A European Legal Approach to Grid Computing

Nikolaos Volanis
Katholieke Universiteit Leuven – Interdisciplinary Centre for Law and ICT
Nick.volanis@law.kuleuven.be

Prof. Dr. Jos Dumortier
Katholieke Universiteit Leuven – Interdisciplinary Centre for Law and ICT
Jos.dumortier@law.kuleuven.be

Abstract

This paper presents a European legal approach to grid computing. In the absence of specific legislation regulating its legal status, we attempt to classify the different layers of grid computing (grid fabric, grid middleware and grid applications) by applying the relevant legal terminology to the nature (hardware-software) and function (provision of services) of each layer. We suggest that grid services should be holistically considered as information society services for the purposes of applying the relevant regulatory framework.

1. Introduction - Social and commercial models of Grid Computing

Perceived from a general perspective, the “Grid” is an infrastructure that involves the integrated and collaborative use of computers, networks, databases and scientific instruments owned and managed by one or various organizations. A first categorization of grid computing applications distinguishes between two dominant models:

The social model views the benefits of grid computing as a resource to be harnessed for the good of society. Projects such as SETI@home, AIDS@home, and the Human Proteome Folding project have created networks of resources that divide a scientific problem and distribute it across the Internet to the computers of people who have volunteered to commit their machines to the project’s cause. Meeting social model’s objective — the achievement of the scientific goal — relies heavily on the moral accolade of helping society by facilitating scientific research; the operational model depends on the voluntary submission of resources by computer owners, who are free to decide whether to install or uninstall the relevant software client. From a legal perspective, the relationship between the project developers and the owners of the resources is limited to the acceptance of the Terms of Use of the software. The latter underline the voluntary aspect of such projects, indemnify the project developers against damages or loss of data that may be caused to the owners’ computers, as well as allow for anonymous submission of resources. Arguably, none of the actors engaged in the social model is willing to commit himself in a legally binding relationship that creates financial claims, obligations and responsibilities.

On the contrary, the commercial model sees in grid computing various business exploitation opportunities; following one implementation of this model, profit is generated by creating a large processing center and renting its capabilities to customers, thereby freeing them from investing money and personnel on purchasing, configuring and managing their own network of computer hardware and software applications. Today, large vendors such as Sun, IBM and HP have already invested in grid technology, using it as a means to provide virtualized resources to meet dynamically changing application demands. In this model, computing resources usually reside within one or more computing centers controlled and managed by the company selling the service. It essential that the company have control over the resources in order to achieve a Quality of Service (QoS) level that meets the contractual requirements laid down in the Service Level Agreement (SLA) between the provider and the recipient of grid services. In a different commercial model, a number of enterprises form a Virtual Organization (VO), whose purpose is to enable the sharing of each company’s data and computing resources, so that every member benefits from the aggregated computing power by submitting requests to the grid administrator. In such model, the VO acts as the grid provider while each member of the VO is considered the recipient of grid services. The management of tasks and the allocation of computing power are made according to the predefined
agreements of the members forming the VO. While this second model is currently adopted solely within the context of academic research, it appears plausible that it could be used in commercial and public sector applications. In practice however, commercial adoption of grid technology in applications that cross enterprise-organizational boundaries has not been realized yet.

Regardless of the specific commercial model that is implemented, the fact that a contractual relationship is forged on the basis of exploiting a grid network raises questions regarding how this relationship should be perceived by the current European legislation, particularly vis-à-vis the legal definitions of an “electronic communications network”, an “electronic communications service” and an “information society service”.

2. The Grid as an electronic communications network

In a sophisticated grid environment, its infrastructure supports a number of specific capabilities such as:

- Fast and secure network embedded in a distributed telecommunications infrastructure
- Uniform access to remote resources (data and computational resources)
- Security access authorization and policy-based authentication
- Interoperability of distributed applications using diverse software components
- Discovery of suitable datasets and computational resources across the network
- Management (mapping and scheduling) of tasks
- Automatic launching of computational tasks by applications
- Remote storage and replication of data sets
- Monitoring and enforcement of SLAs
- Metering/estimating resource usage (needed for calculating the price of the provisioned services)

Regardless of the application that is chosen for implementation, a common feature of grid computing is the fact that the above capabilities are arranged into layers. Each layer builds on the services offered by the lower layer in addition to interacting and cooperating with components at the same and upper layer (for example, the component that is responsible for the allocation of computing power must communicate with the component that handles the authentication of the computing resources — same layer — but also with the network interface that handles the transmission of signals to the distributed resources — lower layer). For the purposes of legal research, we can distinguish between 3 general layers that comprise the essence of Grid architecture (in effect these layers can be further broken down in subsequent layers)

1. **Network and resource layer (fabric):** at the bottom of the architecture, this hardware-centric layer encompasses all the physical infrastructure of the grid, that is, the communication network — cables and routers — and the resources that are part of the grid, such as computers, storage systems, electronic data catalogues etc.

2. **Middleware layer:** this layer is responsible for handling machine-to-machine communication. On a lower level, it abstracts the complexity and heterogeneity of the network and resource layer by providing a consistent method of accessing distributed resources through the use of services such as information registration and discovery, authentication and authorization. On a higher level, it handles general management functions such as scheduling and allocating application tasks for execution, running system diagnostics, and monitoring and billing customers for making use of the grid.

3. **Application layer:** at the top layer of the grid structure, the application layer includes all different user applications (science, business, financial, etc.), grid portals and development toolkits supporting these applications. Usually, this is the only layer with which the user interacts.

In the absence of specific legislation dedicated to the regulation of grid computing, it is necessary to examine whether the European legislator has regulated technological fields that are essential to grid architecture, and see whether the scope of the relevant legislation may extend to cover all or some of the grid layers.

Indeed, grid computing challenges the present regulation through various ways. Overall, it puts forth a new combination of network infrastructure and services that fall under a wide scope of regulatory provisions. Judging from the recent regulatory developments it can be concluded that the trend in the European legislation is to acknowledge the ever-converging dynamic of networks and services, by applying the same regulatory principles for the same services, regardless of the technological platform that is used. This approach is deemed to be technologically
neutral, and therefore does not impose excessive regulatory burdens to the industry, nor does it hinder innovation in specific technological sectors. Moreover, this approach would entail that grid computing should be regulated vertically by one set of legislation, which would cover its entire layered infrastructure.

However, some regulatory classifications in Community legislation remain in effect, and distinguish between two different types of services, with significant overlaps: information society services and electronic communications services (both legal definitions are discussed *infra*). This legislative dualism complicates the task of classifying the provision of grid services under one set of legislation, particularly given that there is only one authentic interpretation of the relevant provisions, found in recital 10 of Directive 2002/21/EC: although the definition of information society services spans a wide range of economic activities that take place online, most of these activities are not simultaneously considered as electronic communications services, since “[…] they do not consist wholly or mainly in the conveyance of signals on electronic communications networks” (voice telephony and electronic mail conveyance are the most notable exceptions). Unfortunately, the Directive does not provide further clarifications on the matter, leaving much space to the national legislator or judge for *in concreto* conclusions. Such *in concreto* examination should take place in the scope of grid computing as well, in order to determine the nature of the proposed services and therefore apply the relevant legislative framework.

3. Legal evaluation of different layers of Grid computing

3.1 Network and resource layer (Grid fabric)

Beginning with the bottom layer of the grid architecture, we should examine whether the network infrastructure of the Grid qualifies as an “electronic communications network”. Pursuant to article 2 (a) of Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services (“Framework Directive”):

> “electronic communications network” means transmission systems and, where applicable, switching and routing equipment and other resources which permit the conveyance of signals by wire, by radio, by optical or by other electromagnetic means, including satellite networks, fixed (circuit and packet-switched, including Internet) and mobile terrestrial networks, electricity cable systems, to the extent that they are used for the purpose of transmitting signals, networks used for radio and television broadcasting, and cable television networks, irrespective of the type of information conveyed”

In addition, paragraph (c) of the same article provides the definition of an electronic communications service:

> “electronic communications service” means a service normally provided for remuneration which consists *wholly* or *mainly* in the conveyance of signals on electronic communications networks, including telecommunications services and transmission services in networks used for broadcasting, but exclude services providing or exercising editorial control over, content transmitted using electronic communications networks and services; it does not include information society services, as defined in Article 1 of Directive 98/34/EC, which do not consist wholly or mainly in the conveyance of signals on electronic communication networks.” *(emphasis added)*

While it seems that the grid network infrastructure satisfies the criteria for falling under the presented definitions, we understand that the answer requires further analysis. The regulatory scope of this Directive —acting as the “flagship” of a set of Directives which were issued in 2002 and established the “New Regulatory Framework (NRF) for electronic communications networks and services”— was to encompass the converging sectors of telecommunications, media and information technology by a single regulatory framework, and eliminate any legal discrimination over networks of different technological platforms [1]. It follows that the main intention of the European legislator was to regulate electronic communications networks and services that are primarily accessible by the public, and whose essential purpose is to be used as platforms for the provision of electronic communication services to third parties. This becomes apparent not only from the addition of a separate definition of “public

---

2 O.J. L 108/33, 24.04.2002
communications network\textsuperscript{3} and the fact that the definitions of “user\textsuperscript{4}, “consumer\textsuperscript{5}, “subscriber\textsuperscript{6} and “end-user\textsuperscript{7} relate only to those entities that request publicly available electronic communications services; it is also apparent from the fact that the bulk of provisions laid down by the NRF address only the provision of publicly available electronic communications services over public communications networks.\textsuperscript{8}

Furthermore, we understand that the Community legislator perceived the notion of an electronic communications network as a necessary and self-evident component in the provision of electronic communications services, making the former definition dependant on the provision of such services. It follows that, if the grid network is not used for the provision of services that consist wholly or mainly in the conveyance of signals, but is used for other purposes (e.g. for the provision of information society services) the grid network per se does not fall under the regulatory scope of the NRF. In other words, a grid network would legally qualify as an “electronic communications network”, if it were used for the provision of electronic communications services (e.g. voice, email) to third parties willing to buy the specific services from the grid provider.

A direct outcome of the above consideration is the understanding that the legal and technical definitions of an “electronic communications network” differ in scope. More particularly, the legal term focuses mostly on the physical infrastructure, the “pipelines” that constitute the entire electronic communications network, capable of autonomously providing an electronic communications service — that is, conveying an electronic signal form its source to its destination. In the example where a direct phone call is realized between two subscribers, the operator of the communications network is responsible for establishing the communication, since his network infrastructure extends up to the premises of the subscribers. An Internet service provider on the other hand cannot be considered as the owner-operator of an electronic communications network, from a legal point of view. Although he has his own network infrastructure that provides his customers with access to the Internet or with other information society services, these services would be impossible to offer without making use of the underlying network infrastructure. (However, providing access to the Internet is still considered, exceptionally, to be an electronic communications service, as well as an information society service, according to recital 10 of Directive 2002/22/EC — in this case, the electronic communications service of the Internet Service Provider is realized over an electronic communications network operated by a third party).

It follows that the mere fact that grid computing technologically presupposes electronic communication between resources of any sort is not enough to classify it as an electronic communications network from a legal perspective. It is also necessary that the grid provider is using the network to provide electronic communications services, and that the network is autonomous enough to reach the recipient of the services without the help of an underlying infrastructure operated by a third party. Tailoring the aforementioned considerations to the various business models of providing grid services, we can distinguish between three cases:

First, when the grid is deployed in a closed and autonomous environment (for example, a company decides to adopt a grid architecture for its 1000 computer and data resources, all placed in the same office building), then communication is indeed possible between the terminals without the interference of an underlying network. Although this layout would technically qualify as an “electronic communications network”, it is hardly affected by the current regulatory framework, since its difference from an intranet that is set up between two or three computers in a family house is only a matter of scale. According to the legislative aims of the European legislator, the NRF’s scope of application does not affect restricted autonomous networks of this kind. The primary reason for this exclusion is the fact that the network is not used for the provision of electronic communications services to third parties. A different approach which would broaden the regulatory definition of electronic communications network would entail that even those networks that are restricted and autonomous, and do not provide electronic communications services to third parties (such as a home Local Area Network) must comply to the NRF’s legislative requirements and administrative formalities (e.g. the notification to the

\textsuperscript{3} “public communications network” means an electronic communications network used wholly or mainly for the provision of publicly available electronic communications services”. Article 2 (d), Directive 2002/21/EC (“Framework Directive”)
\textsuperscript{4} Article 2 (b) Directive 2002/21/EC (“Framework Directive”)
\textsuperscript{5} Article 2 (i) Directive 2002/21/EC (“Framework Directive”)
\textsuperscript{7} Article 2 (n) Directive 2002/21/EC (“Framework Directive”)
\textsuperscript{8} See for example Article 8, paragraph 4 (c) of Directive 2002/21/EC (“Framework Directive”), or even the general scope of application of the Directives establishing the New Regulatory Framework, such as Article 3 of Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications)
and the provider of “electronic communications services” that are essential for the provision of grid services. Accordingly, all the actors involved in a grid computing value chain (grid service provider, business integrator of the grid solution, consumers) are considered as recipients of the electronic communications services provided by the network operator.

The answer would be different, however, in the case the grid provider would lease dedicated lines from the network operator, since then the grid provider would be considered as the operator of the entire network that is needed for the provision of grid services; in that case, the underlying –leased- network would be considered as a part of the grid fabric, and therefore the applicability of the NRF would depend on the nature of services provided over the grid network. As it is explained infra, it is our opinion that these services are information society services and not electronic communications services.

3.2 Middleware layer

With regard to the middleware layer, we deem that it is necessary to distinguish between the middleware as a piece of software that is responsible for the efficient communication between the resources, but also as separate important part in the provision of grid services. According to these different characteristics, two different sets of legislation apply: intellectual property right management and information society service provision.

Since grid middleware is primarily software code, it benefits from the relevant Community legislation, more particularly, Council Directive 91/250/EEC of 14 May 1991 on the legal protection of computer programs (“Software Directive”)10. Pursuant to Article 6 of the Directive, the term “computer program” includes programs in any form, including those which are incorporated into hardware. The term also includes preparatory design work leading to the development of a computer program provided that the nature of the preparatory work is such that a computer program can result from it at a later stage. In a nutshell, the Software Directive grants copyright protection to computer programs, as literary works within the meaning of the Berne Convention for the Protection of Literary and Artistic Works, as long as they are “original”, in the sense that they constitute the author’s own intellectual creation. In addition, it is questionable whether the grid middleware solution can be eligible for patentability, under article 52 of the European Patent Convention. While paragraph 2 of the aforementioned article

---


10 O.J. L 122/42, 17.05.1991
excludes computer programs from patentability, the European Patent Office’s Guidelines clarify that if the claimed subject matter has a technical character, it can qualify for the granting of a patent: “A further technical effect which lends technical character to a computer program may be found e.g. in the control of an industrial process or in processing data which represent physical entities or in the internal functioning of the computer itself or its interfaces under the influence of the program and could, for example, affect the efficiency or security of a process, the management of computer resources required or the rate of data transfer in a communication link.”

Besides its software nature, the grid middleware’s task is of seminal importance for the provision of grid services: to organize and integrate the disparate computational resources of the grid into a coherent whole. It is therefore necessary to examine whether the specific activity falls under the regulatory scope of “information society services” or that of “electronic communications services”.

The former are regulated primarily by Directive 2000/31/EC, which provides examples of economic activities that do and do not fall within the definition of information society services. While there is no reference to grid services, the following examples present similarities and can be considered as specific components of grid computing:

- offering on-line information or commercial communications
- providing tools allowing for search, access and retrieval of data
- transmission of information via a communication network
- providing access to a communication network
- hosting information provided by a recipient of the service

Since one or more of the services mentioned in the Directive cover specific and essential elements of grid computing, it is logical to conclude that the provision of grid services constitutes an information society service as well (argumentum a fortiori). In addition, taking into account the definition of “electronic communications services” in combination with the interpretation by the Community legislator, found in recital 10 of Directive 2002/21/EC (see infra), we are led to the conclusion that grid services should not be considered “electronic communications services” since they do not consist wholly or mainly in the conveyance of signals on electronic communications networks. Indeed, the purpose of grid services is not limited to the establishment of communications links among grid resources and participants, but it extends to the offering of sophisticated services, such as the aggregation of computational power and sharing of information for meeting specific application demands.

However, in order to be classified as information society services, grid services should satisfy a set of requirements that are laid down in the relevant legislative definition, which is provided in Directive 98/34/EC (amended by Directive 98/48/EC). Pursuant to article 1 (b), an information society service is:

“[…] any service normally provided for remuneration, at a distance, by electronic means and at the individual request of a recipient of services. For the purposes of this definition:

- ‘at a distance’ means that the service is provided without the parties being simultaneously present,
- ‘by electronic means’ means that the service is sent initially and received at its destination by means of electronic equipment for the processing (including digital compression) and storage of data, and entirely transmitted, conveyed and received by wire, by radio, by optical means or by other electromagnetic means,
- ‘at the individual request of a recipient of services’ means that the service is provided through the transmission of data on individual request.”

As far as the prerequisite of ‘distance’ is concerned, the service should be provided without the parties being simultaneously present (such as Internet cafés, for example). In the same direction, a provider of a grid network that is wholly deployed within his premises cannot be considered as a provider of an information society service, if its business model focuses on allowing customers to make use of the computing facilities only if they are physically present (e.g. when the customers are required to send their own personnel to supervise the execution of the service). However, remote access over a communications network would satisfy the “distance” prerequisite: for

12 Recital 18, Directive 2000/31/EC
example, the provider of the grid may establish a communication link over the Internet with his customer, through which the grid is “fed” with information that is relevant for the processing of the computational task. Similarly, the same applies in cases where the requisite data are already present on the provider’s resources and invoked over the network by the customers. Moreover, a grid that is deployed over a wider geographical area, where communication between the participants is made possible through the use of any “electronic communications network”, automatically meets the “distance” prerequisite as well.

According to the third prerequisite, the service should be delivered on demand (“at the individual request of a recipient of services”). This applies not to the internal functioning of the grid architecture (for example, the fact that the resource broker may assign a computational task to a specific resource), but to the grid’s external response from the recipient of grid services. The latter should be able to access the network on a request-by-request basis, meaning that it should be independent and autonomous from any other customers of the grid provider.

With regard to the scope of application of the relevant legislation to businesses and consumers, Directive 2000/31/EC makes no distinction: By defining the “recipient of the [information society] service” as “any natural or legal person who, for professional ends or otherwise uses an information society service”\(^{15}\), the Directive encompasses both business-to-consumer and business-to-business transactions, thus covering the relationship between the provider of grid services and the business-recipient of the services, as well as any direct or indirect (through the business-recipient) relationship between the provider and the consumer.

On the contrary, Directive 97/7/EC\(^{16}\) introduces a minimum set of consumer protection legislation on a Community level as regards contracts negotiated at a distance, particularly in respect to the information provided prior to the conclusion of such contracts. By limiting its scope of application to “[...] distance contracts between consumers and suppliers\(^{17}\), the Directive intentionally leaves business-to-business distance contracts outside its regulatory field. It follows that, although relationship between the provider and business-recipient of grid services and is not affected, the Directive is still applicable in cases where the grid solution is an integral part of a service offered to the consumer [2].

3.3 Application layer

As regards the application layer, the same distinction between software and service provision should apply: to the extent that the application computer program is original, that is, it represents the author’s own intellectual creation according to article 1 (3) of the Directive 91/250/EEC on the legal protection of computer programs, it should be granted copyright protection pursuant to the same directive, regardless of whether the authorship of the program belongs to the grid service provider, the business integrator of the grid solution or a third party (for example, software company). The legal controversy regarding the patentability of computer programs applies to the application software particularly with regard to the necessary further technical step, as the latter has been specified in the Guidelines for Examination of the European Patent Office.

Since the application runs in a grid environment that qualifies to be classified as an information society service, we deem that it should be considered as an added aspect of the grid service. For this purpose we consider that it should be regulated by the same legal principles and provisions that form the regulatory framework that applies to grid middleware. It is our opinion that the same regulatory framework should apply to the middleware and the application layer, not only because sometimes it becomes difficult to distinguish between higher sublayers of grid middleware from the application layer, but also because it is the aim of the European legislator to regulate the provision of online services under a uniform legal framework [3]. In the same line of argumentation, grid services should be regarded and regulated as an “ecosystem”, taking into account the fact that sometimes it is difficult to distinguish the line that separates purely hardware-related services from application related services.

Finally, grid portals – internet websites that offer web enabled application services, where users can submit and collect results for their jobs on remote resources through the Internet – also fall within the definition of an information society service and thus should be regulated by the same regulatory framework.

4. Ending remarks
In our attempt to legally classify the provision of Grid services, we first had to distinguish between the different models of grid computing, social and commercial. The fact that the social model depends largely on the voluntary submission of resources to a morally higher purpose, leaves little space for clashes of interests between the participants in such ventures. However, the picture is radically changed in the commercial model, where financial dependencies raise expectations for timely results, security, reliability and accountability.

The first steps to approach grid computing form a regulatory perspective focus on identifying its very nature, that is, classifying it under the current European regulatory framework, by comparing its differences and similarities to other types of services. However, this is not an easy task since the provision of grid services involves many actors and expands on different layers, starting from the physical infrastructure that is needed to connect the distributed resources, and ending to the higher level abstractions and services that are performed by different application programs.

For this reason we have attempted to examine each grid layer separately, vis-à-vis the relevant European legislation. Our conclusive remarks can be summarized in the following bullet points:

- A grid electronic communications network is legally considered as an electronic communications network, only if it is capable of conveying signals between resources without the help of an underlying network infrastructure operated by a third party, and is also used for the provision of electronic communications services (such as voice telephony). In this rare eventuality, the grid network may be subject to a general authorization, pursuant to article 3 (2) of Directive 2002/20/EC.

- In any other case, the “electronic communications network” which is subject to the European regulatory framework is the underlying network and not the grid network.

- The provider of grid services should not be considered as the provider of an “electronic communications service”, since his services do not consist wholly or mainly in the conveyance of signals on electronic communication networks. In a typical grid implementation scenario, this role is taken by the operator of the underlying network infrastructure, who acts as an intermediary that connects the various grid actors. It follows that all grid actors are the recipients of his electronic communications services.

- Grid services are essentially “information society services”, since many of the described functions of the middleware and application layer are already mentioned in the regulatory texts. However, the provision of Grid services should also satisfy the prerequisite of distance and remuneration.

- To the extent that the various components in the provision of Grid services consist of computer code, they are eligible for copyright and/or patentability, according to the relative European legislation.

5. References