A data centre control architecture for power consumption reduction

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Outline

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- Proposal
- Architecture and interactions
- General functionality
- Implementation concerns
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  - Power consumption distribution function
- Conclusions and future works

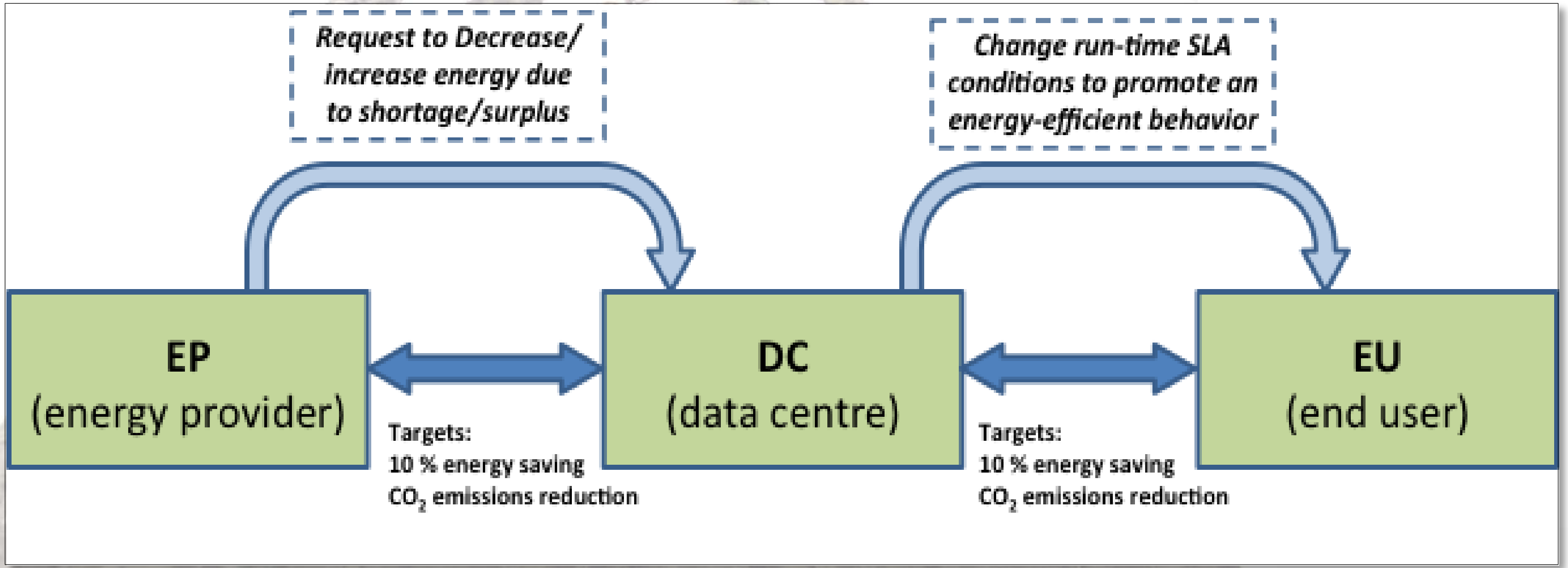
Background

- Energy savings and CO_2 reduction in Data Centers.
  - The emergence of the cloud computing has increased the need of resources to support cloud-based services → Data Centers ha become essential.

- Collaboration between Energy Providers (EP), Data Centers (DC) and End Users(EU)
  - European FP7 funded All4Green Project
    http://www.all4green-project.eu/

Proposal

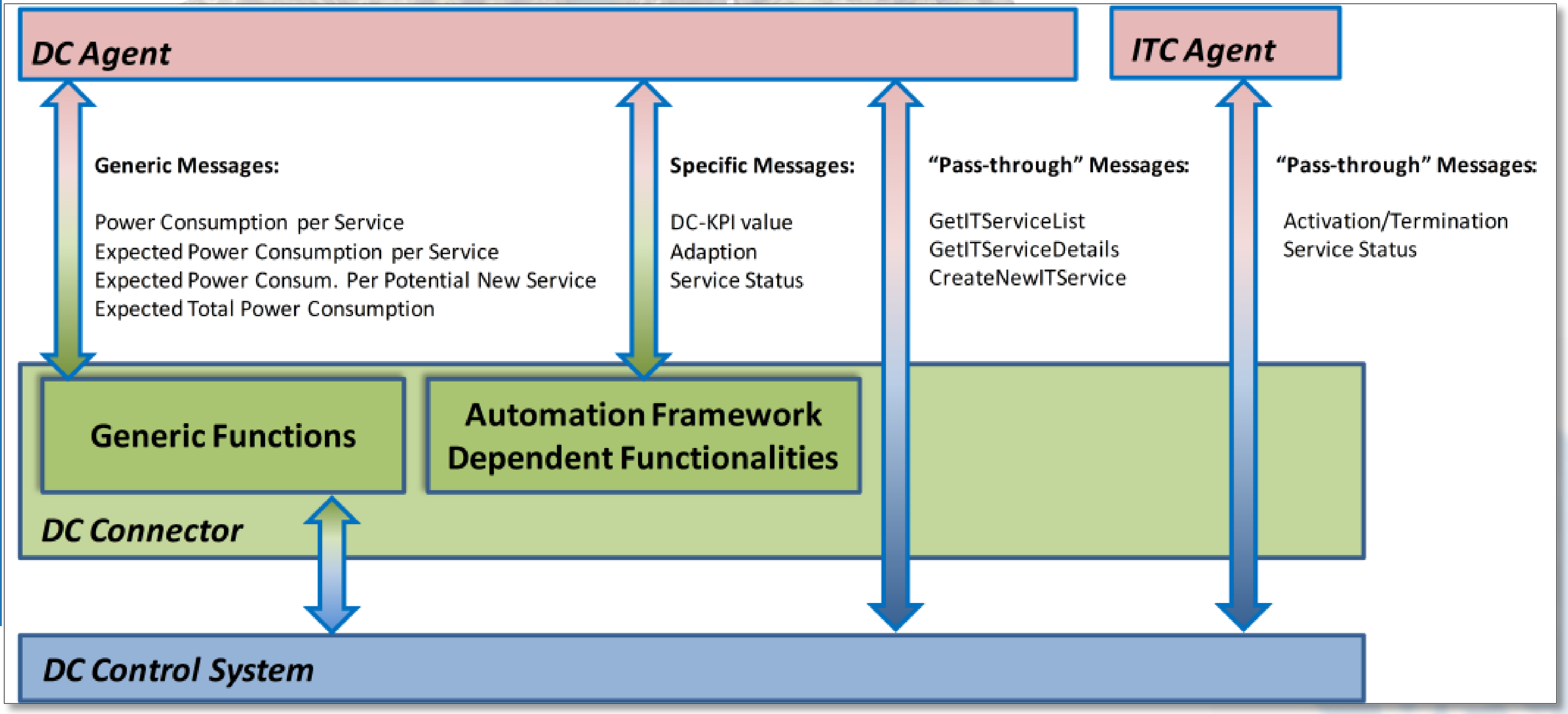
- Agreements, targets and actions between actors:



- Changes in run-time conditions of the IT services

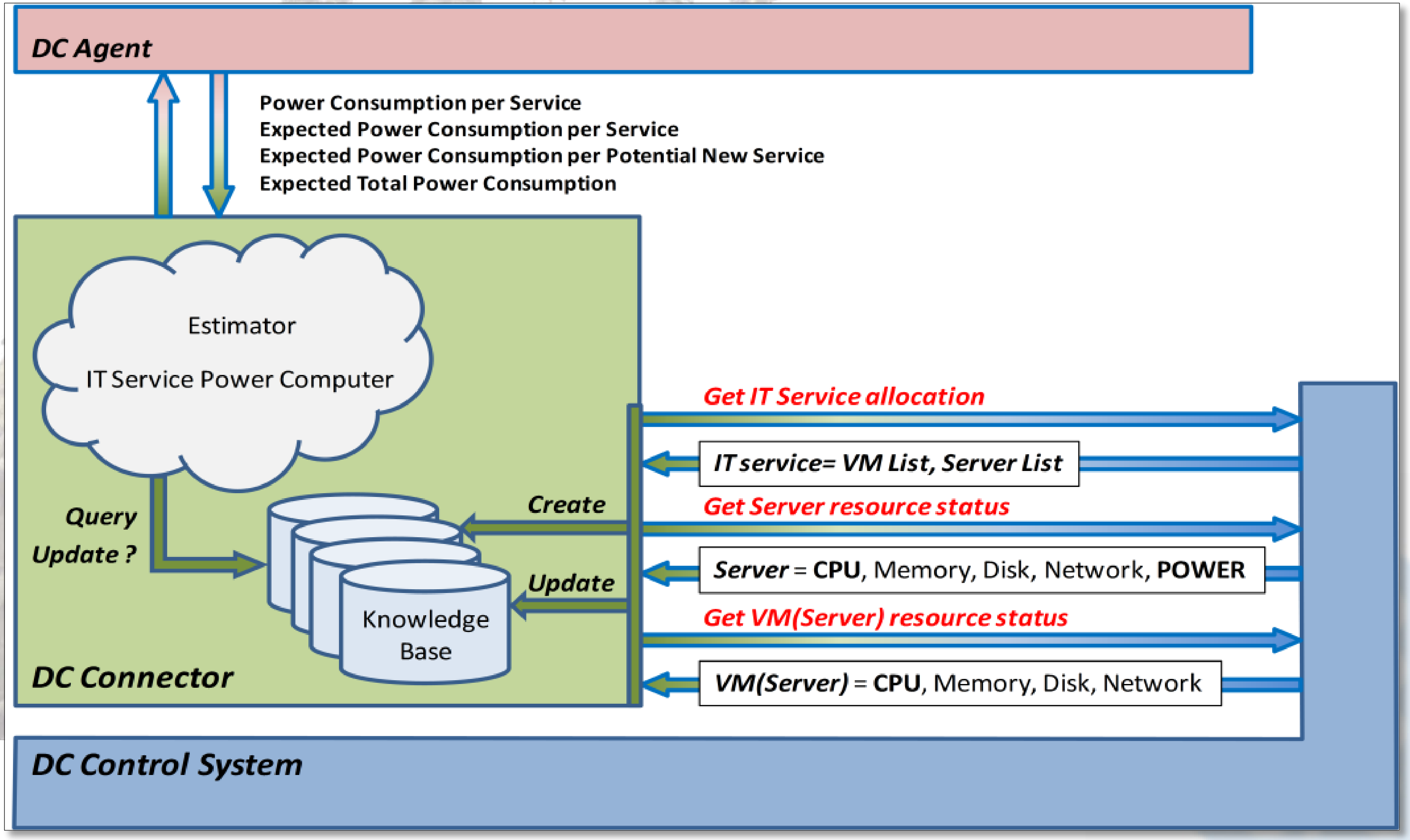
Architecture and interactions

- 3 main elements
  - DC Agent
  - ITC Agent
  - DC Connector

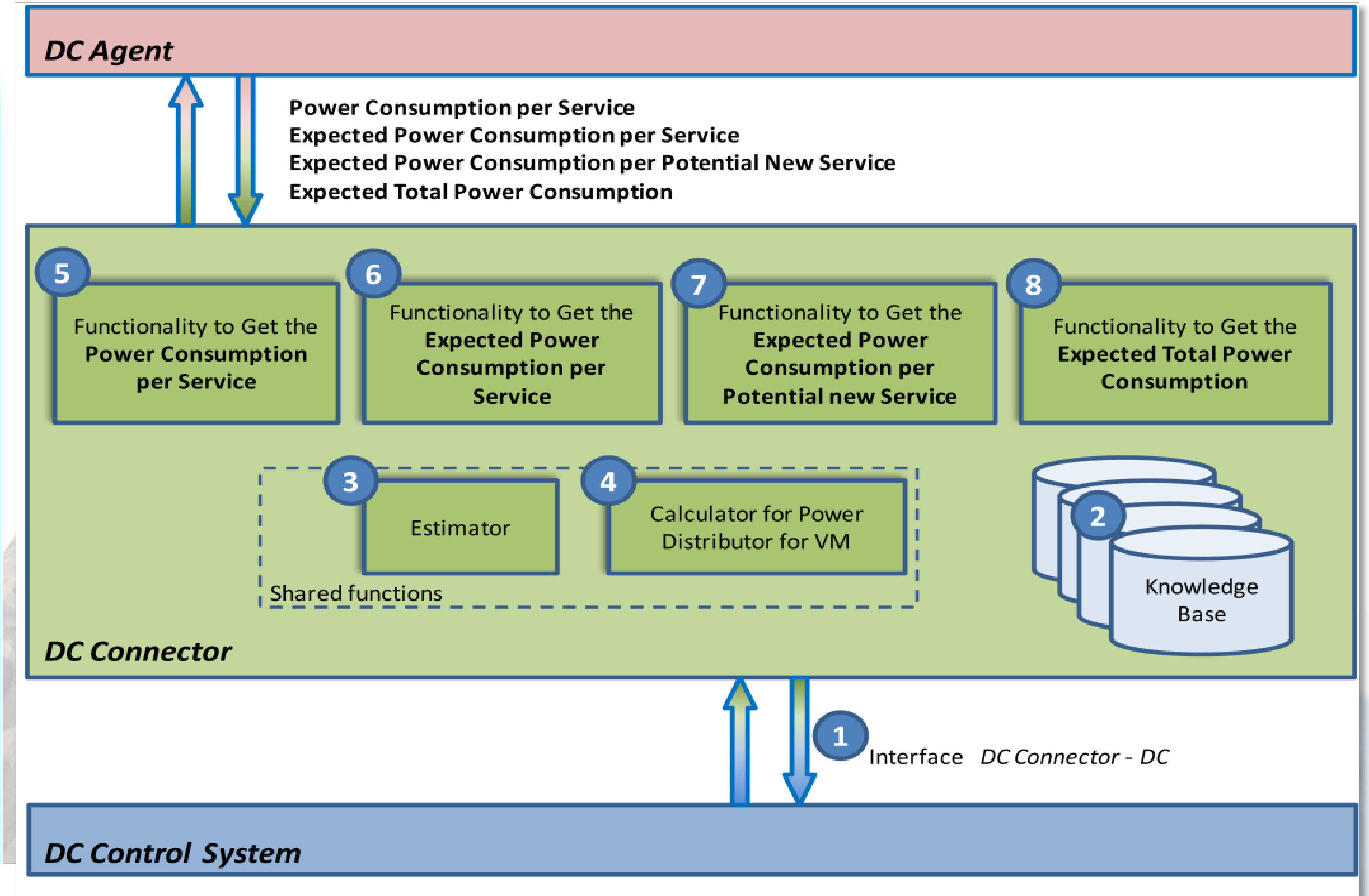


Generic functionalities

Functionalities that do not depend on the specifics of data centers but they are common to all of them.

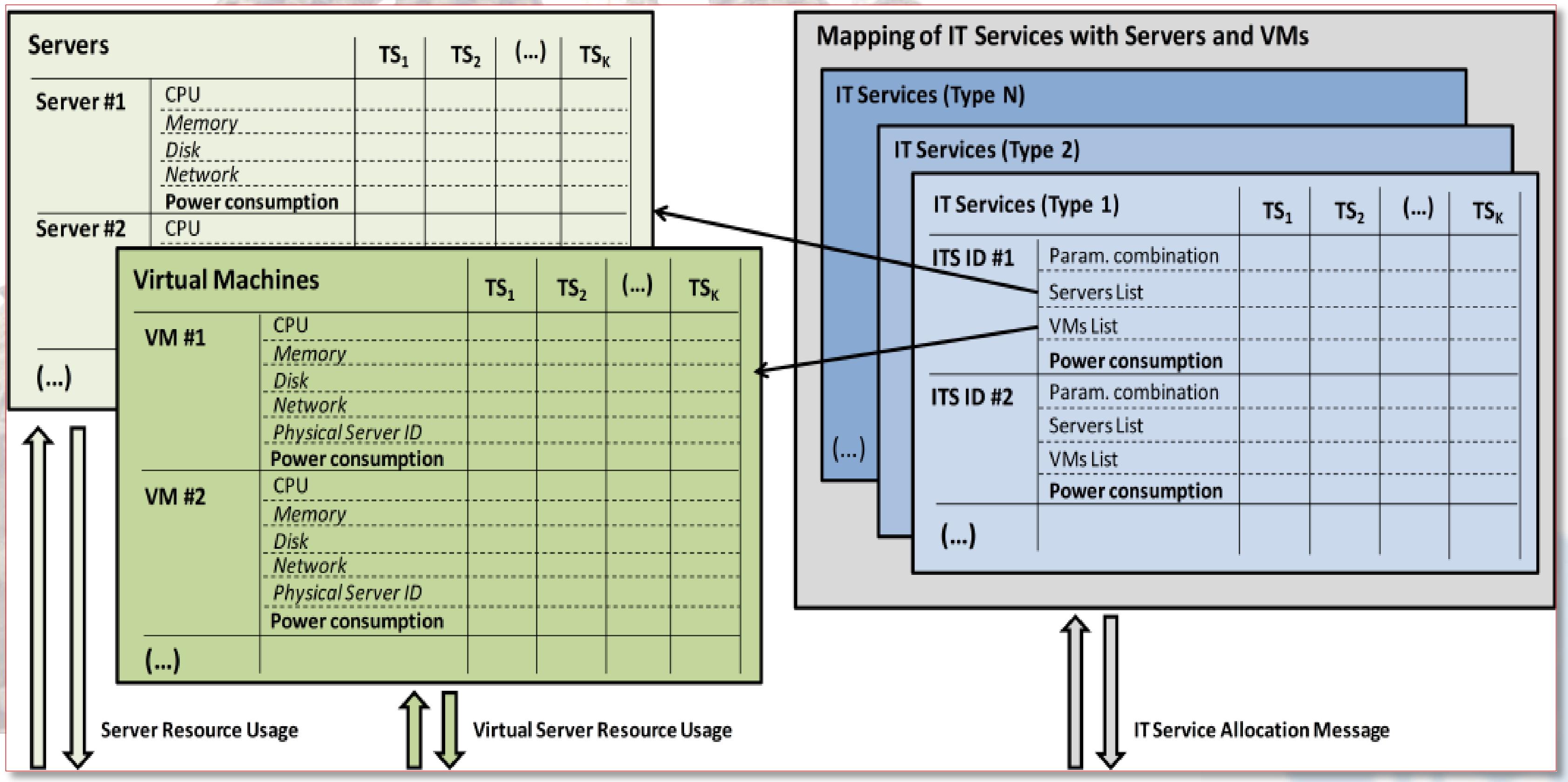


Implementation concerns



Knowledge base

- Stores the power consumption of each IT Service
- Historical values permits estimation



Power consumption distribution function (I)

- Goal
  - The power of dedicated servers can be easily retrieved by means of the Get Server resource status message.
  - It is not easy to get the exact percentage of the server's power being consumed by each of its instantiated VMs → <u>The power information is unknown for VMs</u>.

Formula to estimate the power consumption of each VM

Power consumption distribution function (II)

N = Number of servers

VM= Set of virtual machines

NCj = Number of virtual CPUs of the virtual machine j

Ei = Energy spent by the server i, i=0,1,…,n

VLjk = Load of virtual CPU k in the virtual machine j

CPUi = CPU load of the server i, i=0,1,…,n

Perj = Percentage of CPU load of the Virtual Machine j

VEj = Energy spent by virtual machine j

αij = Binary value indicating whether a virtual machine j belongs to server I

$$Per_j = \left(\sum_{k=0}^{NC_j} VL_{jk}\right) \Big/ \left(\sum_{i=0}^{N} \alpha_{ij} CPU_i\right)$$

$$VE_j = Per_j \sum_{i=0}^{N} \alpha_{ij} E_i$$

To ensure that a VM can be allocated in only one server:

$$\sum_{i=0}^{N} \alpha_{ij} = 1, \forall j \in VM$$

Conclusions and future works

- A novel architecture has been proposed to monitor and control the data centers to take intelligent decisions in order to save energy and reduce the carbon emissions.
- Requirements have been analyzed and functionalities defined to be implemented in a real testbed.
- Performance is currently under evaluation.
  - Results will provide feedback to tune and improve the design.

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Thanks for your attention