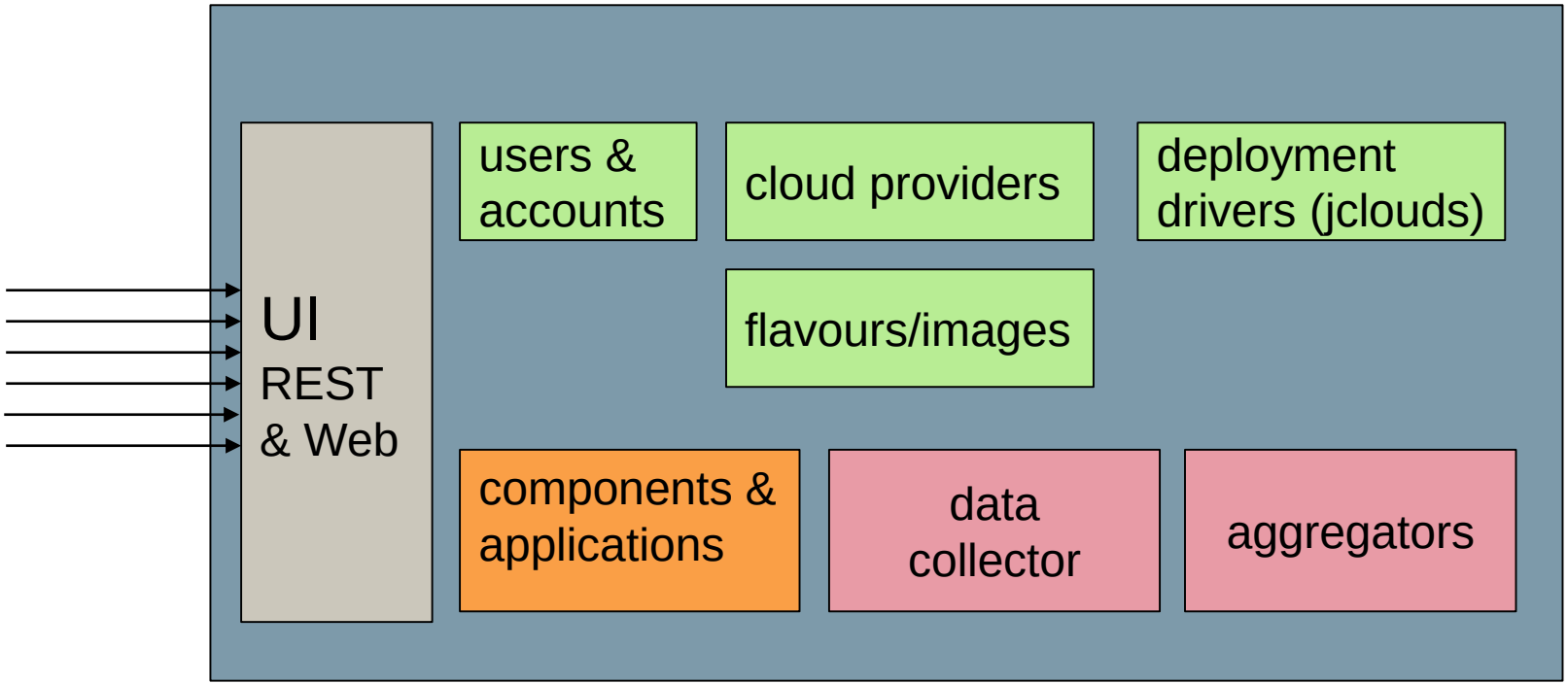
- only has limited resources available

Where to aggregate?

Cloudiator‘s rule of thumb: transmit as little data as possible

scope	input from	aggreator at	output to	example
host	single vm	this vm	this vm collector	10 minutes CPU average of single container
cloud	vms in one cloud	any vm in cloud*	any collector in cloud	average of above across all instances of the same component
global	vms from at least two clouds	home domain	collector at home domain	average of above of all containers of cross cloud application

Cloudiator components



What to monitor and what to aggregate?

(where do probes and aggregator configuration come from?)

- user defined
  - investigate curves at GUI
  - user-requested data is also stored at home domain
- part of the scalability rules definition …

Monitoring and Probing Example

```
{
”sensors” :[
    {”name” :”CPU”, ”type” :”system.cpu”, ”interval” :”1s”}
 ],

”metrics”: [
    {”name” :”raw cpu”, ”scope” :”blog.ghost.EACH”, ”type” :”raw”, ”sensor” :”CPU”},

    {”name” :”avg cpu”, ”scope” :”raw cpu.EACH”, ”type” :”compute”,
                                                    ”params” :[”AVG”, ”10min”, ”raw cpu”]},

    {”name” :”avg global”, ”scope” :”SINGLE”, ”type” :”compute”,
                                                    ”params” :[”AVG”, ”avg cpu.ALL”]}
 ]
}
```

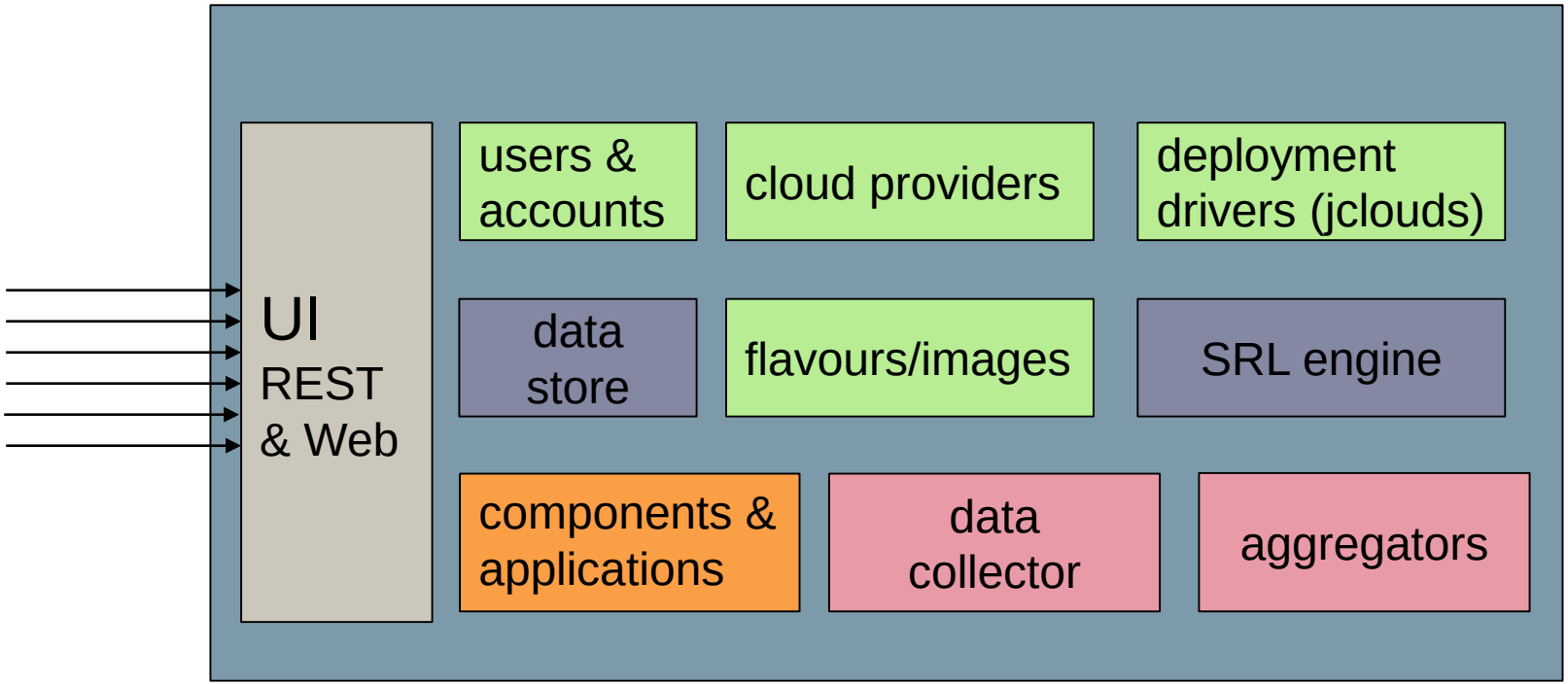
PaaSage Scalability Rules Language (SRL)

- fine grained approach to specifying when to add new instances to a component
- Clouditor ships with an engine supporting SRL
- Basically same concept as for monitoring:
  conditions are treated as metrics

Scaling Rules Example

```
{
”rule” :{
        ”condition” :[”AND”,
                [”avg cpu.ANY”, ”GT”, ”80%”]
                [”avg global”, ”GT”, ”60%”]
        ],
        ”action” :[”SCALE OUT”,
                {”scope” :”component”,
                ”target” :”ghost”}
                ]
        }
}
```

Cloudiator components (final view)



Summary: What *Cloudiator* offers …

simple application specification

application instantiation (deployment)

application operation (monitoring and adaptation)

IaaS provider management

user management

- down to earth software suite
- with barely any magic

open source, hosted@github
https://github.com/cloudiator

Our Roadmap

- Release of version 0.1 at beginning of August
  - Will have been tested by 4 PaaSage use cases by then
- For version 0.2 (end of September)
  - Finalise initial Windows support
  - Add more robustness (failure detection)
- For version 0.3 (end of 2015)
  - Add stateful migration of instances

- Introduce higher layers of abstraction
- Support further deployment mechanisms such as
  - Puppet, Chef, Dockerfiles