

---

---

# Big Data for eHealth Applications in the Mobile Cloud Computing Scenario

---

---

**José L. Ayala**  
Facultad de Informática  
jayala@ucm.es

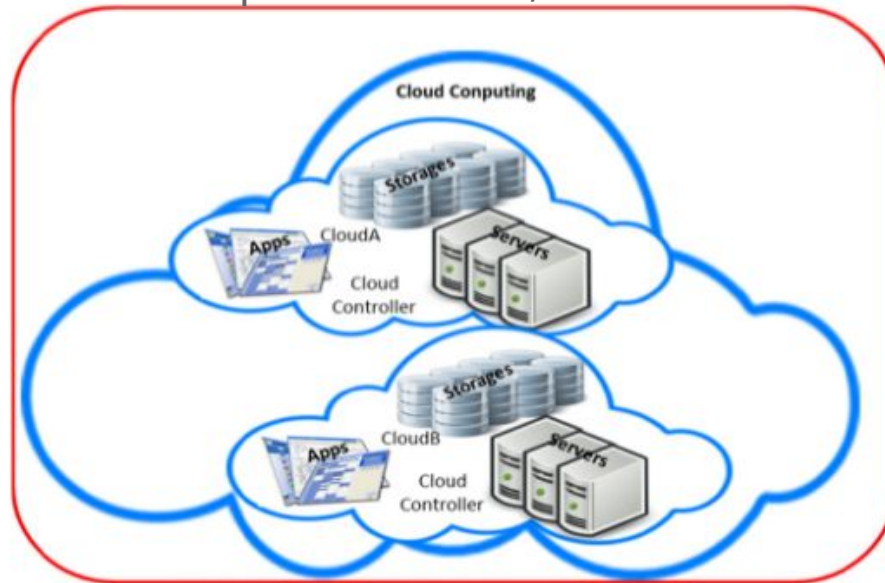
# The benefit of mobile computing

- 3G/4G/5G
- The mobile devices can provide variety of services to facilitate our living style
- The mobility feature of mobile devices changed the way that people use different technologies all over the world
- All these features of mobile devices and integrating them in our life speed up the transition towards greener and smarter cities



# The Concept of Mobile Cloud Computing

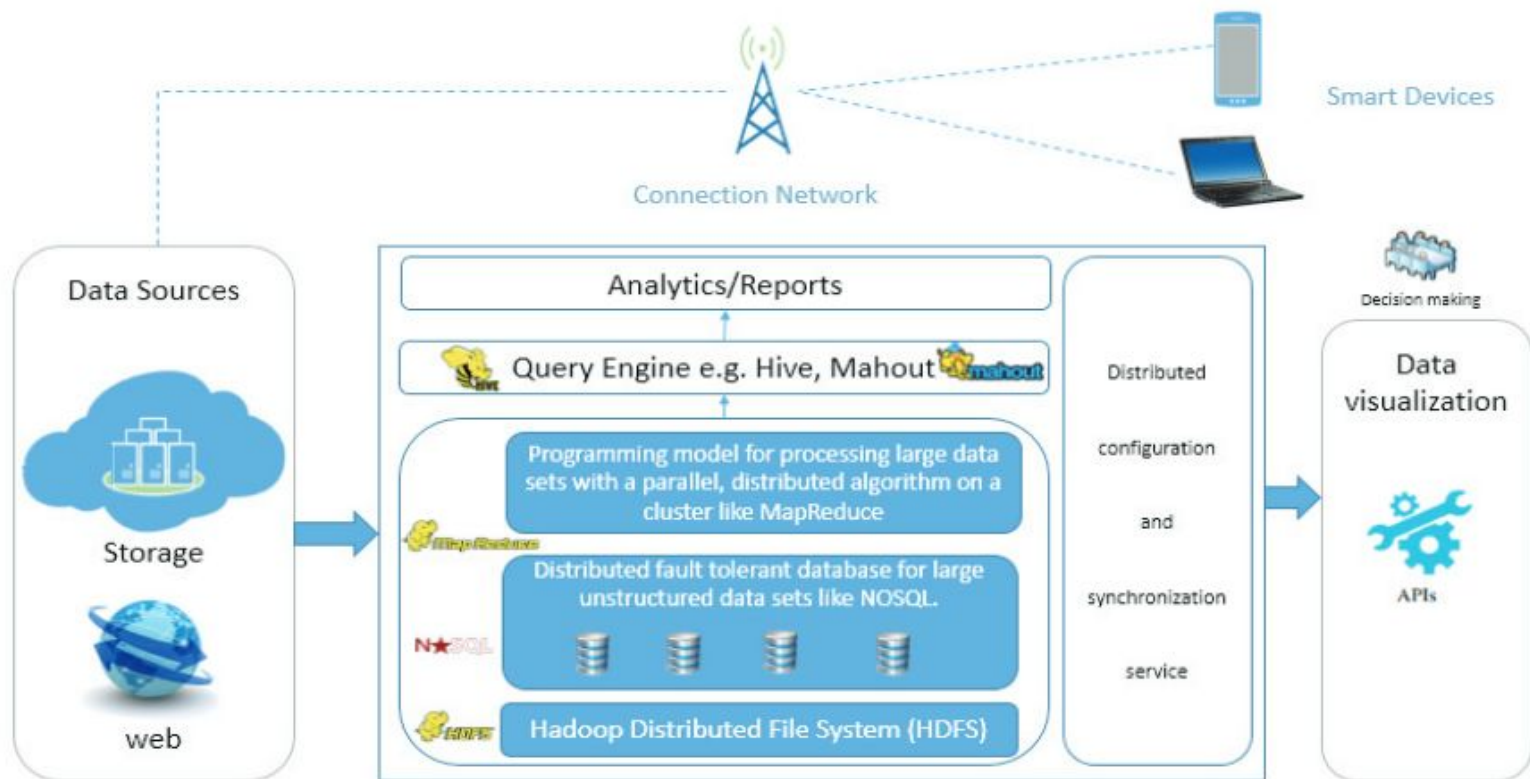
- It allows access to the stored information from anywhere at any time
- It can be used in different organizations or by individuals to enhance productivity and increase performance, and reduce the cost and complexity



# The Concept of Mobile Cloud Computing

- Integrating the mobile devices with cloud computing to utilize the unlimited service provided by the cloud through the mobile device results in what is known as **Mobile Cloud Computing**
- MCC healthcare system was built to capture and analyze real time biomedical signals (such as ECG and Blood pressure) from users in different locations
- On the mobile device, a personalized healthcare application is installed and health data are being synchronized into the healthcare cloud computing service for storage and analysis

# Proposed Framework

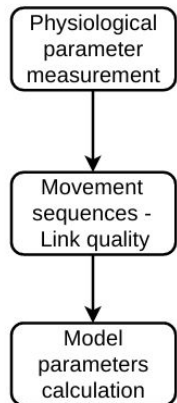


# Offloading Policies

- It is a solution to alleviate resource limitations on mobile devices and provide improved capabilities for these devices by migrating partial or full computations (code, status and data) to more resourceful computers.
- **What to offload:** before offloading, the program needs to be partitioned
- **When to offload:** applications may have different requirements on performance and mobile devices may have different capabilities and energy concerns.
- **How to offload:** the development of virtualization and the emerging cloud computing technologies provides a powerful, flexible, manageable and secure platform for offloading.

# Experimental Work

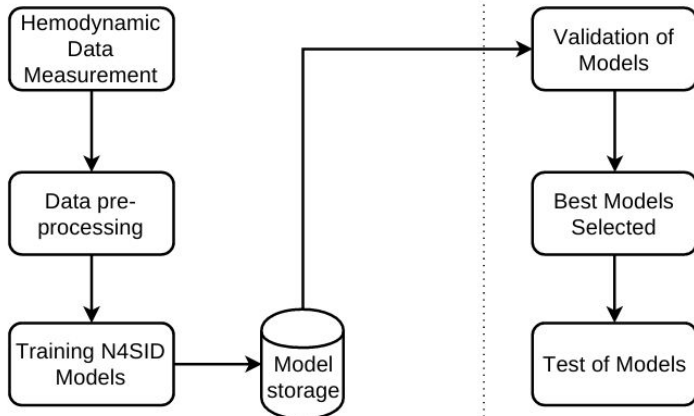
## On-body Channel Transmission Modeling



*In the Clinic*

Day: 1

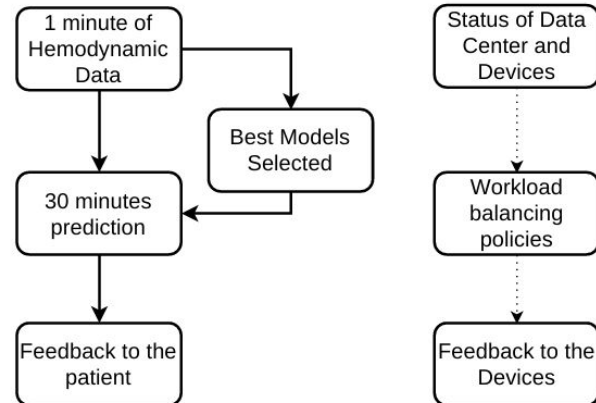
## Migraine Prediction Modeling



*Ambulatory Monitorization*

Day: D-1

## Real-time Migraine Prediction



*Ambulatory Monitorization*

Day: Indefinite

Day: D

# Experimental Work

Five scenarios for the workload balancing policies.

	Sensor device	Coordinator	Data Center
SC1	Collect + transmit data	Receive + transmit data	Process data + perform predictions
SC2	Collect + transmit data	Receive + process + transmit data	Perform predictions
SC3	Collect + transmit data	Receive + process data + perform prediction + transmit data	-
SC4	Collect + process + transmit data	Receive + transmit data	Perform predictions
SC5	Collect + process + transmit data	Receive data + perform predictions + transmit data	-



# Experimental Work

Average saving for a federation of Data Centers in Europe. Savings calculated for the variable electricity prices. Savings in nodes and Data Centers have repercussion in consumption and electricity costs in coordinator nodes.

Country	Target population	Household [40] energy price (€/kWh)	Industrial [40] energy price (€/kWh)	Saving in nodes (k€)	Expenses in coordinators (k€)	Saving in Data Center (k€)	Total energy saving (M€)
Turkey	305,138	0.122	0.070	93.0	0.50	200.4	478.9
Germany	184,150	0.295	0.149	135.2	0.73	426.1	594.3
UK	183,922	0.218	0.152	100.1	0.54	433.8	601.8
France	147,472	0.243	0.160	89.3	0.48	455.8	590.5
Italy	182,348	0.168	0.095	76.1	0.41	270.8	437.3
Spain	117,211	0.237	0.113	69.2	0.37	323.4	430.4
Netherlands	78,088	0.183	0.084	35.7	0.19	238.3	309.6
Switzerland [41]	40,047	0.192	0.142	19.2	0.10	405.3	441.8
Sweden	25,462	0.187	0.059	11.9	0.06	168.4	191.6
Norway	23,497	0.143	0.069	8.4	0.05	195.5	217.0
Denmark	21,496	0.304	0.091	16.3	0.09	258.6	278.2
Hungary	18,965	0.115	0.087	5.4	0.03	248.3	265.6
Portugal	18,352	0.229	0.115	10.5	0.06	329.4	346.1
Austria	17,354	0.198	0.105	8.6	0.05	298.8	314.7
Croatia	16,138	0.131	0.093	5.3	0.03	264.9	279.6
Georgia [42]	14,010	0.050	0.030	1.7	0.01	85.6	98.4
Total	1,393,649			<b>685.8</b>			<b>287.7±104.1</b>

# Thanks!

**José L. Ayala**

Facultad de Informática

[jayala@ucm.es](mailto:jayala@ucm.es)