UNIVERSITY of BRADFORD

BradStack

Developing Cloud computing Research and Capabilities

Cloud Modelling & Simulation Research Group(CloudMSGroup)
University of Bradford. UK

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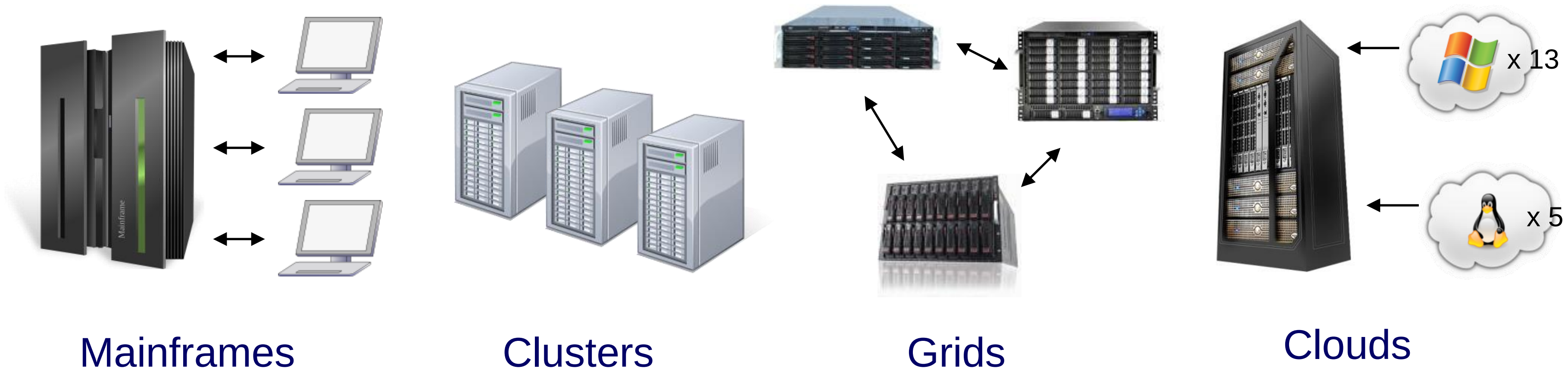
Introductions

- Led by Dr Mariam Kiran , Dr. Mumtaz Kamala and Experts in e-governance, e-services, software engineering, simulation and HPC/Cloud
- 4 PhD students
- Work with other research groups (NetPerf, AI, etc.)

What is Cloud Computing?



- Moving towards Service Oriented Economy
  - With new technological requirements
- Technology Evolution:
- Cloud Computing: “the next natural step in the evolution of on-demand information technology services…”
- Requires a paradigm shift from Grid Computing to enable on-demand services.
- Key technological requirement for Clouds: virtualisation

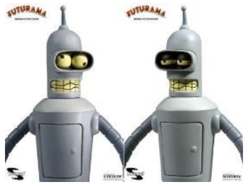
What is cloud computing (2)

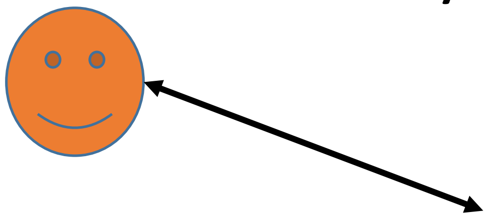
- Users can request virtual machines and work remotely
- Basically servers at the back-end
- A lot of computational challenges – Parallel computing, networking, software provisioning etc
- Charging on per time use, rather than buy machines
- Team to manage the

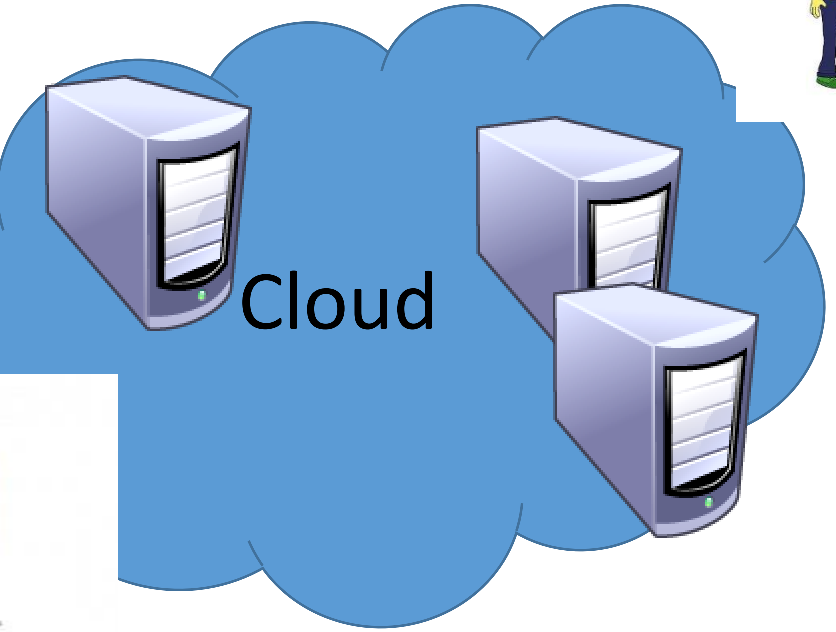
work at the back-end

- Write software

to manage as well







salesforce.com
ISV Application Partner

cloud.com

IBM

Windows Azure

Google
Docs & Spreadsheets
BETA

MAKARA

vmware

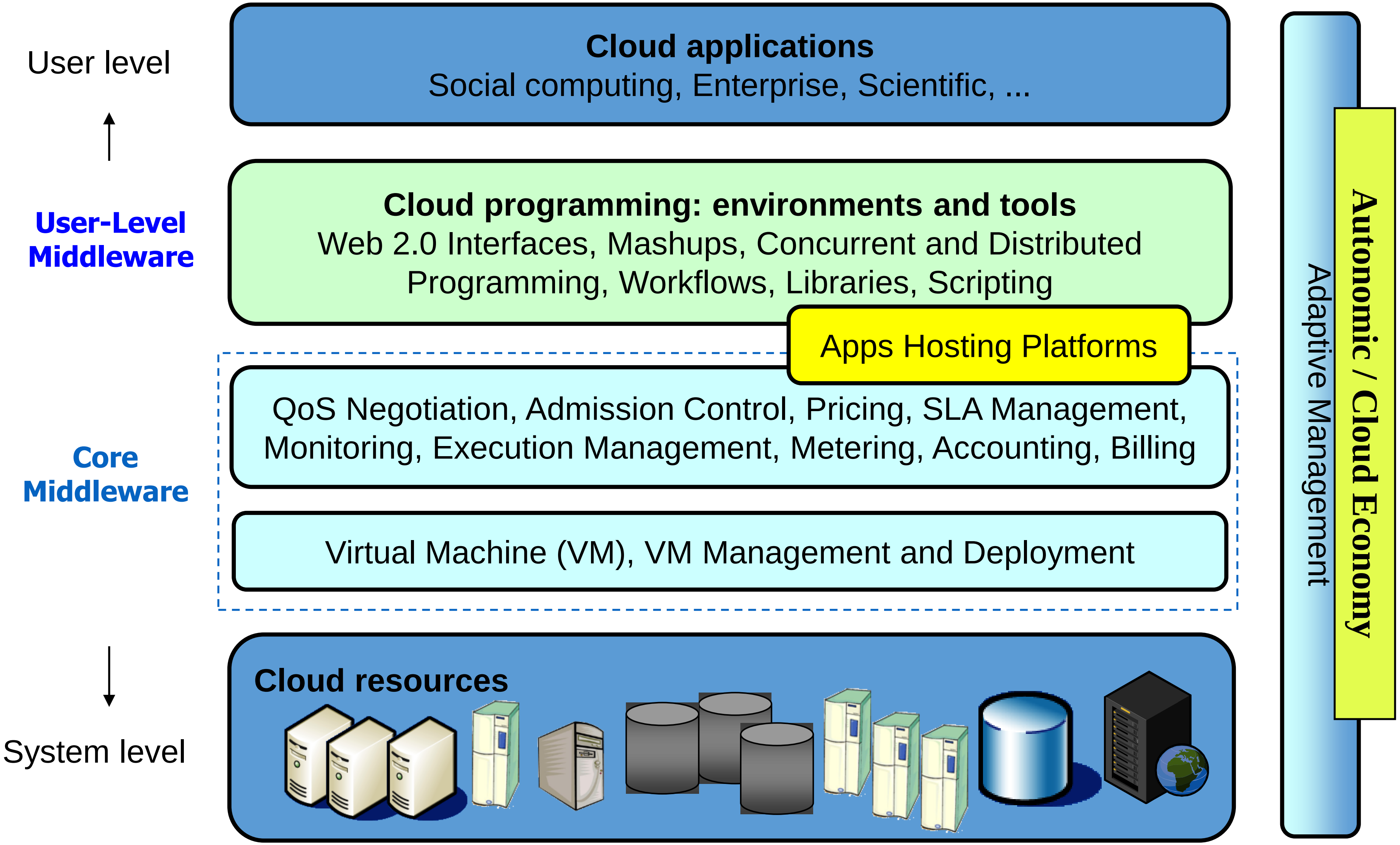
amazon
web services

GOGRID

at&t

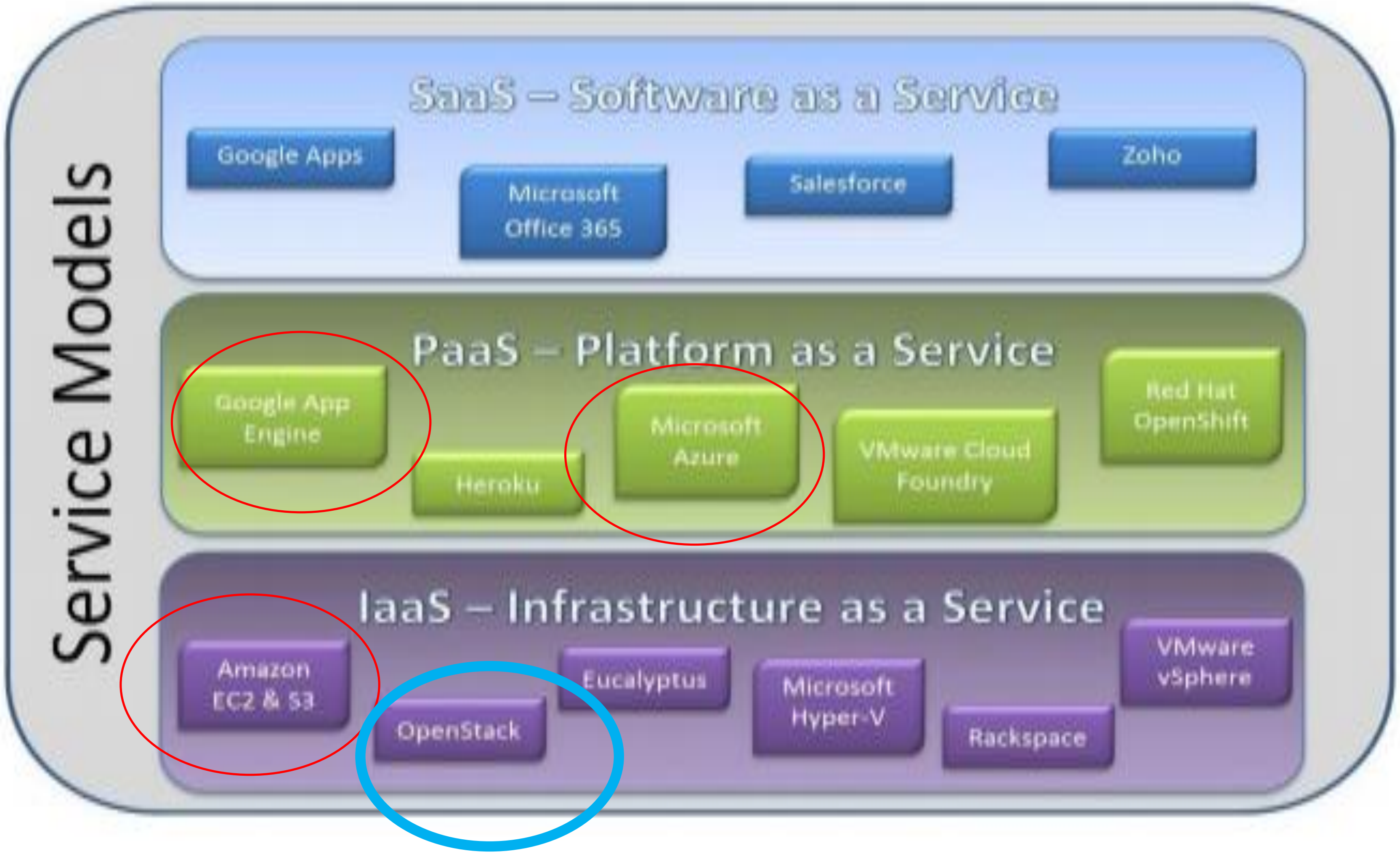
Dropbox

A (Layered) Cloud Architecture

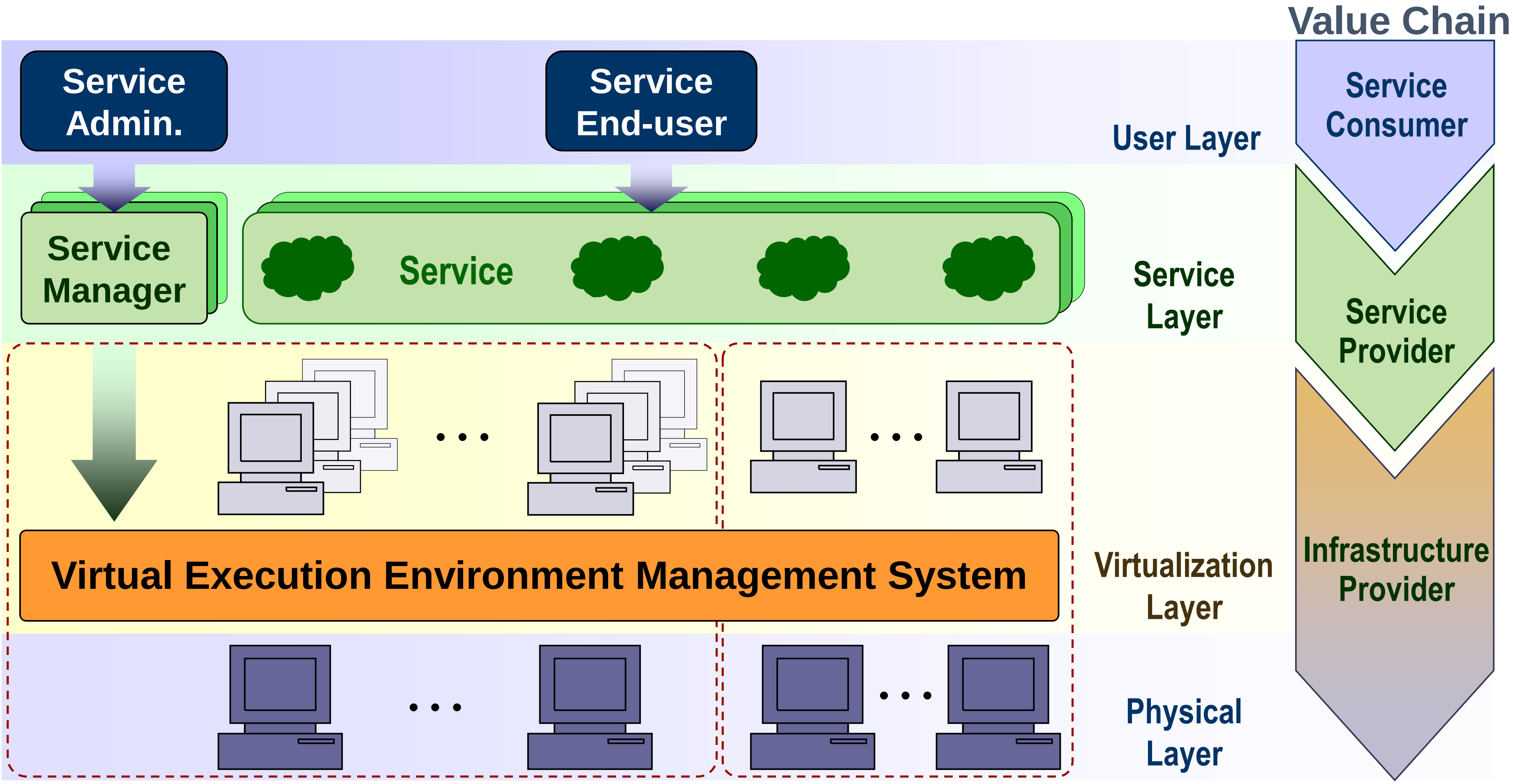


Service Models and Examples

- SaaS
- PaaS
- IaaS

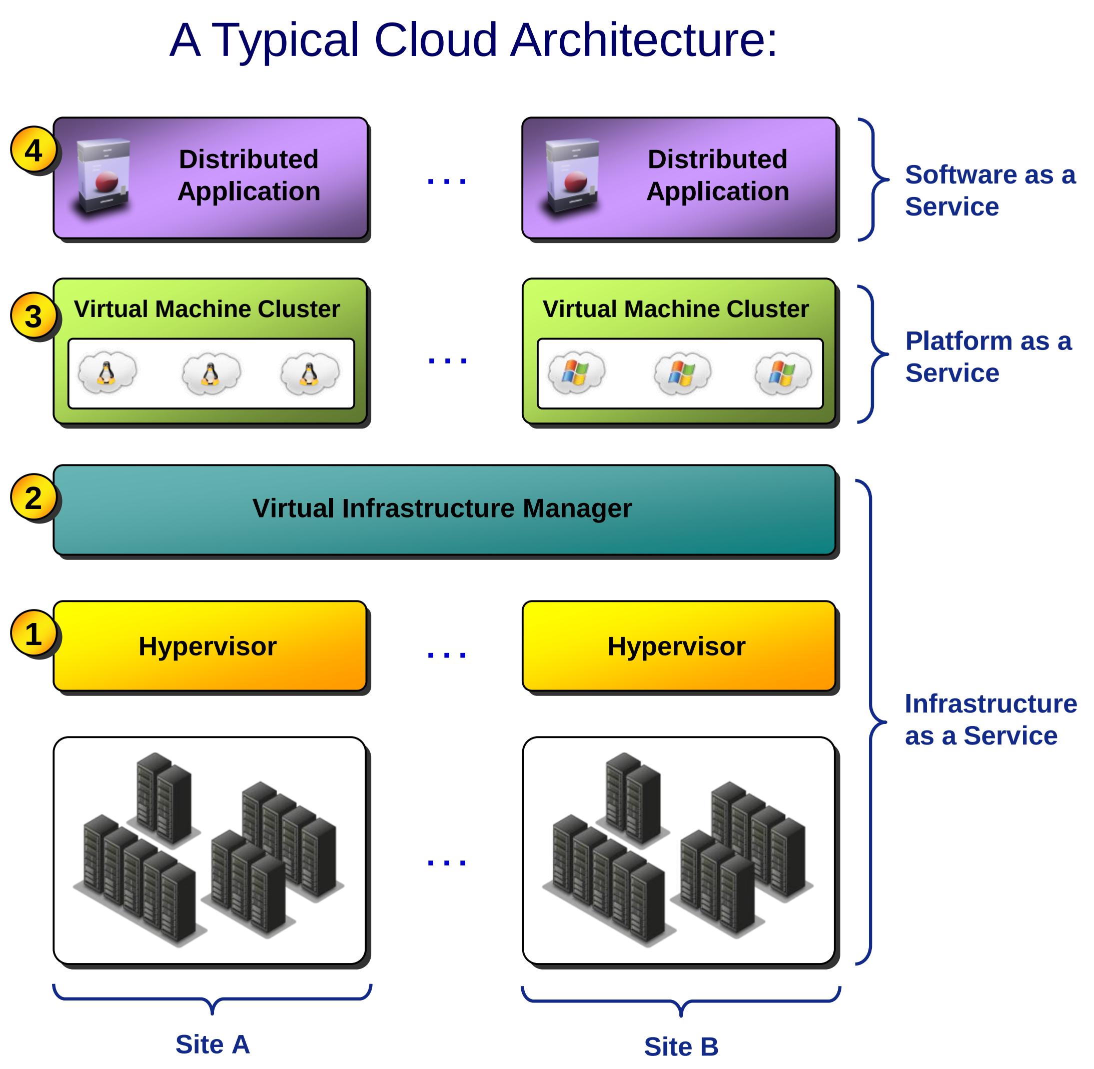


The Vision



Value Chain
Service Admin.
Service End-user
User Layer
Service Consumer
Service Manager
Service
Service Layer
Service Provider
Virtual Execution Environment Management System
Virtualization Layer
Infrastructure Provider
Physical Layer

Cloud Architecture



Typical System Components

1. Hypervisor: Creates multiple software implementation of a Virtual Machine executed on the same physical machine

2. Virtual Infrastructure Manager: Organises Virtual Machines into partitioned groups

3. Virtual Machine Cluster: Groups of Virtual Machines with embedded software, act as middleware for a running application

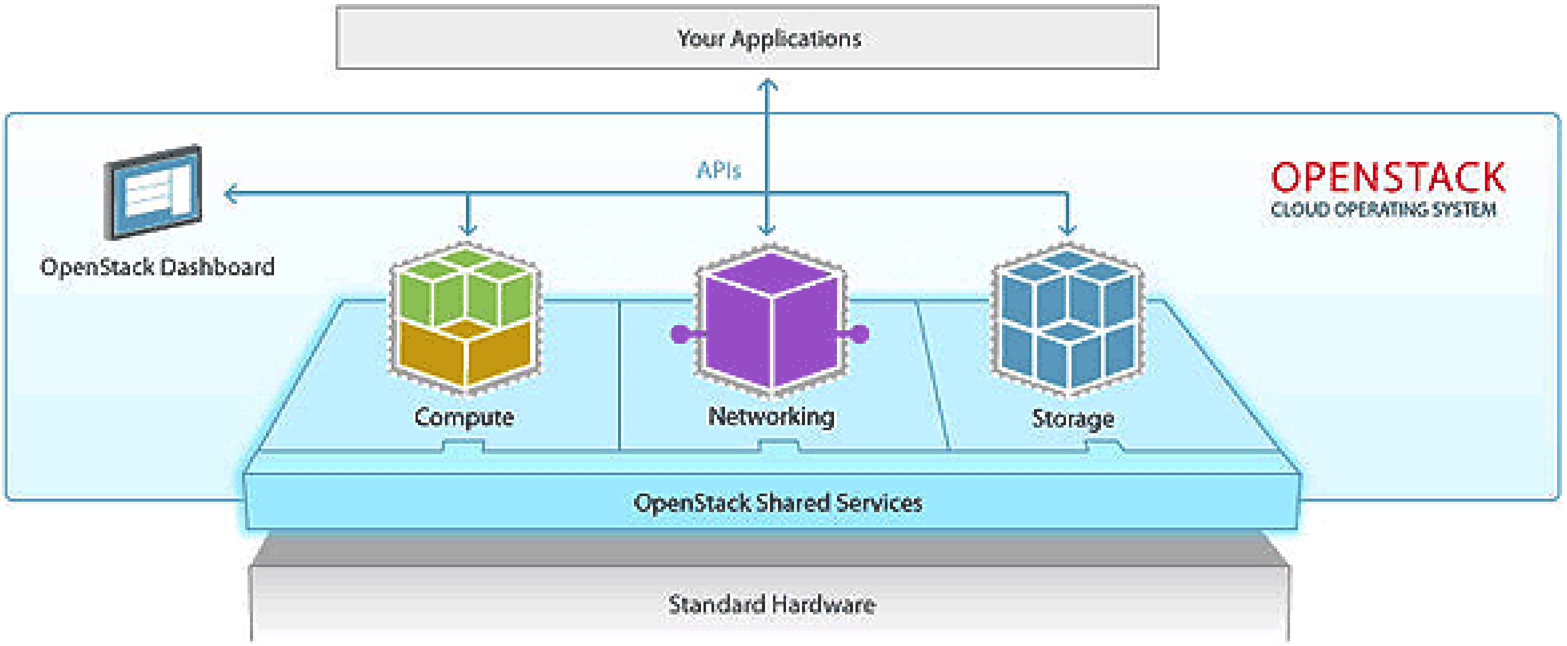
4. Distributed Application: Software designed to run on multiple machines to perform a specific task

Creating BradStack

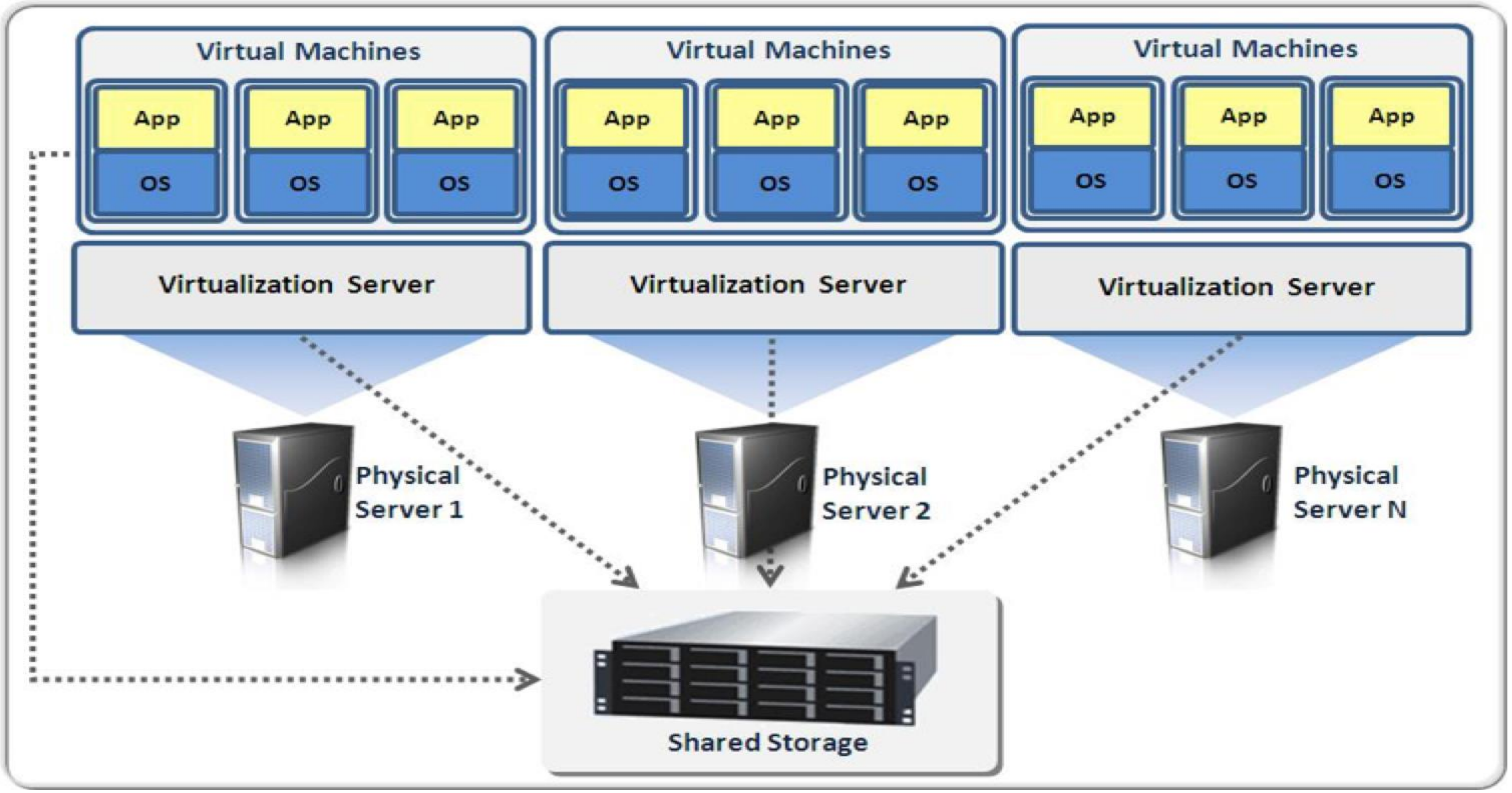
BradStack - reasons

- Commercial clouds have different levels of capabilities
  - Azure versus AWS
    - Both don’t reveal complete monitoring logs
    - Cannot determine how virtual machines are affecting the back end?
    - Energy use?
    - How can we optimise the physical machine usage- how test it (apart from simulators)
- Chose OpenStack
  - Free Open Source and a large international community,
  - add our own software such as hypervisors, managers, testing units, security algorithms
- Collaborating with
  - local and EU SMES,
  - Other universities

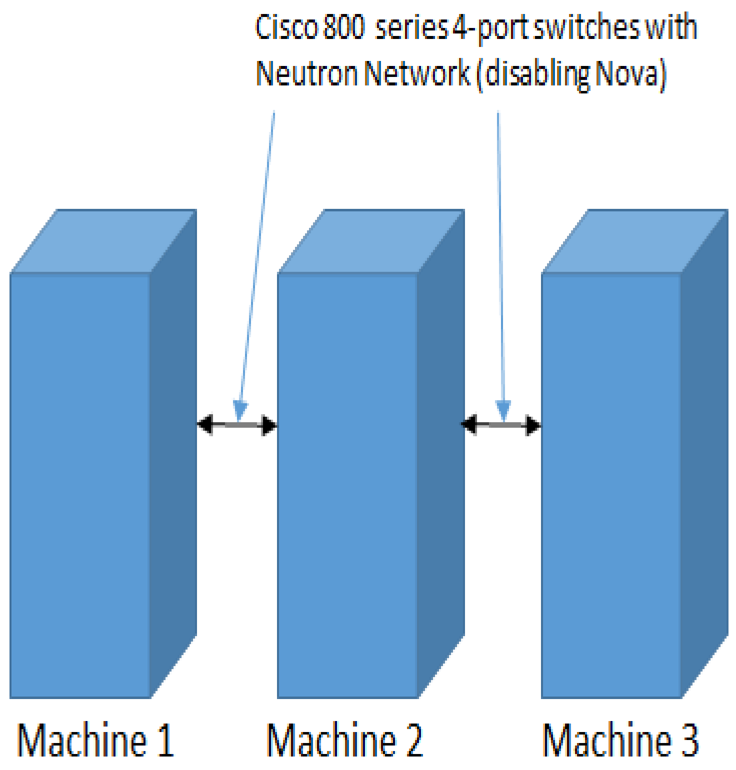
OpenStack -> BradStack



Experimental Setup (stage 1)



Experimental Setup (picture)

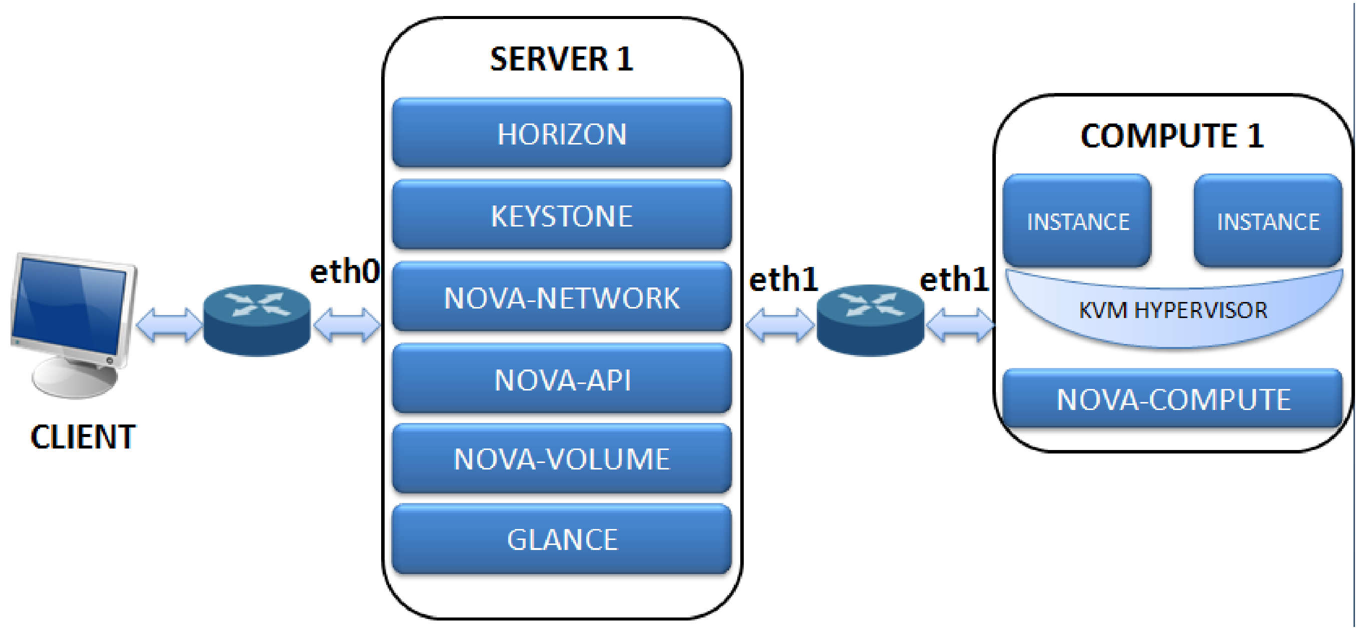


The testbed was constructed using three hosts:

- The first server hosts a WEB service
- The second server hosts a DATABASE service.

These exact physical servers, network equipment and their configurations were replaced by spinning up virtual instances on the testbed.

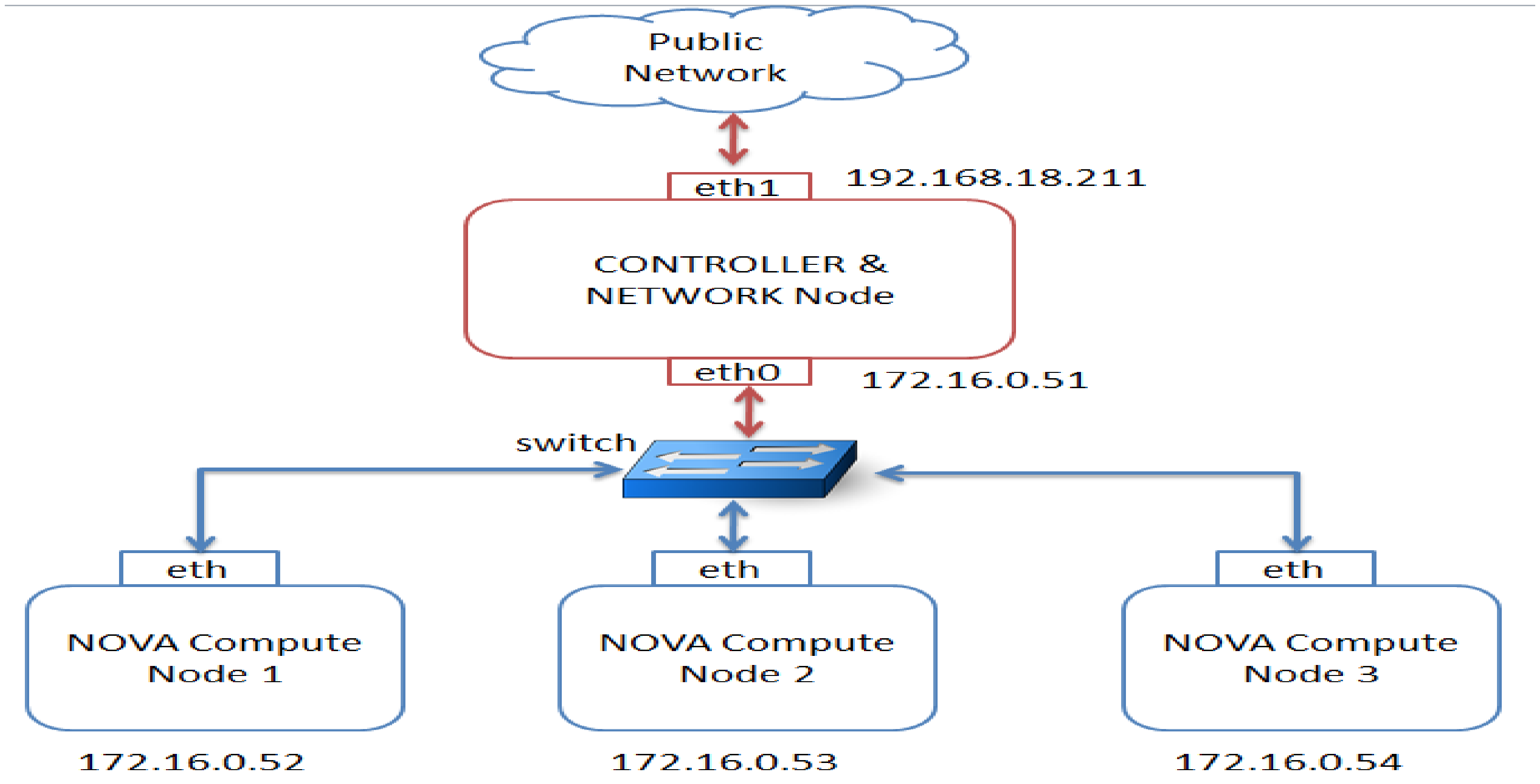
Single Node Deployment Architecture(SNA) (Stage 2)



Server 1 acts as monitor and authenticator

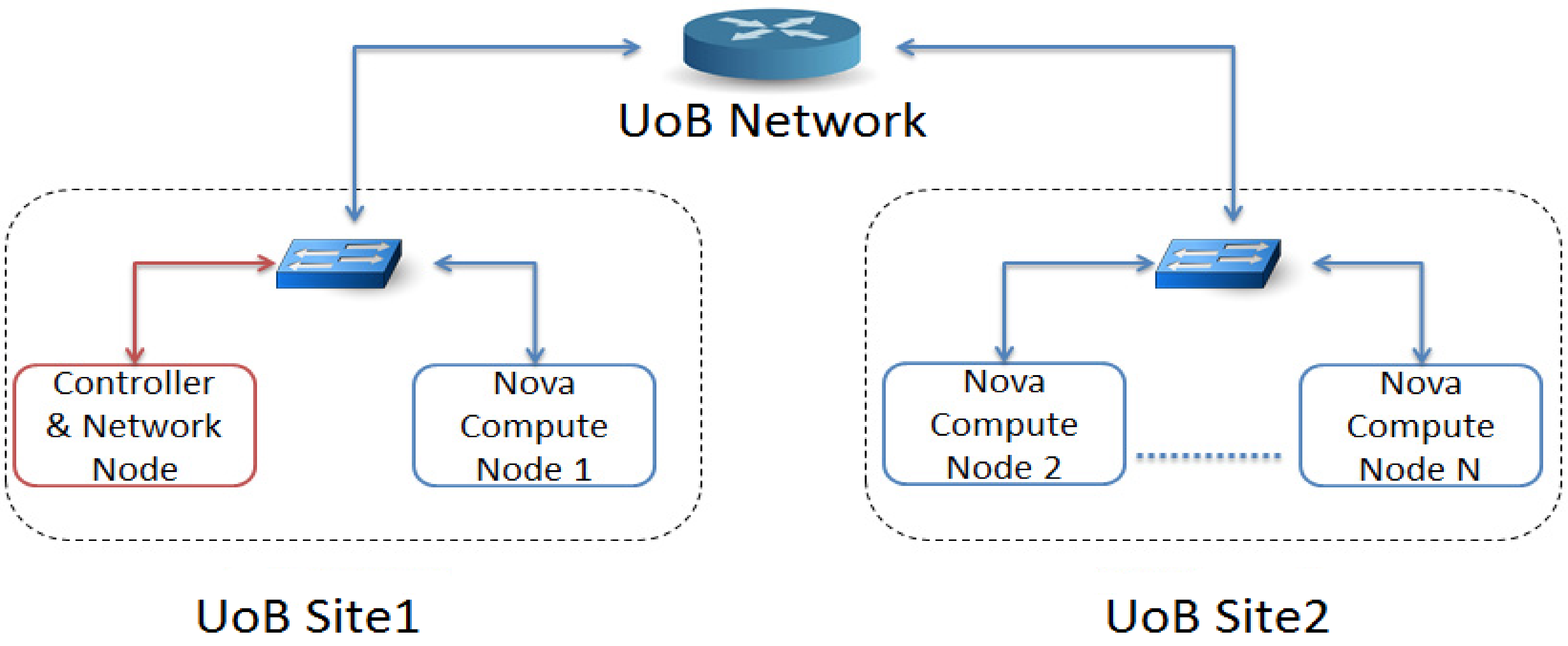
Compute performs the activities

Multi-Node Architecture(MNA) (Private) (Stage 3)



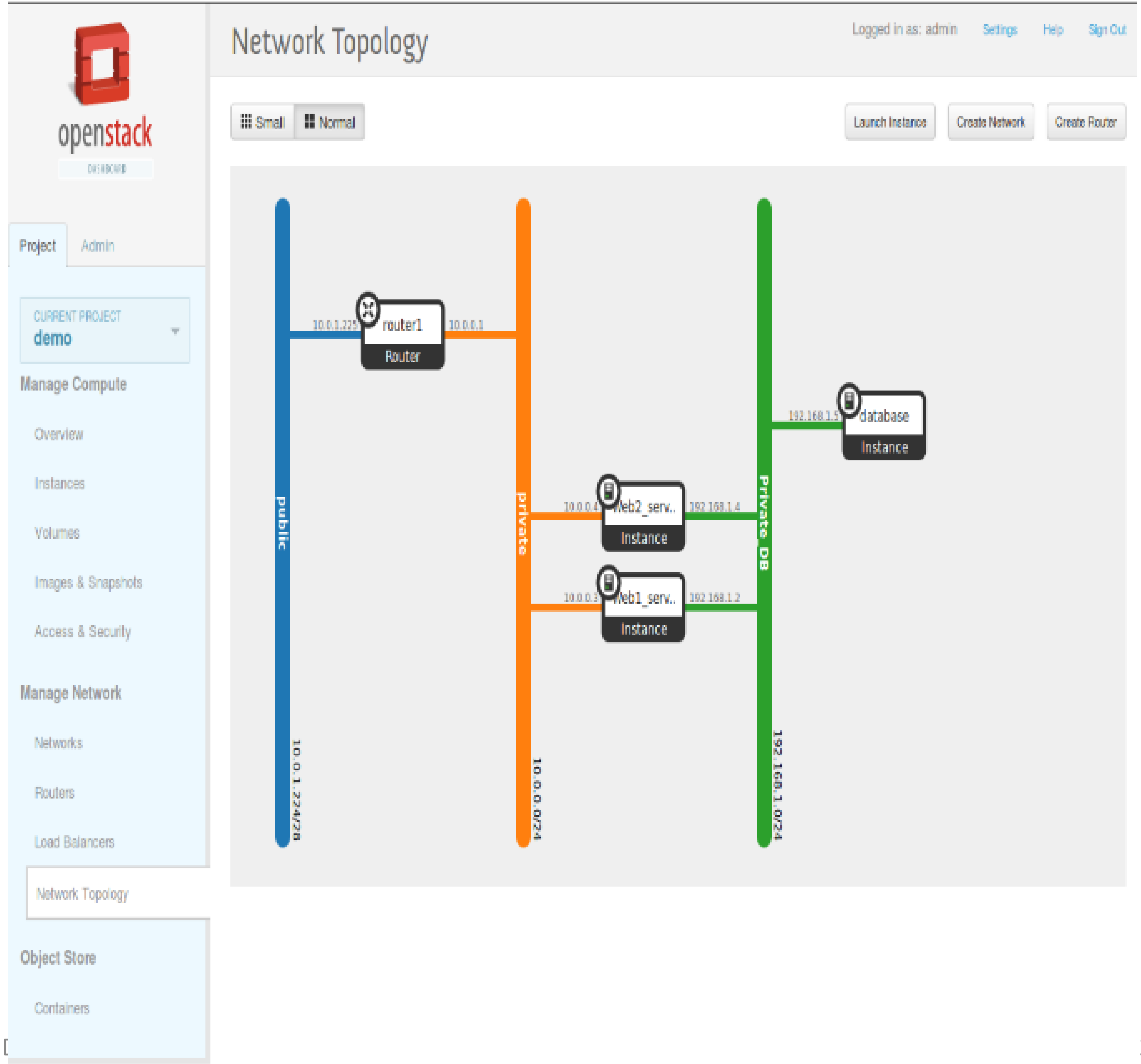
One controller but 3 compute nodes for work distribution

Multi-Node Architecture(MNA) (Public) (Stage 4)



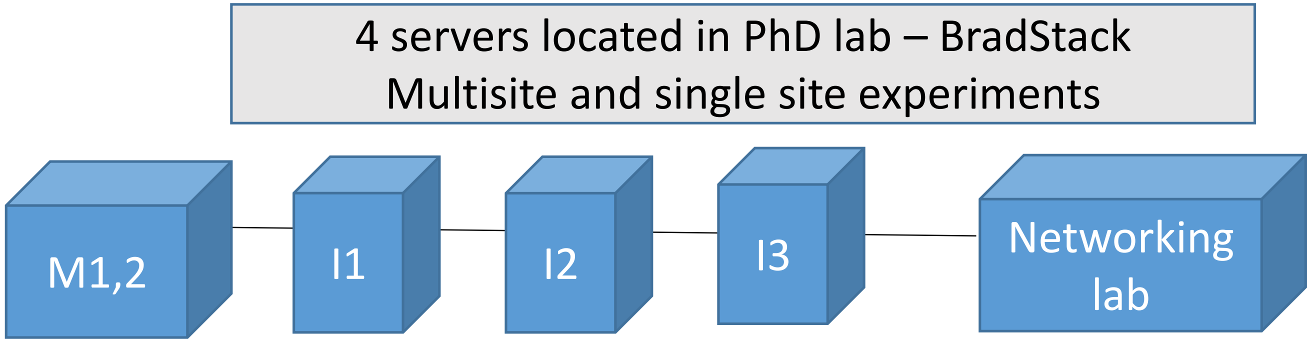
University of Bradford geographically separated nodes. One controller and three compute nodes

Topology



- *Monitor usage at the Controller node*

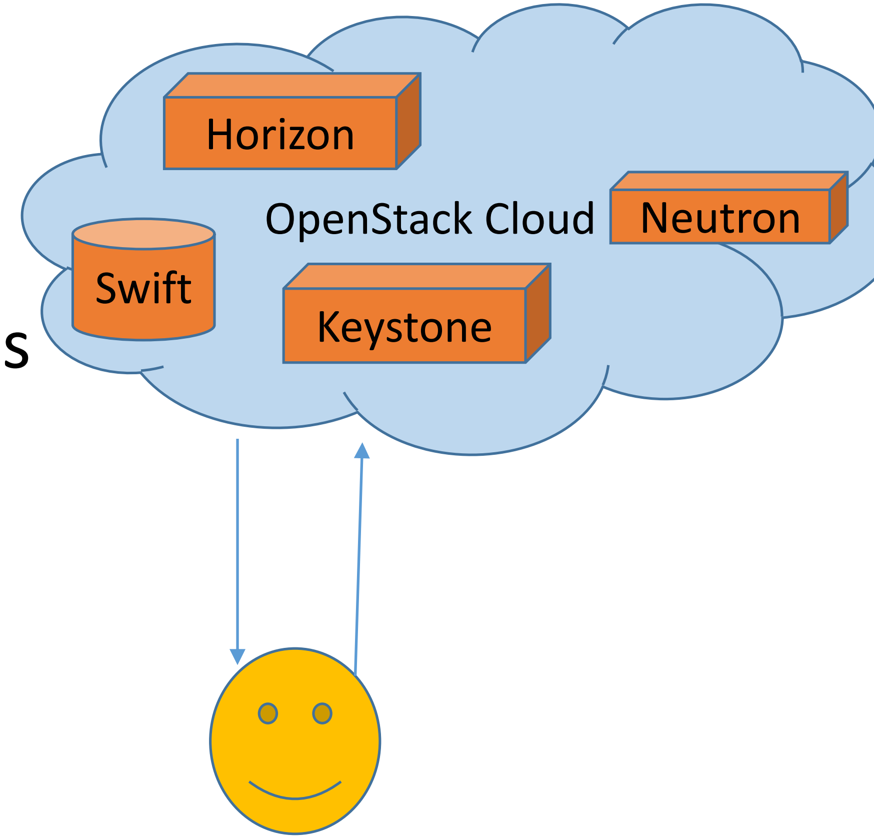
Machine Specifications



Component	Num	Description
Fuel Master server	1	Dell Optiplex 745 (CPU: Intel Core 2 6400 @ 2.13GHz X 2 Cores, RAM: 2 GB, OS: 64 Bit, HDD: 160 GB, NIC: X 1)
Cloud Controller	1	Dell Precision T5400 (CPU: Intel Xeon E5405 @ 2.00GHz X 8 Cores, RAM: 32 GB, OS: 64 Bit, HDD: 1TB, NIC: X 2)
Compute servers	2	Dell Precision T3400 (CPU: Intel Core 2 Quad Q6600 @ 2.40GHz X 4 Cores, RAM: 4 GB, OS: 64 Bit, HDD: 500 GB, NIC: X 1)
Compute Server	1	Dell PowerEdge 1600SC (CPU: Intel Xeon @ 2.8GHz X 2 Cores, RAM: 4 GB, OS: 64 Bit, HDD: 150 GB)
Storage server	1	Dell Precision T3400 (CPU: Intel Core 2 Quad Q6600 @ 2.40GHz X 4 Cores, RAM: 4 GB, OS: 64 Bit, HDD: 500 GB)
Public switch	1	HP ProCirve Networking 10Gb
Private switch	1	ZyXEL Internet Security gateway
Cables		7 x RJ 45 straight through copper cables

Research being done

- PhD Fault tolerance – to prevent VM failure
- PhD Optimising performance and successful jobs
- PhD security of cloud algorithms
- PhD governance
- Software management



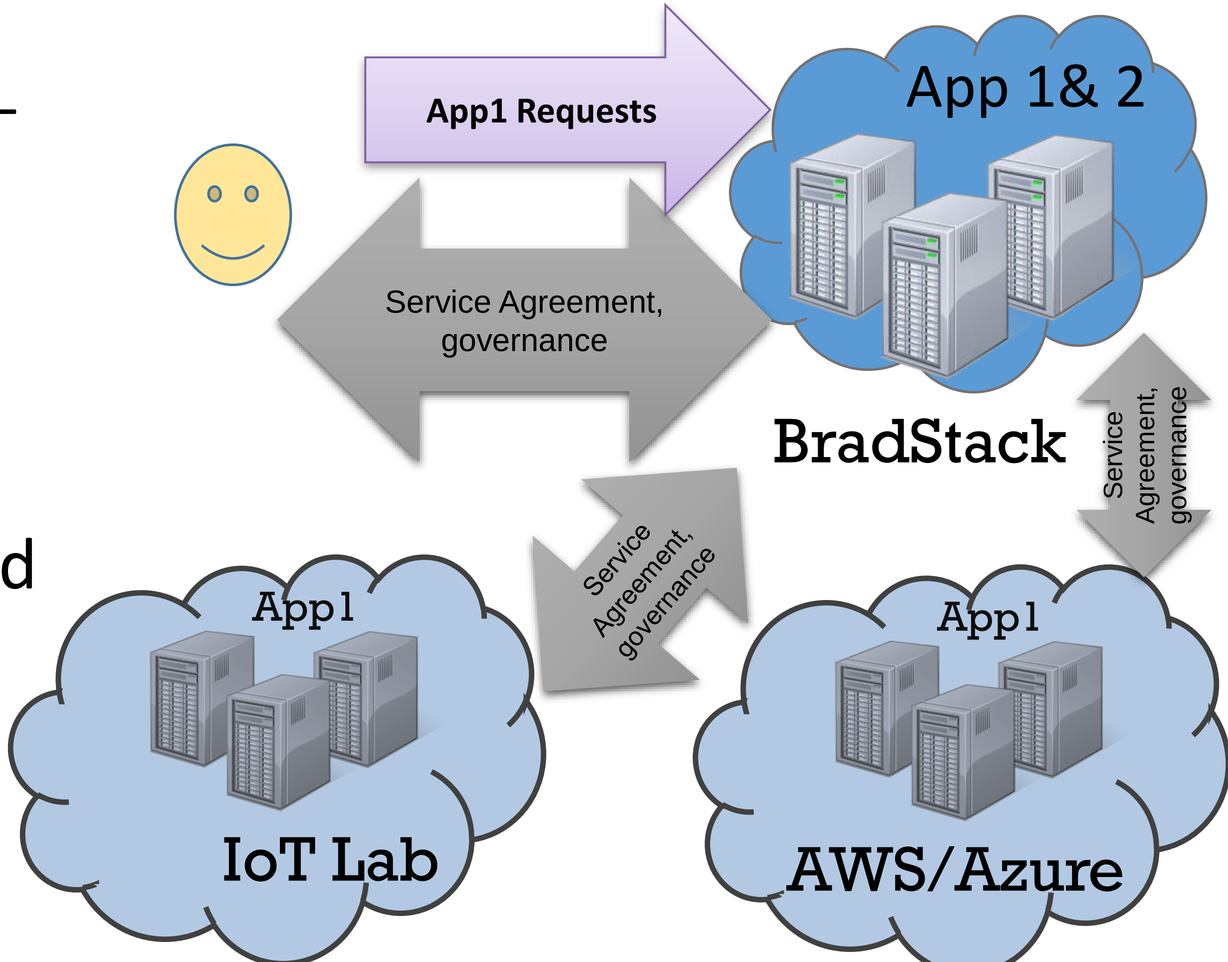
- We needed this facility to do our research!
- Cannot monitor back-end statistics on public clouds

Why are we unique across UK?

- Cambridge university – Microsoft cloud computing research centre – Smart Flow, Cam Flow, legal and security – Azure Services.
- Cambridge (prof S.Teller) One implementation of OpenStack – SME (point of contact for OpenStack in UK) (visit us soon!)
- Manchester (SMEs)
- St Andrews + Bristol + Aston (LCITS prj EPSRC 2009) Eucalyptus open source
- NewCastle Cloud - tried but failed to network it so switched to data analysis on cloud using AWS and Azure, but are willing to learn and collaborate with us
- Leeds – OpenNebula, Globus, Eucalyptus to manage infrastructure

Future Plans

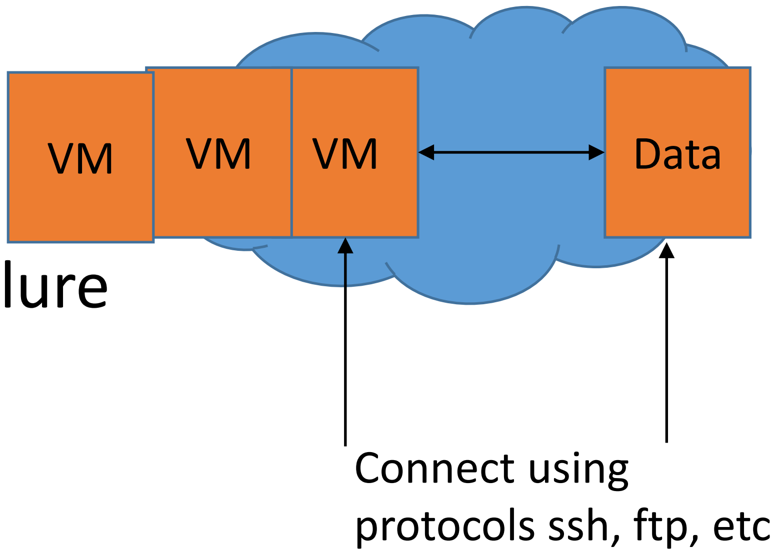
- Need more users to test our potential. Open for all
  - Data storage
  - Partnering with IoT lab for data processing – Lead by Dr Thakkar.
  - Bursting to other clouds eventually with governance, SLA



- Grow steadily as per needs are developed

How Users Can Connect/Access

- We will give users – usernames, pwds with their accounts.
- Same as Azure/AWS
- They can '–ssh' or 'checkin' to their virtual machines.
- Virtual machines can run software or processing on data
- Data Stores can store all data via ftp commands
- User documentation available

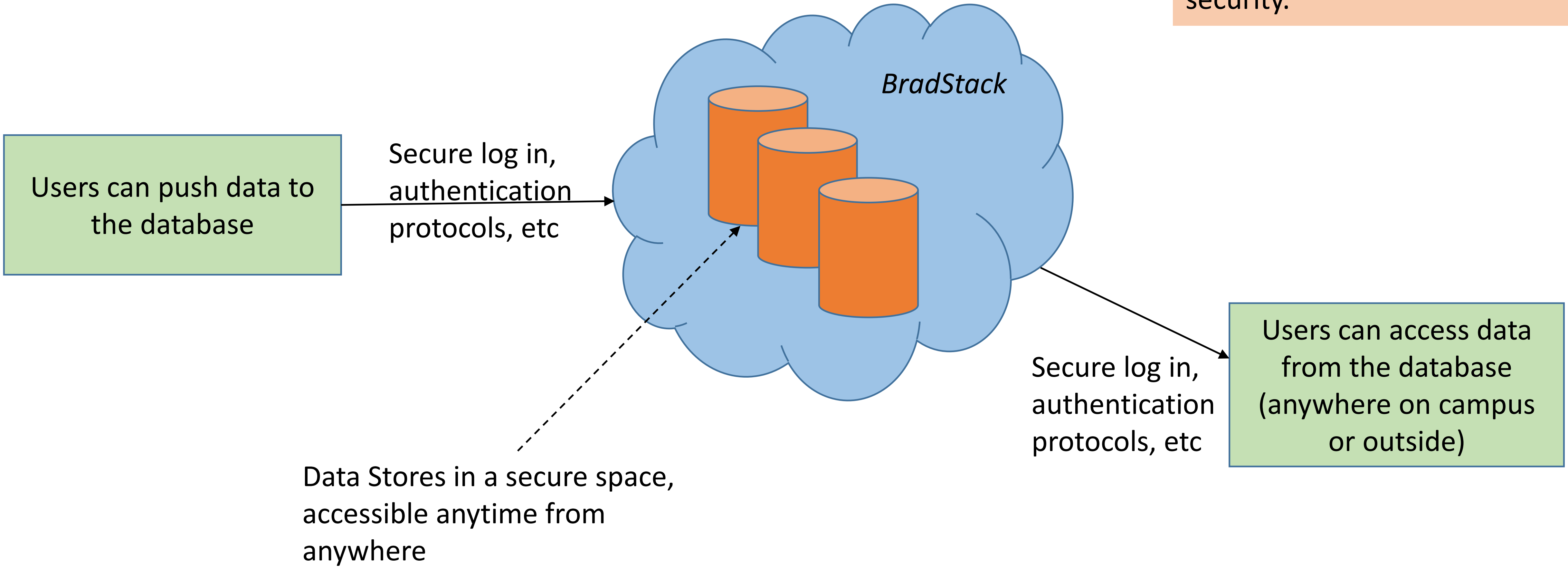


- Still working on fault tolerance in case of failure
- VM tolerance and recovery
- Need case studies to ensure it works

Example Case Studies

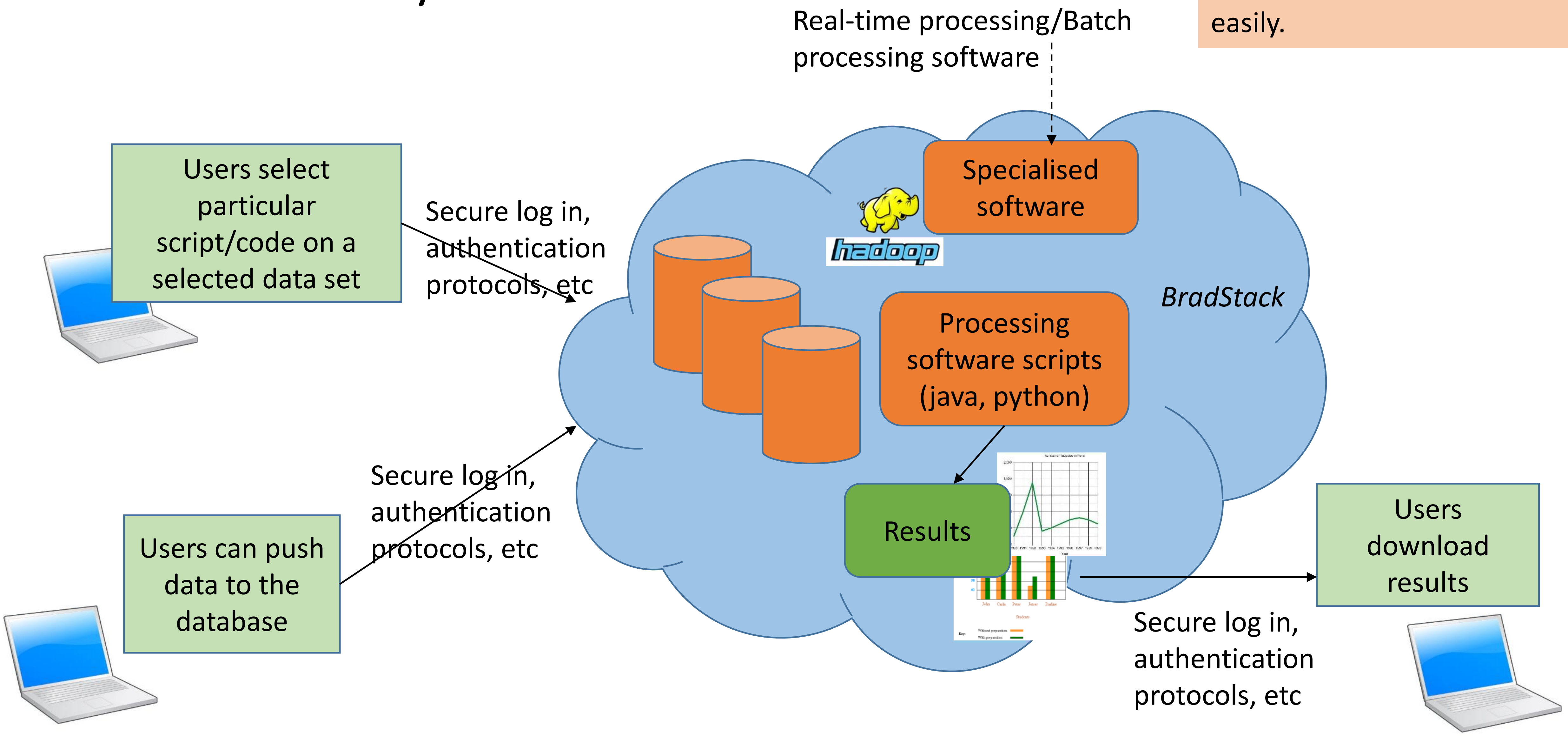
Data Storage

Users can send data directly to database by uploading it. And download it later if needed. We can compress the data and encrypt it for security.

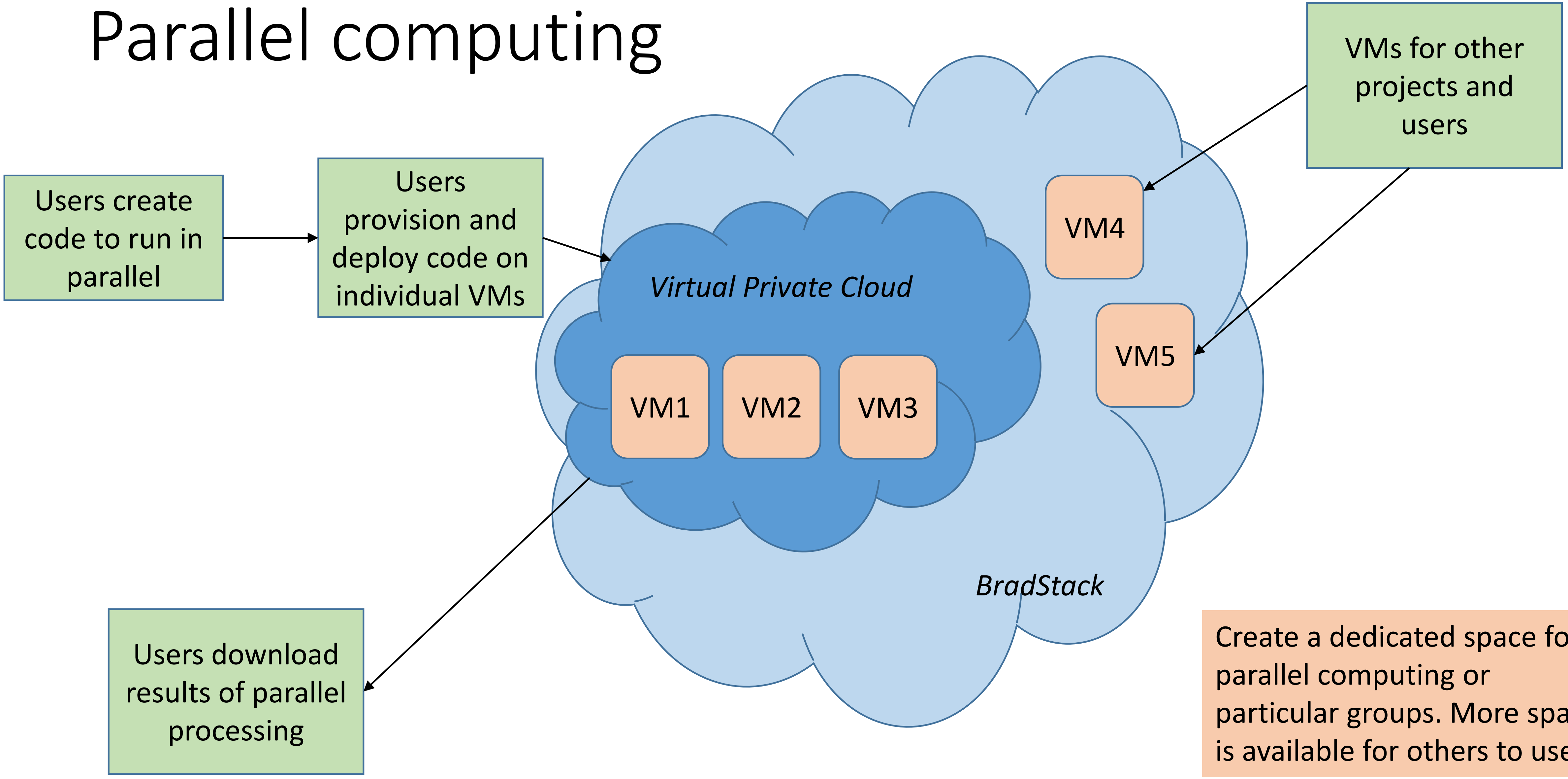


Data Analytics

Users can run specialised software on the data sets, all resident on the Cloud.
These can be downloaded easily.



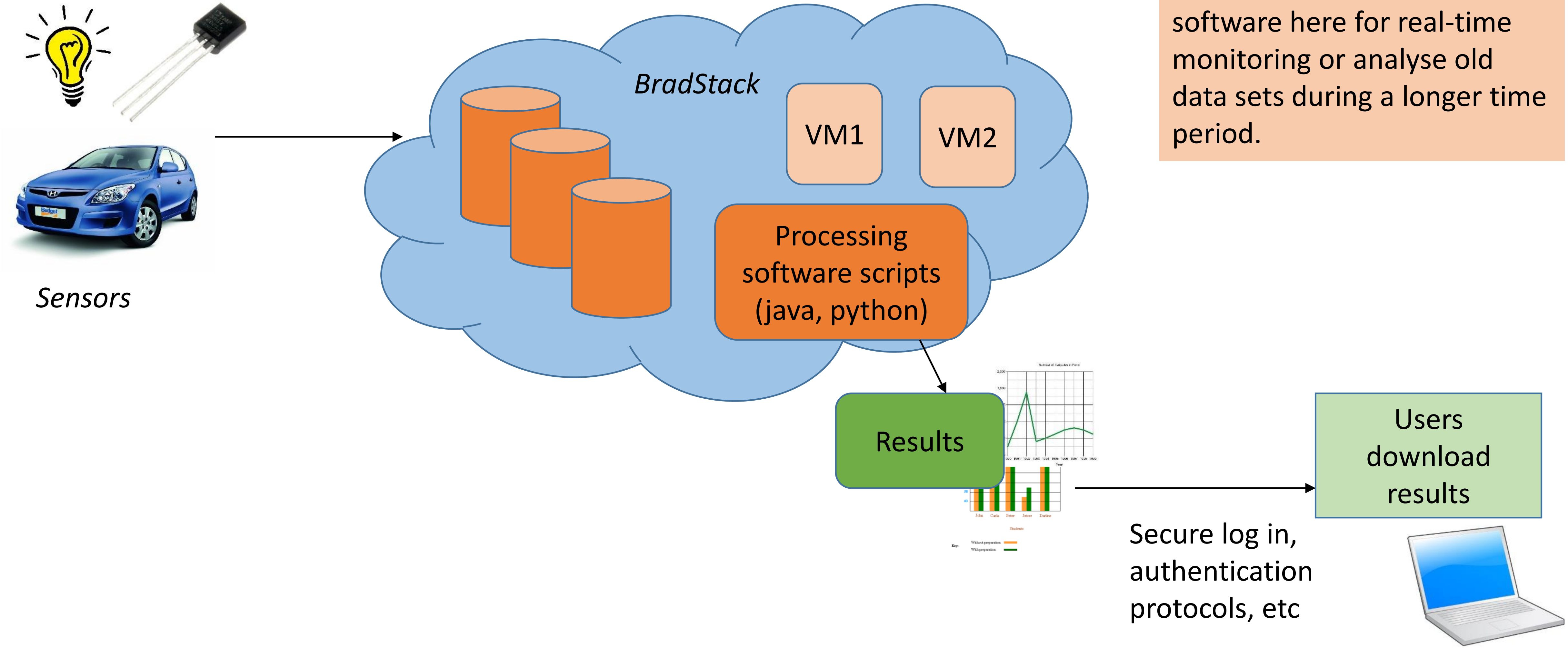
Parallel computing



Create a dedicated space for parallel computing or particular groups. More space is available for others to use.

Working with IoT

Sensors send data directly to database on Cloud. Can run data processing scripts as soon as data arrives. We can set up ‘alarms’ to run software here for real-time monitoring or analyse old data sets during a longer time period.



- Happy to take questions and collaborate.