# Mathematical Problem Formulation

## Workflow Model

Given a set of precedence constrained tasks modeled by a weighted DAG (Directed Acyclic Graph).

Where,

## Cloud Model

Cloud consists of heterogeneous virtual machines of various types with varying CPU capacity, storage and memory.

## Terminology

|  |  |  |
| --- | --- | --- |
| **S No** | **Notation** | **Definition** |
|  |  | DAG modelling a set of precedence constrained tasks |
|  |  | Set of precedence constrained tasks |
|  |  | task in |
|  |  | Amount of data in bits to be transferred from task to |
|  |  | Set of virtual machines |
|  |  | All predecessor tasks wrt to |
|  |  | All successor tasks wrt to |
|  |  | Entry level task or |
|  |  | Exit level task or |
|  |  | CPU capacity of virtual machine in instructions per second |
|  |  | Power consumed by if task is executed on it |
|  |  | Number of instructions in task |
|  |  | Data transfer rate (in bits/s) among virtual machines (assumed constant for all) |
|  |  | Virtual machine which task is mapped to |
|  |  | Data transmission time from to |
|  |  | Earliest starting time of task on |
|  |  | Latesh finish time of task on |
|  |  | Execution time of task on |
|  |  | Earliest time is available to execute any task being mapped to it |
|  |  | Deadline for the entire set of tasks |
|  |  | Total energy consumed by task when executed on |
|  |  | Set of all virtual machine instances actually used to execute tasks or |
|  |  | Lease time of virtual machine |
|  |  | Mean lease time of all virtual machines or |

## Preliminaries

1. , after completion of task on , ) will be updated to

## Problem Formulation

We aim to find a schedule S such that

Subject to constraint that a task can be mapped to a single virtual machine only

1. Minimize:

Subject to

Corresponds to minimizing makespan

1. Minimize:

Corresponds to minimizing energy consumption

1. Minimize:

Corresponds to load balancing