# GRID Network Used in Production Systems Engineering

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*Abstract:* - Under the given circumstances, i.e. globalisation and a knowledge-oriented society, in which information technology and communication technologies play a major role, productions systems are naturally being "affected" by these innovative transformations brought about by the development of the Internet and especially that of its most important service, namely the WWW space.

*Key-Words:* - GRID network, production systems, Internet

## 1 Introduction

In order to be competitive in a globalised economy, in which the quality-cost-time triplet is decisive in terms of survival on the market, production systems undergo major changes triggered by the fact that they have emerged from that traditional "four-wall" pattern, to multinational companies that have operations all over the world. Due to this fact and to the huge amount of data to be handled, transferred and processed – taking into account that it is always crucial to be able to quickly obtain accurate data – GRID networks, in which the tasks are shared among all interconnected computers, are the key to these equations and to avoiding gateways, even when data is handled by way of the XML metalanguage.

## 2 Current Status in Romania

In Romania, the situation is not very promising because few people have access to the Internet and Web services [2], [4].

Therefore, the service-oriented Web-based architectures are still in their incipient stage of development. This, however, does not discourage researchers from creating scenarios and simulations related to distributed calculations and increasing the data-processing speed. This present paper suggests a data handling and processing solution for modern production systems, a solution that uses a GRID network in order to speed up the calculation process.

## 3 Web-Based Parallel and Distributed Processing GRID Network

The decisional issue [5], [6], [7] related to planning the water retention and allocation system has several objectives: a) maintaining water flows of rivers and water accumulations close to prescribed levels and b) meeting, as much as possible, the necessities related to water consumption. The plan uses as input data the values of water stored in reservoirs and predictions related: to the water flow of rivers and their tributaries, to the water consumption in supplied areas and water loss (especially due to evaporation)[1].

Considering the fact that mathematical modelling (mathematical models, algorithms, etc.) may be applied to any actual situation, one of the project's objectives is precisely, but not exclusively, modelling and simulation of floods and overflows.

Therefore, because processing a huge amount of data is time consuming, a GRID network [3], able to perform these parallel and distributed calculations seems to be the best alternative. The GRID network that will be used for performing these modelling is briefly presented below.

### 3.1. Platform (General Architecture)

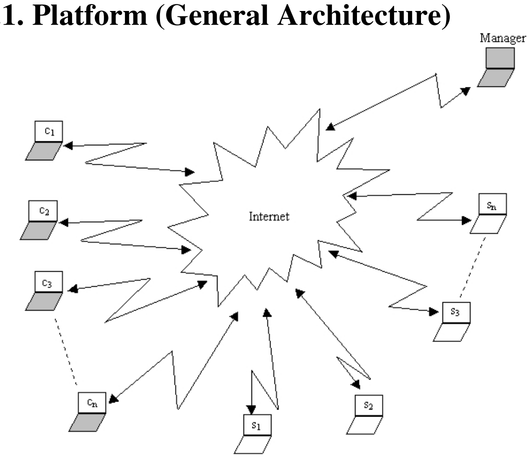


**Fig. 1. General Architecture**

$c_1$, $c_2$, $c_3$, … , $c_n$: client stations (process initiators). These stations deal with formatting the relation to be processed, so that it becomes understandable from an informational point of view. Their role is to synthesise information and they can be a person or a software application that is able to provide such an relation.

$s_1$, $s_2$, $s_3$, … , $s_n$: performing stations (processing stations). These stations deal with practically processing the information provided by the processing manager (M). Different platforms may be used (Windows, Unix, Linux) provided that they are web-service enabled.

Manager: the processing manager (fig. 2) (and in detail below) deals with:
- receiving the processing task;
- organising the processing (divides tasks into subtasks);
- implementing a logical architecture between processing stations;
- centralising results.

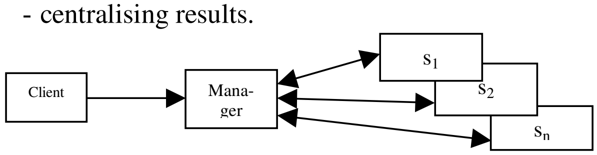


**Fig. 2. Processing Manager**

## 3.2. Technical specifications

<u>Client stations (features)</u>:
- easy installation;
- user-friendly GUI;
- internet access.

Platform (fig. 3):

I. Internet Browser (IE, Firefox, Opera, etc.)
- *Tasks:* setting up the processing manager and sending processing relations;
- *Specifications:* HTML (XHTML), JavaScript;

II. Standalone Applications
- *Tasks:* pre-processing relations to be processed;
- *Specifications:* any programming language.

<u>Server</u>

*Processing manager (features) (fig. 4):*
- receives processing relations;
- manages available processing stations;
- implements a logical architecture between performing stations;
- centralises results.

*Platform:*
- server: IIS, Apache
- Scripting language : PHP, ASP.NET (C#. VB.NET)
- Databases: MSSQL, MySQL

*Optimisation:* some of the calculations performed are recorded in a DLL (fig. 5) that the abovementioned languages may use.

*Databases* are used: for storing the status of processing stations and/or recording a context.

*Processing stations (features):*
- processing mathematical relations;
- according to its configuration architecture (star, hypercube, etc.) receives/sends results;
- may contain partial results.

Benefits / Drawbacks of using scripting languages and solutions:

*Drawbacks:* they provide a standard way of interfacing with the Web Server, with the implemented Web services.

A major *drawback* is the processing speed. These scripting languages are more interpreted (with the exception of ASP.NET).

*Solution:* DLL that work at the processor's speed because instructions are written in assembly language.

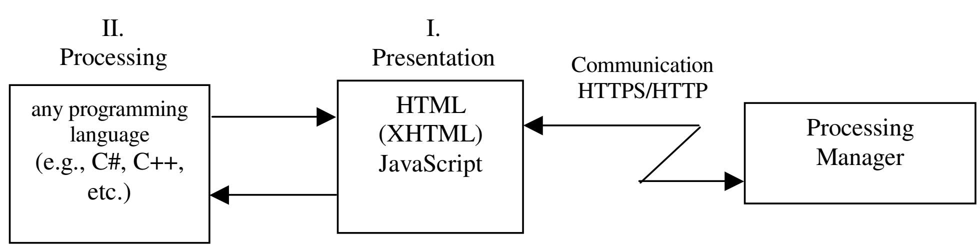


**Fig. 3. General Architecture Communication**

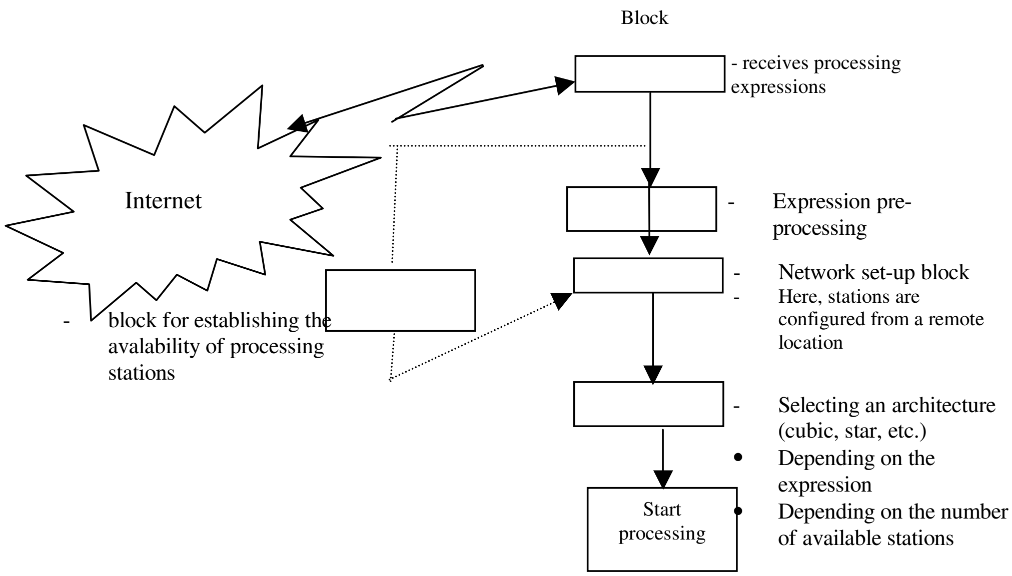


**Fig. 4. Connection Manager Task**

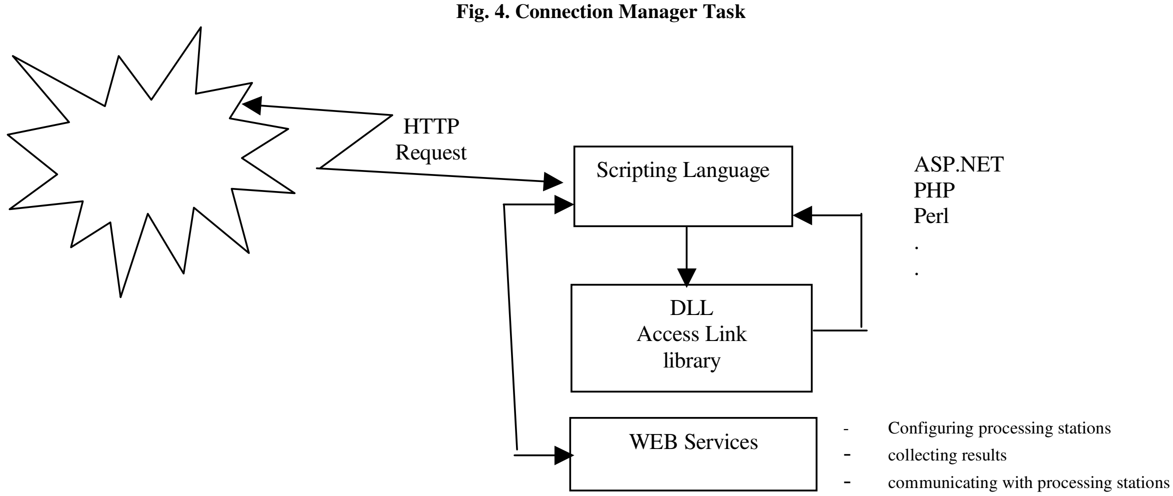


**Fig. 5. Resource-consuming calculations are performed by a DLL**

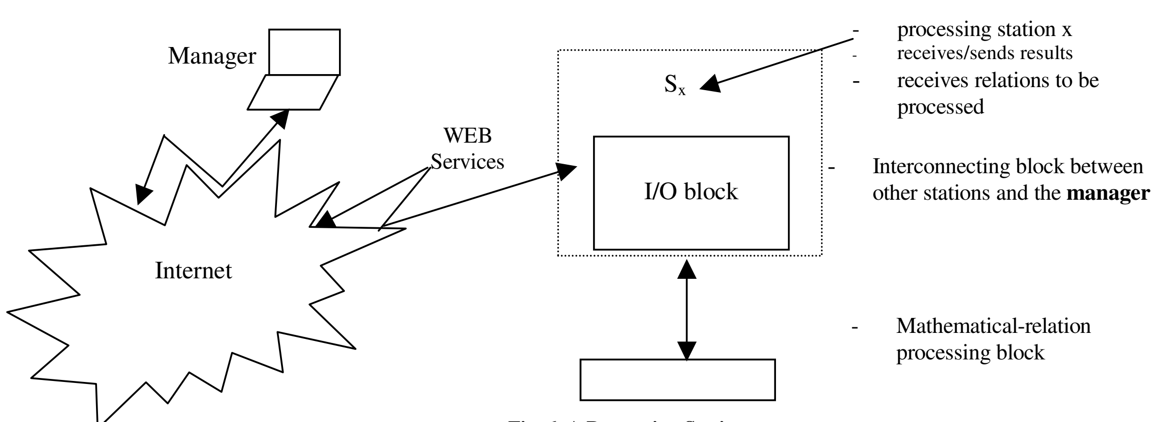


**Fig. 6. A Processing Station**

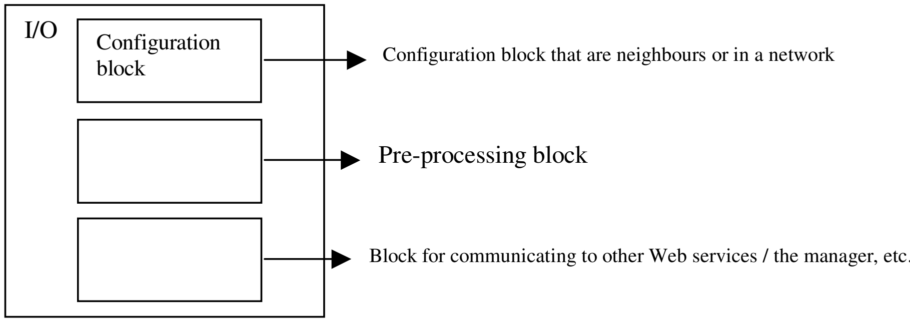


**Fig. 7. I/O Block**

### 3.3.The Processing Manager

The processing manager, the most important piece in a GRID network, is presented in detail below.

Relation transformation algorithm

*Step 1* the relation is received

*Step 2* a symbolic tree is created for the relation (postfix writing with references, in the figure they are represented as a tree), some nodes are grouped, if possible especially those that are not with a reference.

Network Interconnection Algorithm (Processing Manager)

*Step 1:* the network symbolic tree is undertaken and each leaf is recorded horizontally;

*Step 2*: checking the number of processing stations and allotting a number to each of them. This choice is made according to an algorithm that takes into account the server's performance (this step cannot be easily presented in detail because, to be able to do that, one must first analyse all references).

Note: There is a problem when the leaves are more than the processing stations (a solution to this problem might be allotting each relation a multiple execution order => at a given moment, a station may execute several parts of a relation (may perform several tasks at the same time)).

Executing a relation

*Step 1*: network interconnecting algorithm

*Step 2:* set variation limits for the relation

*Step 3:* launch in execution each leaf to target station

Processing stations

*Configuring processing station*

*Step 1:* receives relation tree

*Step 2:* receives running limits (for variables)

*Step 3:* receives execution order(s) (from the tree, i.e. index)

Note: this is a static version, orders set at the beginning, a subsequent version might request the manager a free station (see Performance Test()).

Execution order = roles that it is able to perform within the GRID

*Step 4:* establishes the stations where results will be sent (as a rule, to the parent in the symbolic tree), it is as well a list depending on the current order that it carries out.

## 4 Conclusion

To conclude, we could add that production systems have not managed to "escape" the major changes triggered by the "information era" and neglecting them in this respect and failing to use effectively the information and communication technology in the field would enlarge the gap between Romania and EU-member countries as regards modern production systems.

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[5] http://www.**gridcomputing**.com;

[6] http://www.globus.org;

[7] http://www.ibm.com/**grid**.