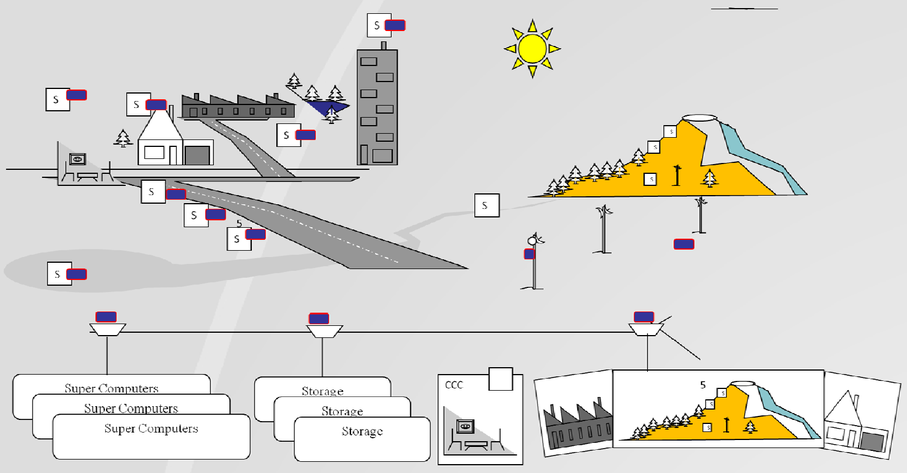
Network Control in Distributed Computing



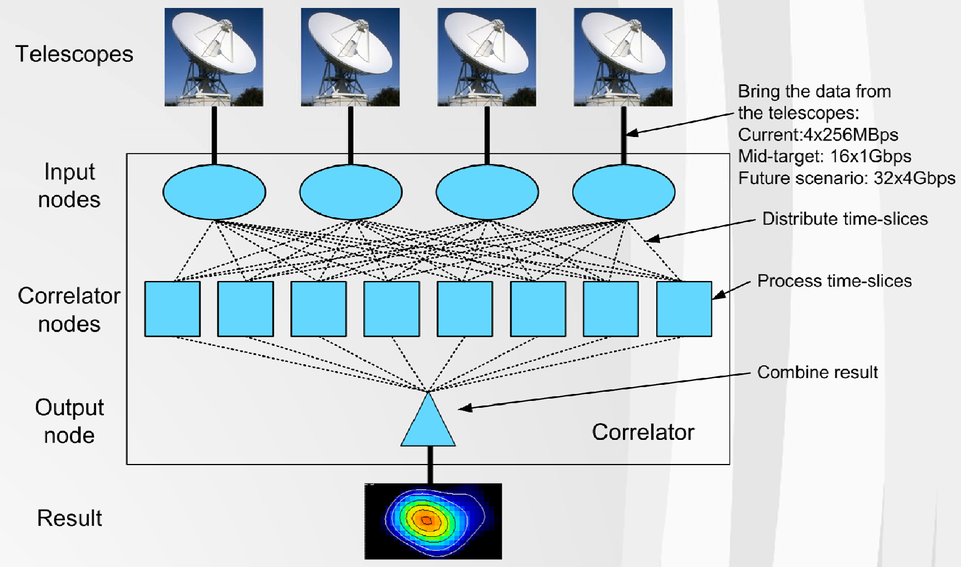
Motivation: when over-dimension is unfeasible

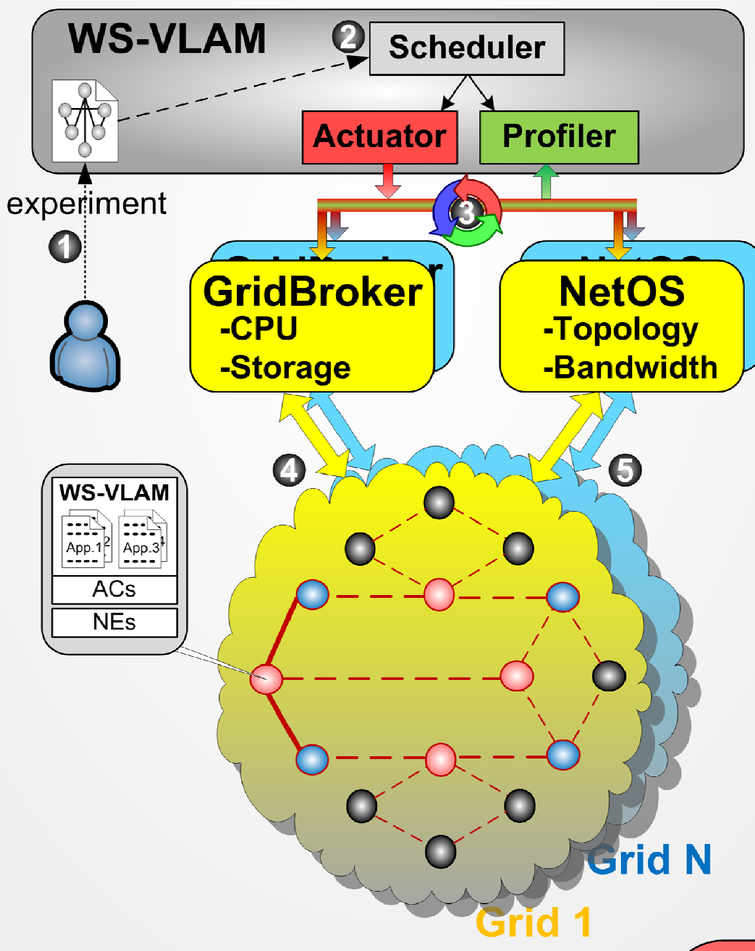
- Large-scale observation systems monitor environmental objects such as dikes in order to prevent disasters, or watch radio wave emissions from stars;
- Large-scale observation systems are dynamic in their resource demands;
- Large-scale observation systems need distributed computing where the available resources are used in an optimum way. Hence, infrastructure topology does matter!
- Distributed applications need specific network services and the ability to optimize themselves;
- Distributed computing platforms, such as Grids or Clouds need application support for network service development, deployment and management.

Applications that require specific network services that current distributed systems lack to deliver:

- ***IJkdijk***: large-scale sensor networks collect enormous amount of environmental data such as dikes and push the data into forecast models in order to predict dangerous events
- ***SCARIe***: a Grid-based software correlator for radio-telescope images requires high-throughput communication, but with specific services such as soft real-time or constant throughput

Network services can be part of applications or stand-alone distributed programs.





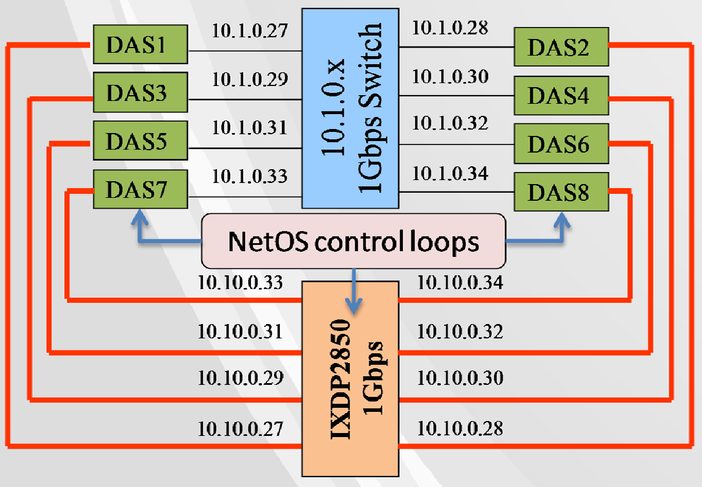
WS-VLAM – workflow execution environment coordinates the execution of distributed Apps

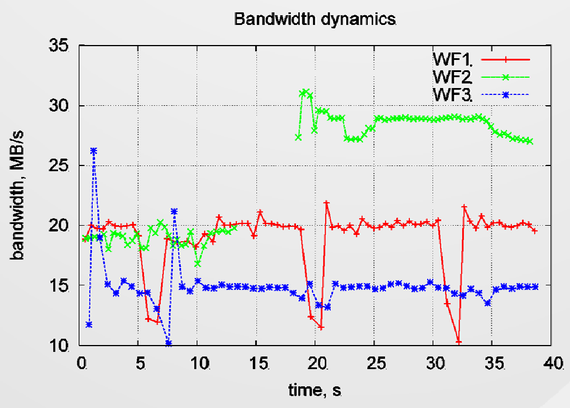
1 - ***User*** deploys an experiment: application & basic infrastructure requirements;
2 – ***WS-VLAM*** maps the experiment using *Actuator* onto available distributed resources as detected by *Profiler*;
3 - **Control loops** may occur in which WS-VLAM is a controller to adjust the resources such as to solve the applications demands regardless of the environment changes;

4 - ***Broker*** manages the computational resources;
5 - ***NetOS*** programs the networking infrastructure of distributed system;

Each node:

- supports the applications running under WS-VLAM supervision
- provides the application-specific network services through application-components ***ACs*** supported by network elements ***NEs***.





A testbed showing a distributed system in which nodes are interconnected through 2 networks, as follows:

- a default network uses a shared 1Gbps gigabit switch
- a second network uses a network processor unit programmed to route IP packets at 1Gbps, too.

1 – WS-VLAM management starts applications and setup the paths one by one on the default network (10.1.0.x);
2 – When measured network performance (throughput) decreased below an application threshold, WS-VLAM starts “offloading” the paths from 10.1.0.x network onto 10.10.0.x network;

Management of the programmable network services in a distributed computing leads to a dedicated operating system for network resources.

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