

## CLOUD COMPUTING - SUPPORT FOR INTELLIGENT AGRICULTURE

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**Abstract:** *This paper presents how Cloud Computing is seen at European level in strategies and action plans, how it improved the IT&C field and how it can also be implemented in the agricultural sector. There is also presented and example of a Romanian Cloud Computing system already implemented in a national institute. The need of moving towards the green and intelligent agriculture is underlined by the EU which will allocate important funds to large projects for doing research in this area. Romania, just like other member states, should do and already did important steps in developing/implementing/offering Cloud Computing systems for all sectors, including agriculture. The system presented has the characteristics and abilities to be implemented also in the agricultural field.*

**Key words:** *European strategies, intelligent agriculture, cloud computing*

### INTRODUCTION

The European Union launched 2020 strategy for intelligent and green agriculture for homogenous development of member states, for common actions regarding farming. The direct result of these strategy and politics should assure that aliments and products are available for entire Europe, by encouraging farmers and developing a sustanable plan. At the same time, common agriculture strategy and politics must be orientated towards the rural development and facilitate the introduction of digital technologies in agricultural areas.

The increased demand of agricultural products should take into consideration measures for protecting the environment and low production costs. The should be taken into consideration by the decision-making in order to find innovative measures "to produce more at lower costs". Intelligent agriculture is an innovative solution that helps farmers manage their farms better by using the new technologies.

Thus, the European Commission through DG Connect and DG AGRI (Agricultural Productivity and Sustaintability) has as main priorities the digital agriculture and supports the research in this area. European Union's financiary proposition will be available through " Alliance for Internet of Things Innovation - AIOTI) which will dedicate 30 billion euro for large pilot projects.

Intelligent agriculture is based on the existing in all European rural areas of Internet. This is why, one of the most important objectives of the EU is the access to internet of at least 30mb/s until the end of 2020 [6].

In this perspective, using the new technologies may become real for every European country.

### MATERIALS AND METHODS

In order to analyze the way new technologies can be used in agriculture, all existing trends regarding information technology at European level have been analyzed. One can observe that European Union, just like many member states, has its own strategy of using Cloud Computing in all activity domains from public administration to social sciences, education, culture and including agriculture.

In IT&C field, the Cloud Computing concepts are more and more used in varied fields.

19% of EU enterprises used Cloud Computing in 2014, mostly for hosting their e-mail systems and storing files in electronic form.

46% of those firms used advanced Cloud services relating to financial and accounting software applications, customer relationship management or to the use of computing power to run business applications. Four out of ten enterprises (39%) using the Cloud reported the risk of a security breach as the main limiting factor in the use of Cloud Computing services.

A similar proportion (42%) of those not using the Cloud reported insufficient knowledge of Cloud Computing as the main factor that prevented them from using it.

Cloud Computing is model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. network servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

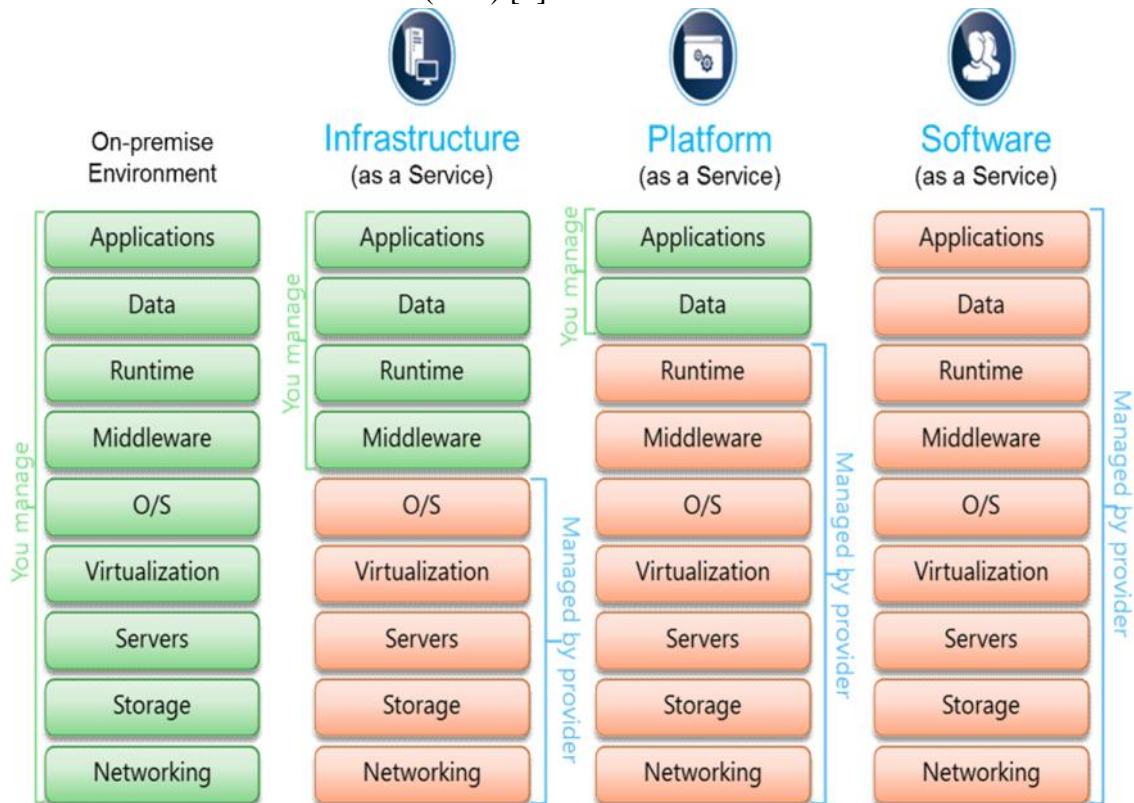
Cloud model is composed of five essential characteristics shown below:

- a) On-demand self-service
- b) Broad network access
- c) Resource pooling
- d) Rapid elasticity
- e) Measured service.

The models for Cloud services are (figure 1):

- Software as a Service (SaaS)
- Platform as a Service (PaaS)

Infrastructure as a Service (IaaS) [5].



**Figure 1. Separation of responsibilities**

Source: <https://www.simple-talk.com/iwritefor/articlefiles/cloud/2011/11/cloud-service-model.png>

## RESEARCH RESULTS

Analyzing the Cloud Computing systems and the direct needs of the farmers helped us identify a few types of services they can use in their own computing systems.

For farmers, using Cloud systems provide a lot of advantages. Among these, we name [1]:

- qualified human resources in IT system maintenance
- low costs for IT savings
- possibility of resource allocation by rental
- relieving staff from farming from nonspecific activities (updating IT systems, safety, etc.)
- possibility of being rapidly informed.

From the farmer's point of view, some aspects define direct benefits of using Cloud systems [2]:

- information about software which can be used in different fields of agriculture (on-line catalogue of public services software)
- hosting of potential software products which can be used in by farms
- delivering of ICT resources on demand only
- consultancy on software implementation in cooperation with private providers
- consultancy on agriculture software service based on Cloud Computing.

Precisely, Romania already has Cloud computing systems that can be used by farmers or farmer organizations (associations, foundations) for free at least for a period of time. One of this system is the one the National Institute of Research - Development in Informatics - ICI Bucharest implemented through ICIPRO Project (Cloud-type Infrastructure for Public Institutions in Romania), a Cloud-type platform with the following services (*figure 2*):

- IaaS - Infrastructure as a Service - represented by virtualized servers, data storage space, virtualized sets of resources with access to the self-service-type interface;
- Virtual Library service offers public institutions access to electronic archiving services and the opportunity to publish electronic documents through a public access portal;
- Through the Open Data Service, public institutions are able to publish in a standardized manner public information, generated by the institution itself or as replies to public requests

The Cloud platform provides services to 27 entities, while for other entities the Institute is in the process of establishing the specific usage procedures. Totally, there are 31 subscribed Public Institutions as follows [3]:

- 10 public libraries
- 11 public Universities, and Research and Development Institutions
- 7 central public institutions (ministries)
- 3 local public institutions.

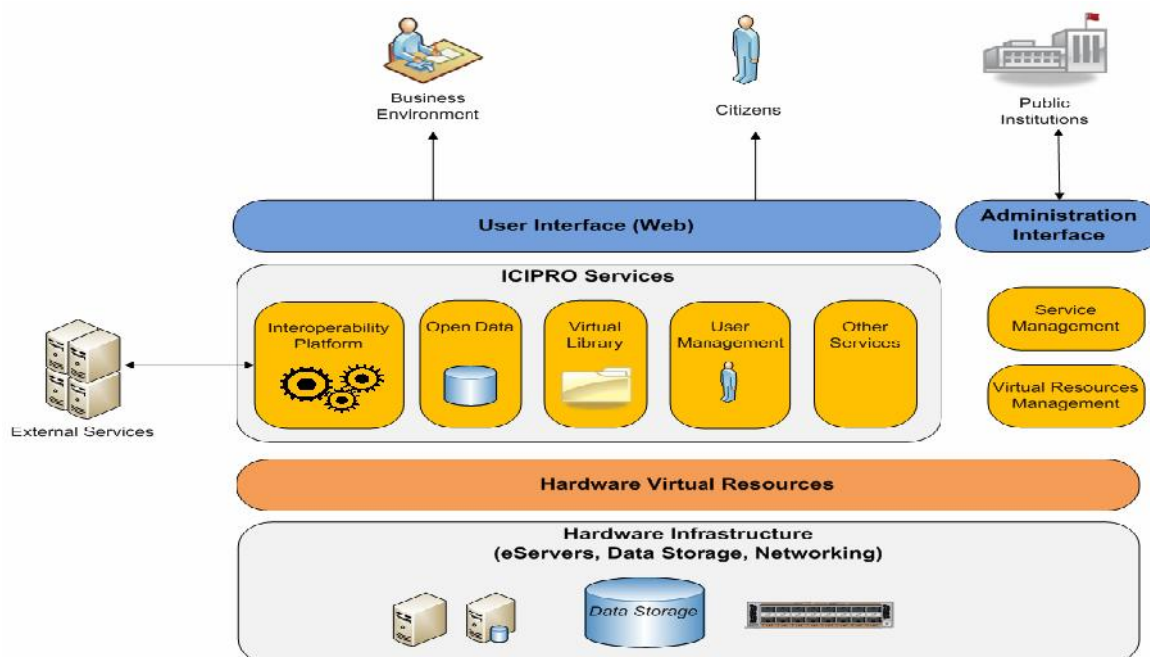


Figure 2. Schematic diagram of the ICIPRO system

## CONCLUSIONS

Transition to intelligent agriculture is today an option for institutions from agricultural field. Of course, there are many systems in this field, but, just like in the public administration case, they are fragmented or need ensuring interoperability both at informatics level and at specific procedural level. Considering the above mentioned advantages, but also the existence of the cloud computing systems in Romania (ICIPRO offers free services until 2020), it can be concluded that through politics and strategies well defined at national, regional and local level, intelligent agriculture can become a reality in Romania.

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