Automating Resource Selection and Configuration in Inter-Clouds through a Software Product Line Method

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Netflix @Netflixhelps

Follow

We're aware that some members are experiencing issues streaming movies a TV shows. We're working to resolve the problem.

Google Cloud Outage: Virtual Networking Breakdown

Google's virtual networking software stopped providing routing updates, and customers lost their connections to the outside world.

(http://ubm.io/1XZ0kgx)

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reddit what's hot new controversial top

reddit is in "emergency read-only mode" right now because Amazon is experiencing a degradation. they are working on it but we are still waiting for them to get to our volumes. you won't be able to log in. we're sorry and will fix the site as soon as we can.

The problem with network connectivity in Google Compute Engine is resolved as of shortly after 01:00 US/Pacific. We are sorry for any issues this may have caused to you or your users and thank you for your patience and continued support. Please rest assured that system reliability is a top priority at Google, and we are constantly working to improve the reliability of our systems.

We will provide a detailed analysis of this incident once we have completed our internal investigation.

(status.cloud.google.com/incident/compute/15045)

Pinterest @Pinterest

Hi Pinners, we are currently experiencing site issues and working hard to resolve this as soon as possible. Thanks for your patience!

7:32 PM - 22 Oct 12

146 RETWEETS 28 FAVORITES

Connection Error

iCloud encountered an error while trying to connect to the server.

foursquare support @4sqSupport

You may have noticed that some of your favorite sites a down, including Foursquare. We're hoping things will b back to normal soon!

7:11 PM - 22 Oct 12

200 RETWEETS 15 FAVORITES

"Users may notice slower than normal performance when using iCloud Drive, My Photo Stream, iWork for iCloud, Backup & Restore, iPhoto Journals, iMessage attachments, Mail Drop, or iMovie Theater."

Airbnb @Airbnb

Apologies. Our site is h We'll Airbnb as soon as

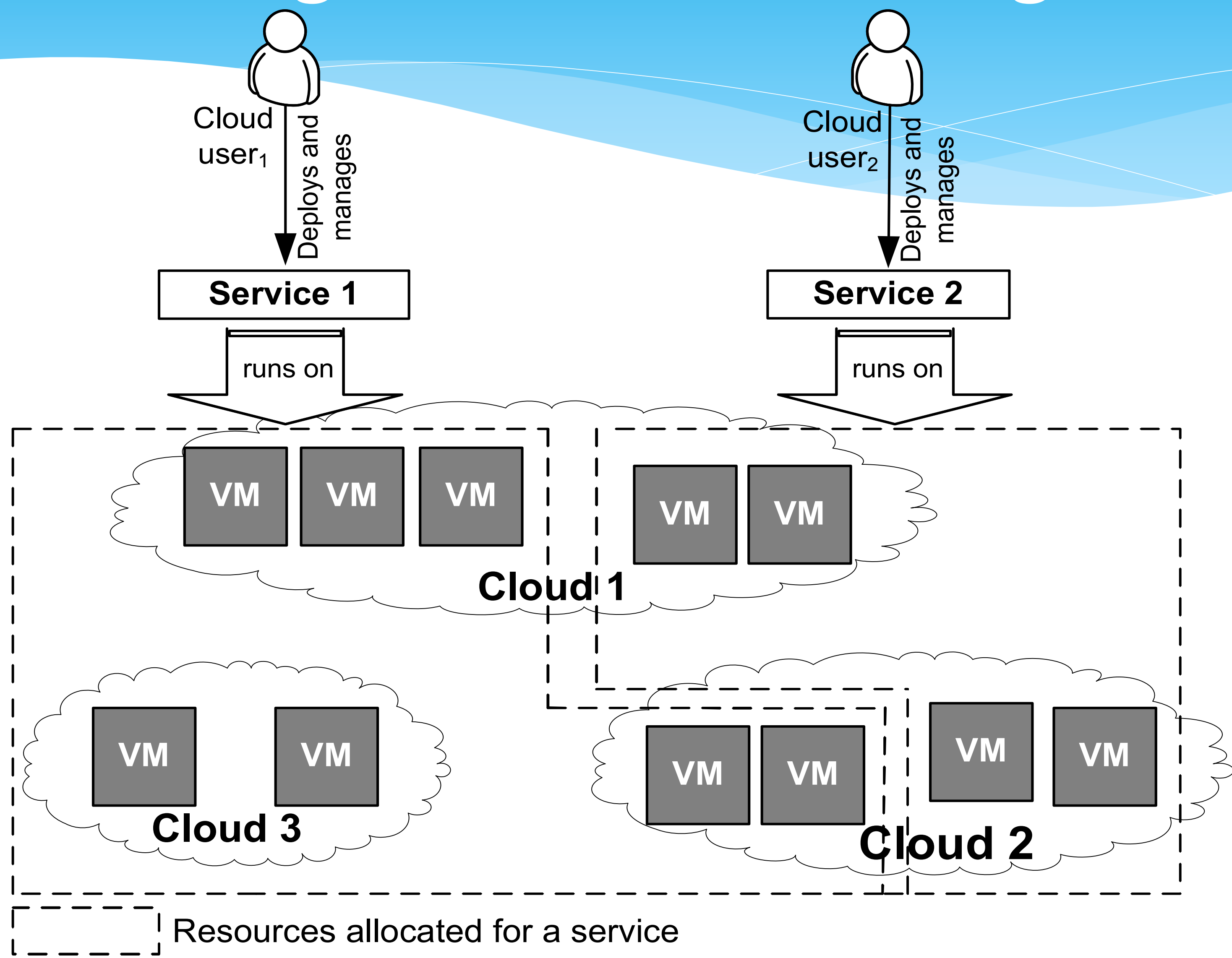
4:46 PM - 22 Oct 12

15 RETWEETS 6 FAVORITES

Netflix US @netflix

We're sorry for the Cl Terrible timing! Engineers are working on it now. Stay tuned to @Netflixhelps for updates.

An inter-cloud scenario may help us on dealing with clouds' outages



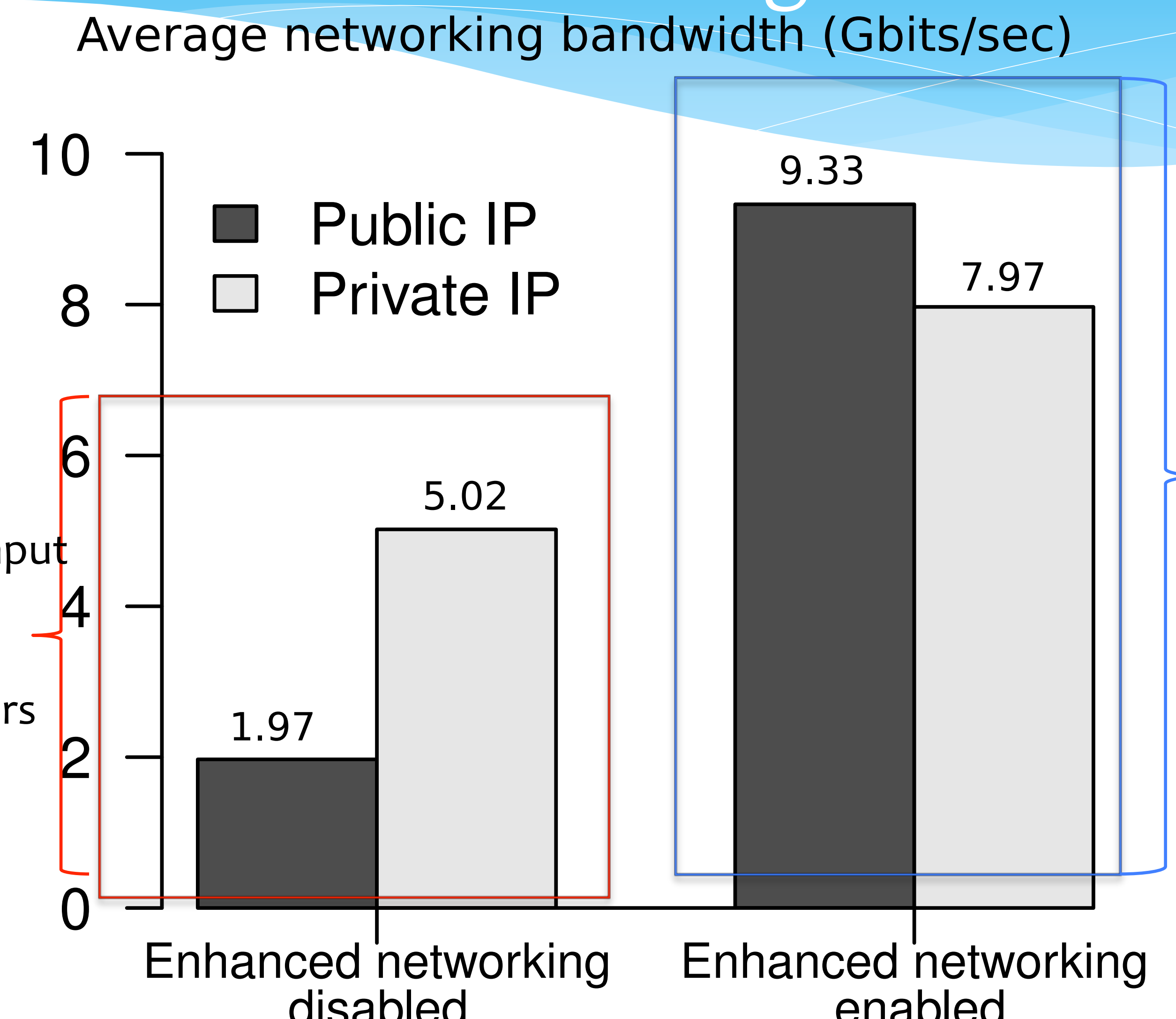
There are some challenges to implement an inter-cloud scenario

* Complexity
* Lack of models to describe multiple cloud environments
* Lack of tools that implement automatic resource selection and configuration
* Environment configuration tools still demand programming skills

Why inter-clouds scenarios are complex?

* The users are responsible for:
  * Identify the clouds and the virtual machines types
  * Select the virtual machine images (VMI) in each cloud
  * Deploy the applications, taking into account dependencies and clouds' constraints
* Even with the pre-configured VMIs configuration involves manual activities (time consuming and error-prone)
* A cloud configuration may demand specialized skills

Example of a networking feature that requires advanced knowledge -- AWS's enhanced networking feature



Network throughput when the VM is started with the default parameters

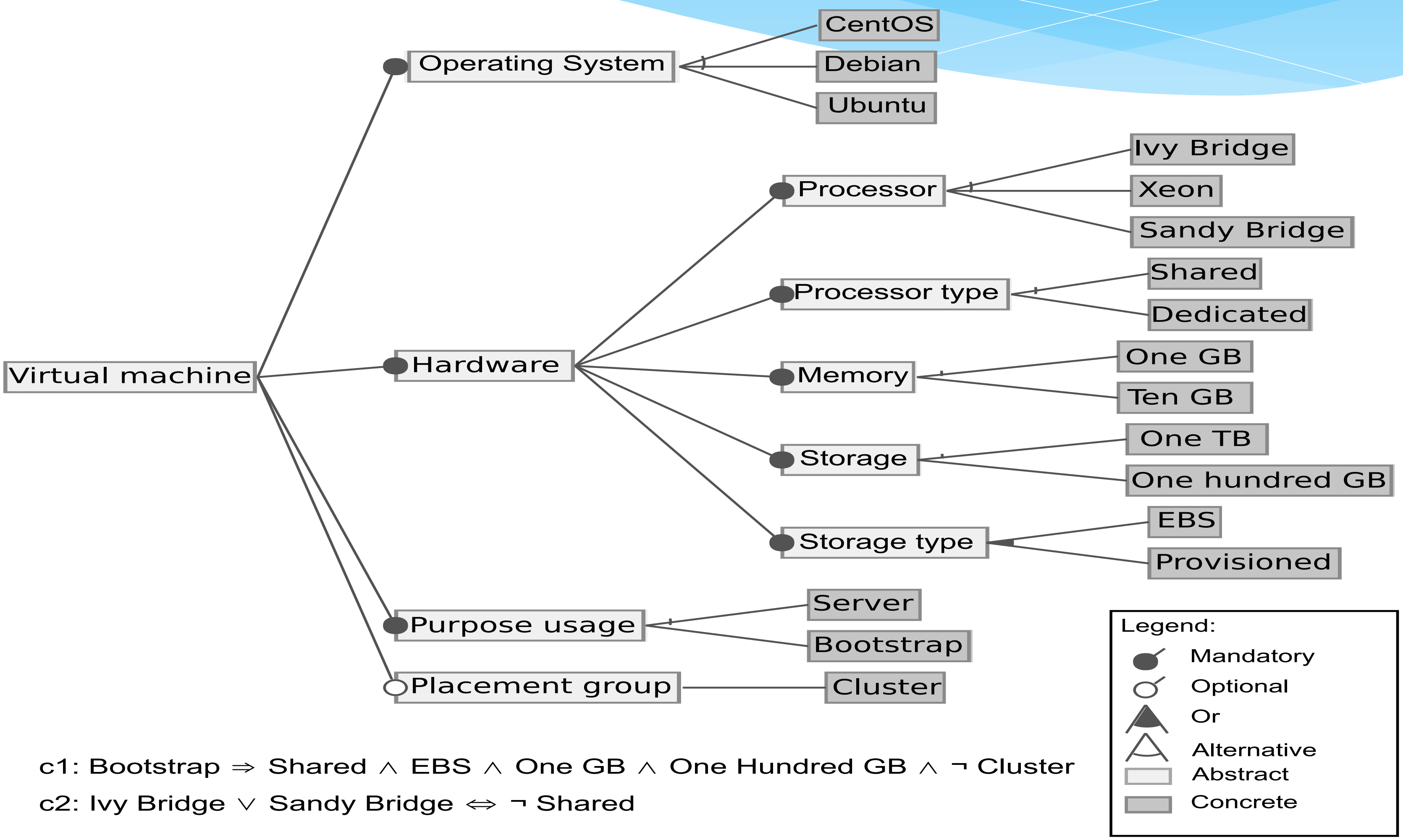
Network throughput after enabled a kernel's driver

Software engineering techniques may help us on dealing with **cloud variability** and on implementing **automatic inter-clouds configuration**

A Software Product Line (SPL) is a strategy to design a family of related products using a **common architectur**e, with **variations in features.**

With a SPL, a single platform can be massively customized to generate a group of products

SPL relies on feature model to describe the features



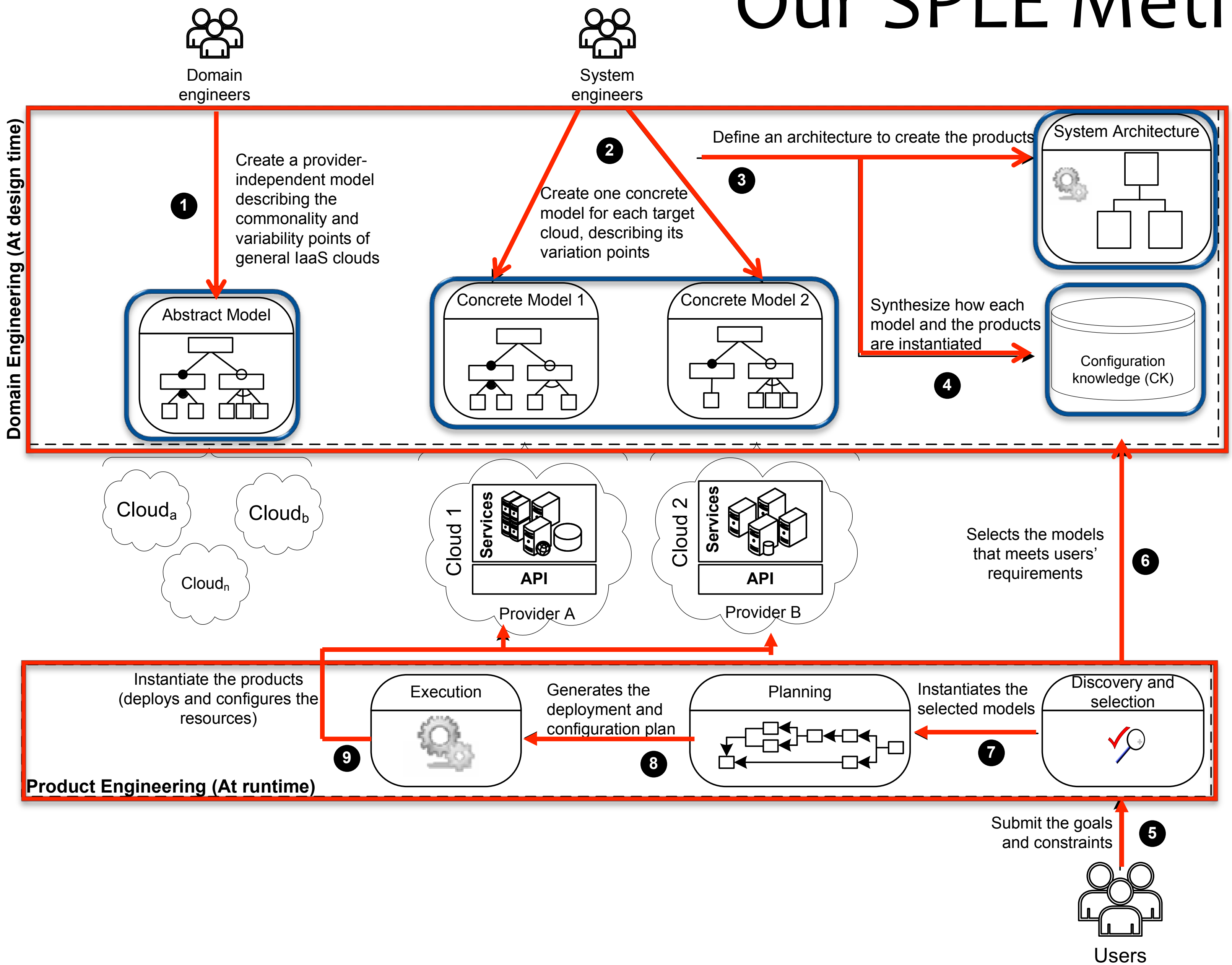
c1: Bootstrap ⇒ Shared ∧ EBS ∧ One GB ∧ One Hundred GB ∧ ¬ Cluster

c2: Ivy Bridge ∨ Sandy Bridge ⇔ ¬ Shared

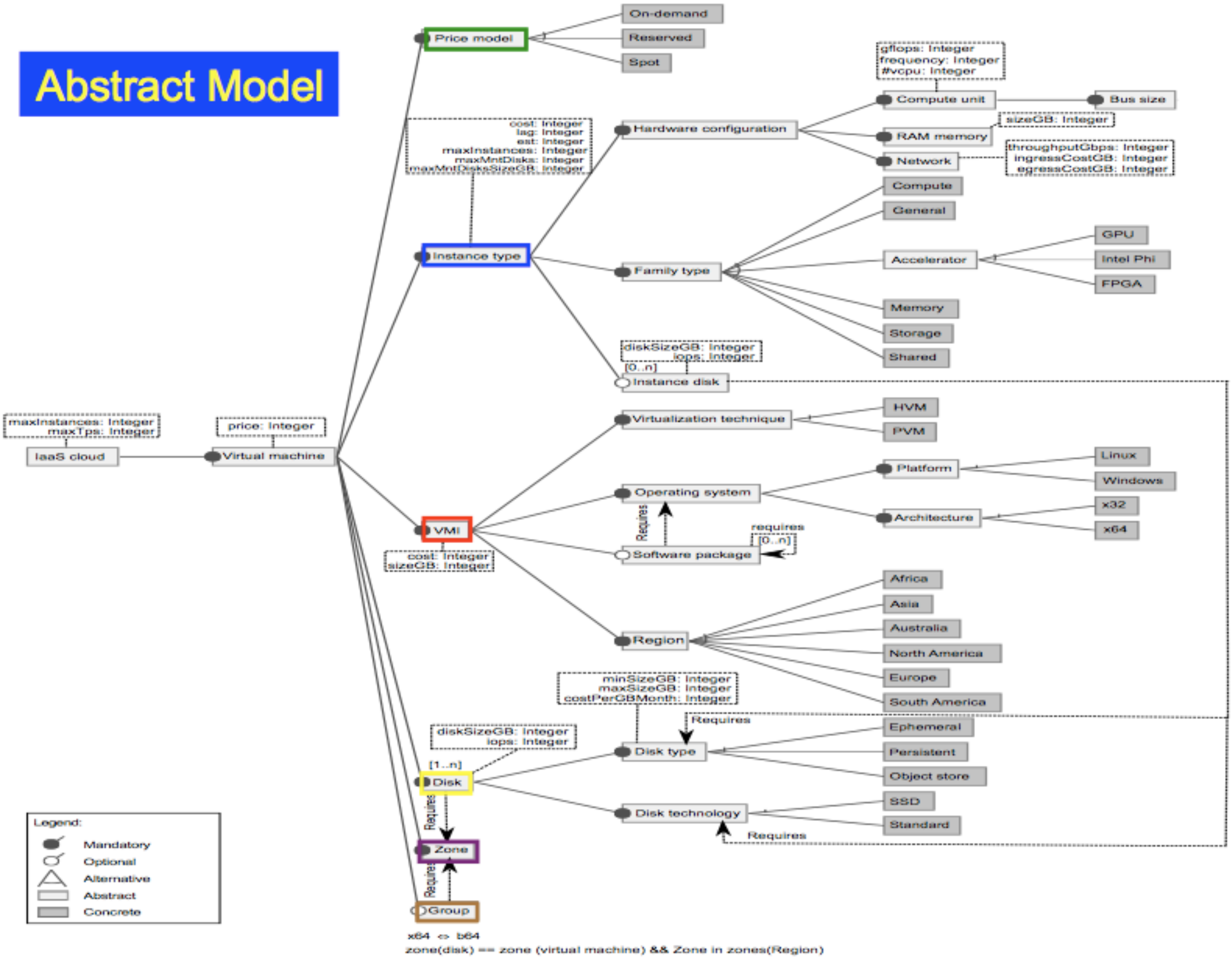
We developed a SPLE method and a tool to implement the method

* **A Software Product Line Engineering (SPLE) method** for inter-cloud environments. It aims to enable both automatic resource selection and configuration.
* A tool, called Dohko, that implements the proposed method.

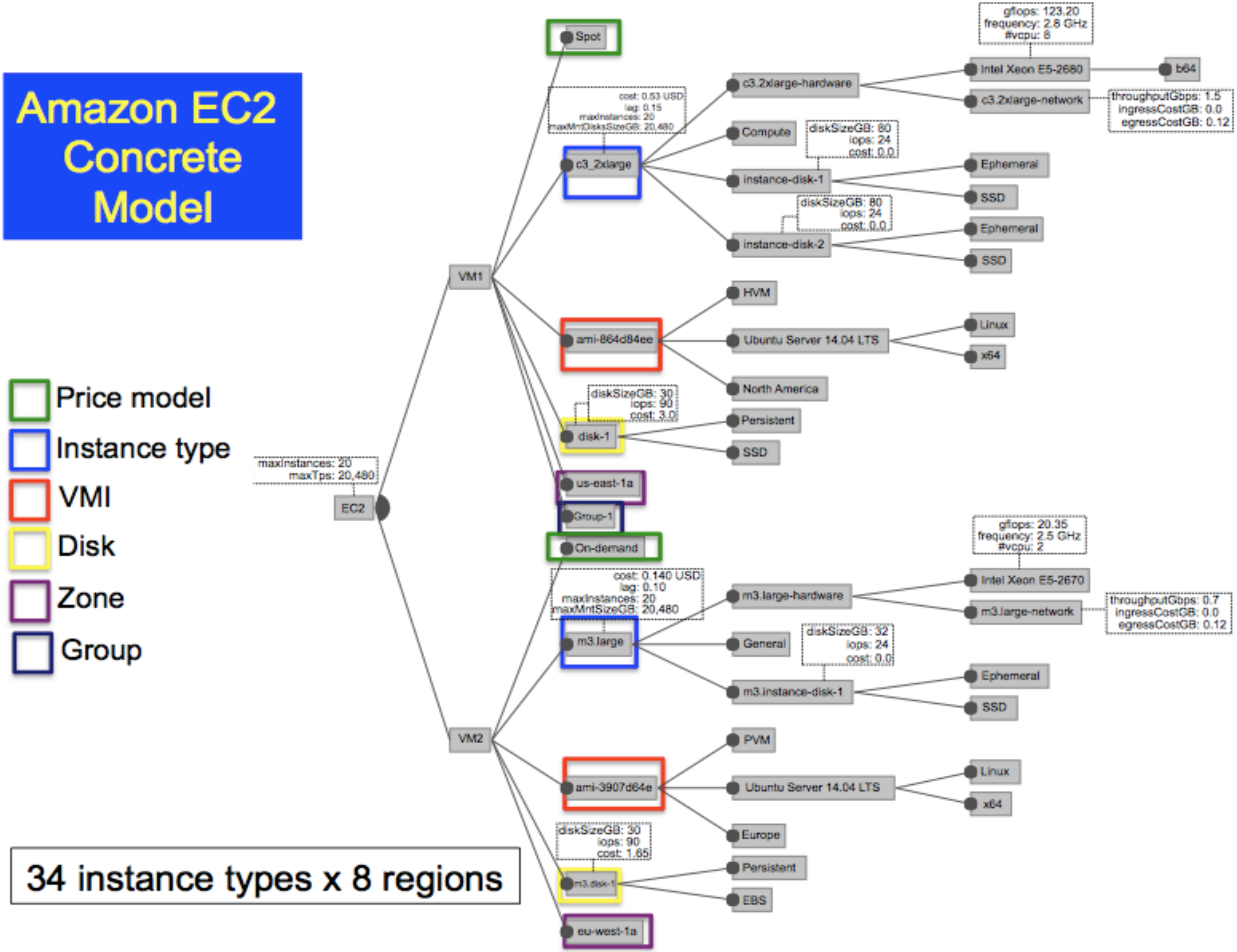
Our SPLE Method



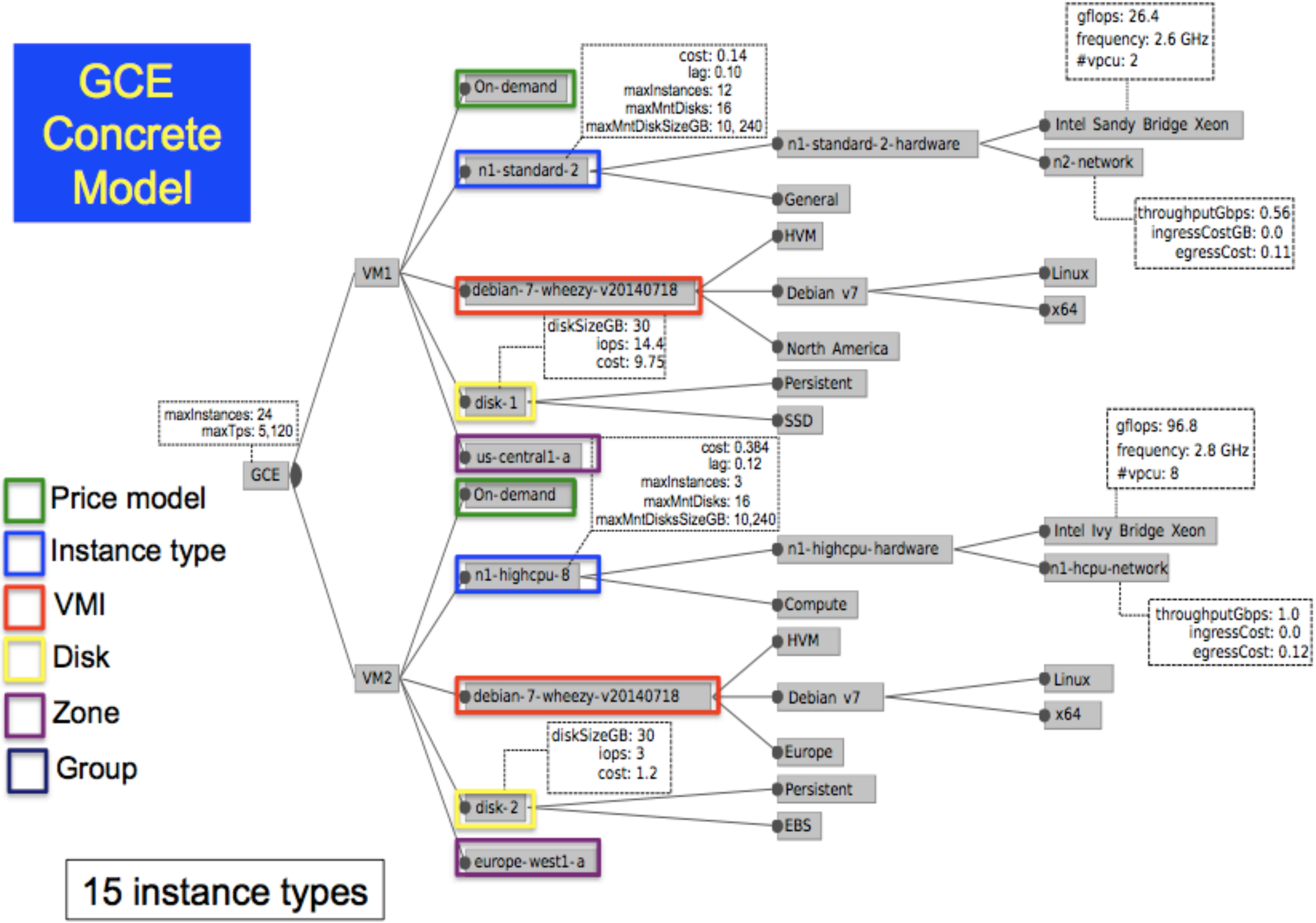
Abstract Model



Amazon EC2 Concrete Model



34 instance types x 8 regions

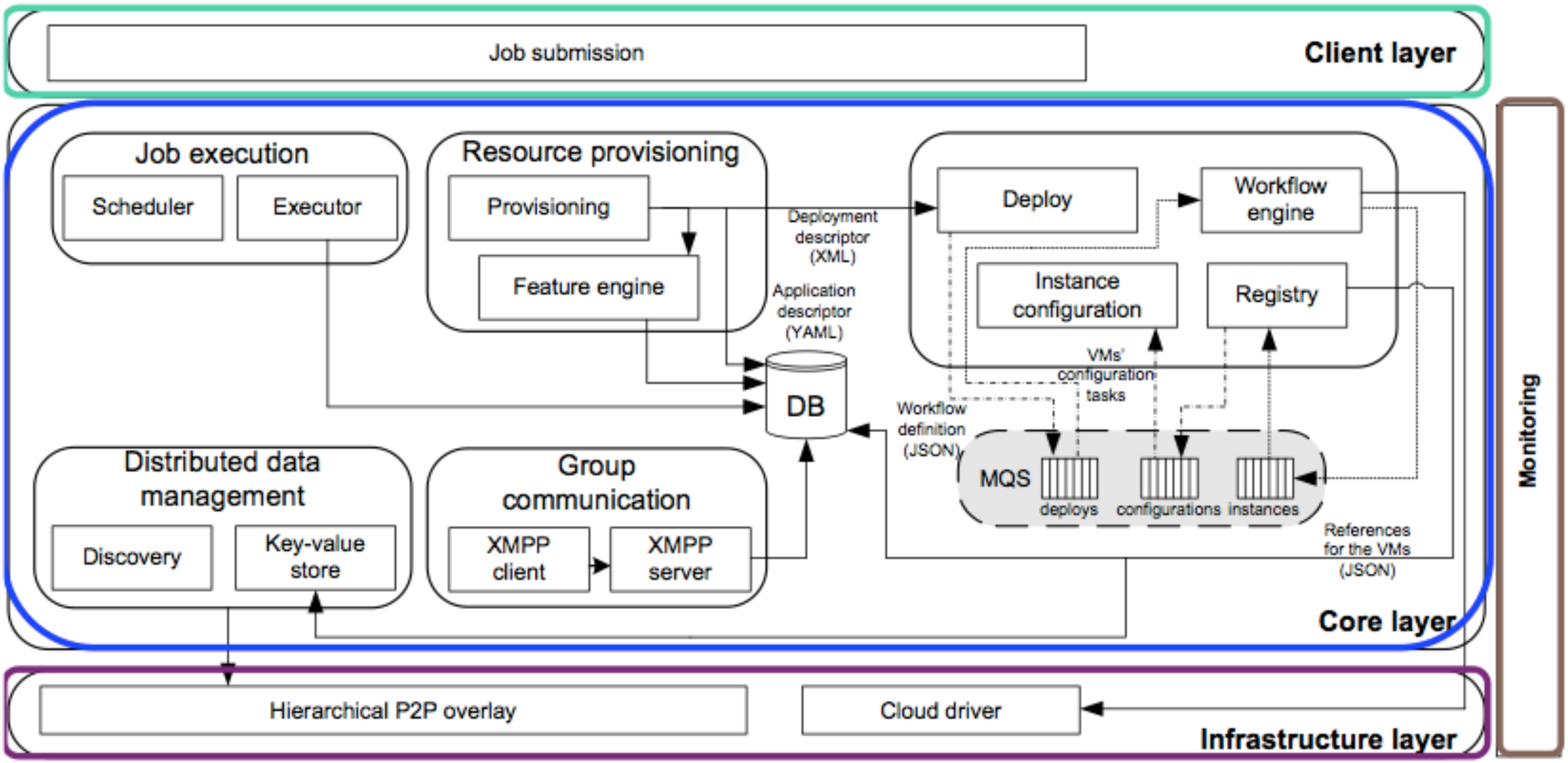


GCE Concrete Model
Price model
Instance type
VMI
Disk
Zone
Group
15 instance types
GCE
maxInstances: 24
maxTps: 5,120
VM1
On-demand
n1-standard-2
cost: 0.14
lag: 0.10
maxInstances: 12
maxMntDisks: 16
maxMntDiskSizeGB: 10, 240
n1-standard-2-hardware
Intel Sandy Bridge Xeon
gflops: 26.4
frequency: 2.6 GHz
#vpcu: 2
n2-network
throughputGbps: 0.56
ingressCostGB: 0.0
egressCost: 0.11
General
debian-7-wheezy-v20140718
HVM
Debian v7
Linux
x64
North America
disk-1
diskSizeGB: 30
iops: 14.4
cost: 9.75
Persistent
SSD
us-central1-a
VM2
On-demand
n1-highcpu-8
cost: 0.384
lag: 0.12
maxInstances: 3
maxMntDisks: 16
maxMntDisksSizeGB: 10,240
n1-highcpu-hardware
Intel Ivy Bridge Xeon
gflops: 96.8
frequency: 2.8 GHz
#vpcu: 8
n1-hcpu-network
throughputGbps: 1.0
ingressCost: 0.0
egressCost: 0.12
Compute
debian-7-wheezy-v20140718
HVM
Debian v7
Linux
x64
Europe
disk-2
diskSizeGB: 30
iops: 3
cost: 1.2
Persistent
EBS
europe-west1-a

Overview of Dohko

* Implements the runtime part of the SPLE method
* Creates a deployment plan to configure the products across the clouds
* Uses the Configuration Knowledge to execute the actions in the clouds
  * Uses a Constraint Satisfier Problem (CSP) solver to find valid configurations

Dohko’s Architecture



Experimental Setup

* We used to public cloud providers (Amazon EC2 and Google GCE)
* A real bioinformatics application (ssearch36)
* Users' goals were to minimize monetary cost and maximize resources' capacity.

Example of an User's request descriptor (YAML file)

```yaml
....
requirements:
  cpu: 16
  memory: 90
  platform: "LINUX"
  cost: 2.0
  number-of-instances-per-cloud: 10
applications:
  application:
    name: "ssearch36"
    command-line: "ssearch36 -d 0 ${query} ${database} >> ${score_table}"
    file:
    - name: "query"
      path: "${HOME}/sequences/O60341.fasta"
      generated: "N"
    - name: "database"
      path: "${HOME}/uniprot_sprot.fasta"
      generated: "N"
    - name: "score_table"
      path: "${HOME}/scores/O60341.fasta_scores.txt"
      generated: "Y"
...
on-finished: "TERMINATE"
```

Multiple VMs selection – single and inter-cloud scenarios

# Req.	# vCPU	Memory (GB)	Cost (USD/hour)	# VM	Cloud provider
1	2 2	6 6	0.2 0.2	5 10	EC2
2	2 2	6 6	0.2 0.2	5 10	GCE
3	4 4	6 6	1.0 1.0	5 10	EC2
4	4 4	6 6	1.0 1.0	5 10	GCE
5	4 4	6 6	1.0 1.0	5 10	EC2 and GCE

User Request

Inter-Cloud

# Req.	Instance type	# vCPU	RAM (GB)	Cost ($/hour)	Family type	CP[♭]
1	m3.large	2	7.5	0.14	General	EC2
2	n1-standard-2	2	7.5	0.14	Memory	GCE
3	c3.xlarge	4	7.5	0.21	Compute	EC2
4	n1-standard-4	4	15	0.28	General	GCE
5	c3.xlarge n1-standard-4	4 4	15 15	0.21* 0.28	General General	EC2 GCE

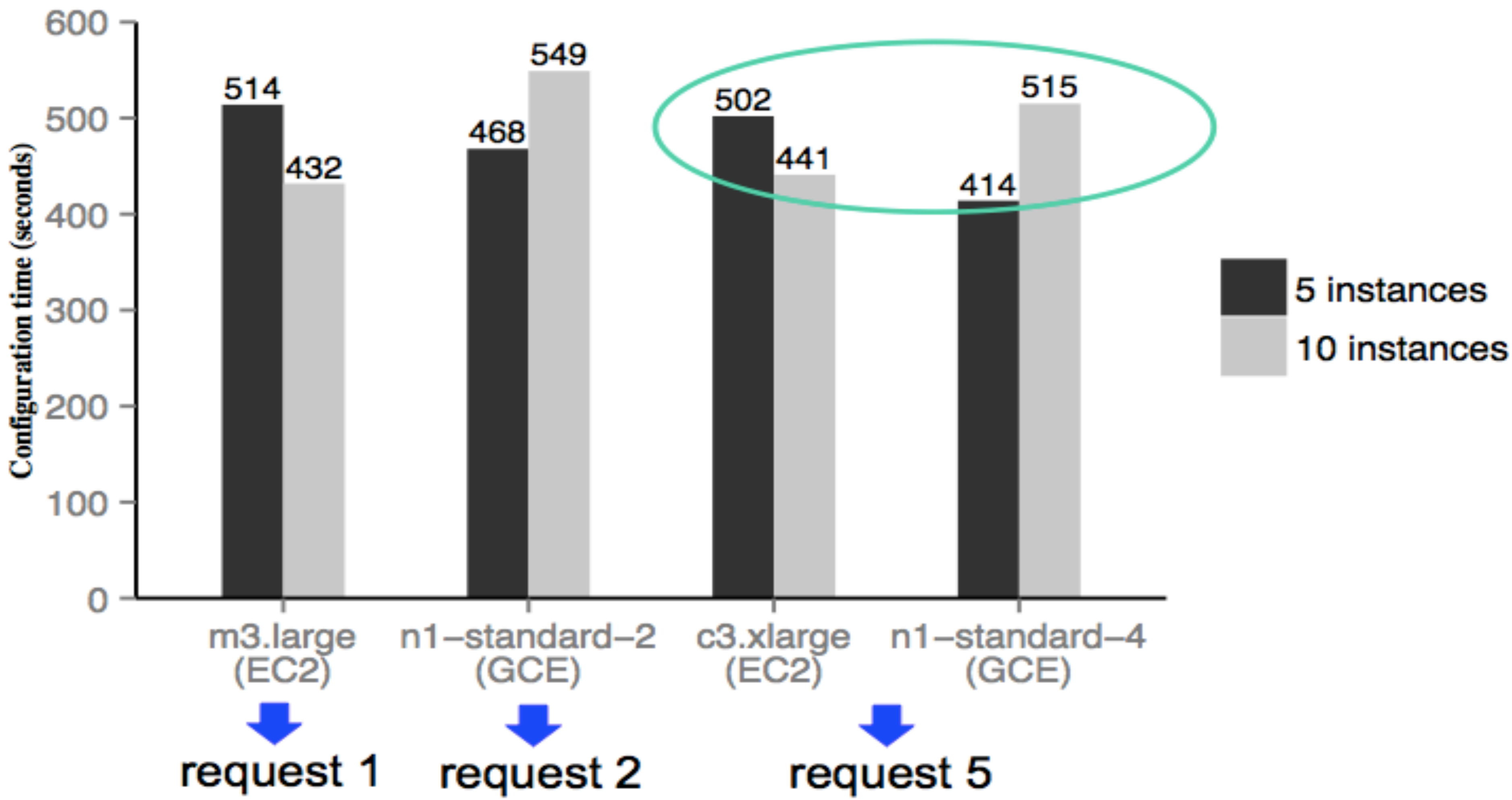
[♭] cloud provider

* 3 *c3.xlarge* and 2 *n1-standard-4*

Result

Inter-Cloud

It takes less than 10 minutes to automatically select and to deploy a real inter-cloud environment



Summary

* We proposed a SPLE method and a tool to help the users on instantiating inter-cloud environments.
* Our SPLE Method relies on:
  * Abstract Feature Model
  * Concrete Feature Model
  * Configuration Knowledge
  * Well-known benchmarks to uniform clouds' performance description
  * A tool that implements the method, and enables automatic inter-cloud configuration


That's all Folks!

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