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THE COGNITIVE APPROACHES OF THE COMMUNICATION AND INFORMATION TECHNOLOGIES – A LEVERAGE FOR THE PROGRESS OF KNOWLEDGE BASED SOCIETY

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Abstract

The paper presents an analysis of an actual family of approaches, we generally name “cognitive”, designed to optimize the resources and the development of communication and information technologies (CIT). This family of cognitive approaches and applications includes: cognitive wireless communications (an intelligent radio spectrum usage), cooperative/collaborative communications, context-aware communications, quality of user experience management, smart grid (power plants) networks, distant learning.

The analysis shows how these CIT new approaches tend to have a leveraging role in the progress of Information Society (IS) toward the Knowledge Based Society (KBS) – providing more and more instruments and concepts generated for an optimized development of CIT, which soon could become useful, in generalized forms, for other fields too and generally for IS and then KBS.

The paper also presents the mechanisms by which, the main or specific cognitive approaches could improve the efficiency of CIT resources, generate refined knowledge and leverage the use of innovative potential of people in the progress of IS towards KBS.

The paper concludes that the analyzed CIT cognitive approaches and further implications of their products, services and principles in IS represent long term and powerful instruments to optimize the resources management, providing for CIT (and beyond, in KBS) the versatile features that generate progressive matching processes in a ever-changing environment, either technological, economic, financial or social.

Keywords: *information/knowledge based society, communication and information technologies, cognitive communications, context-aware communications, quality of user experience.*

JEL Classification: M15, O32

1. Developing communication and information technologies (CIT) and services by cognitive approaches

Step by step, CIT – the most dynamic field of Information Society (IS) toward the Knowledge Based Society (KBS) – provide more and more instruments and concepts generated for an optimized development, which soon could become useful, in generalized forms, for other fields too and generally for IS and then KBS [7].

The last most relevant examples could be “network centric” and “cloud”, for which the reasons and mechanisms of action were presented in [3].

In the present, we may observe the proliferation and growth of a new family of approaches, we generally name it “cognitive”, designed to optimize the resources and the development of CIT.

So we encountered some impressive approaches of CIT applications, as cognitive wireless communications (an intelligent radio spectrum usage), cooperative/collaborative communications, context-aware communications, intelligent (context-aware) services etc.

Along with these main approaches, there are other issues (approaches), more specific, as quality of user experience management, integrated context management, semantic services, smart grid (power plants) networks, ubiquitous healthcare, distant learning, social networks etc.

All these main or specific approaches have some cognitive features which could be further detailed in order to reveal their potential to become generalized approaches/instruments, in a diversity of forms and applications, useful to leverage the progress of IS and KBS.

The main features of these approaches, beyond their potential as pure hard or soft CIT, could lend to other fields (outside CIT) their power of progress as essential ideas and principles which may include:

- generation of instruments for a better efficiency of resources by functionally/real time usage of additional information from the application context (continuously matching with the context concrete conditions);
- inserting feedback from users in the operational processes in order to offer them efficient satisfaction;
- leveraging innovation and prosperity growth by attracting users’ potential in distributed management, accurate information for decision making, home working, healthcare networks, distant learning, social networks etc.

It is important to notice that these features, among other, could be realized today in a diversity of activity fields (industry, commerce, finances, education, healthcare, culture etc.) as a direct contribution of CIT performant/real time products and services, but in the future they could be extended too as ideas, principles or methods regardless of the degree of CIT applications usage.

This way, CIT could bring fundamental and continuously refined contributions to the ever-changing “knowledge” in IS and KBS.

2. How the cognitive approaches work for better, in CIT and beyond

The development and operational use of the above mentioned cognitive approaches and applications aims to provide a better management of the CIT systems resources and in the same time greater services efficiency and customer satisfaction.

More than these, the cognitive CIT leverage the participation and the education of involved people, by adding refined knowledge in the concrete activity fields where they are deployed.

In order to reach these objectives, starting from the already high levels we have in present, the new cognitive CIT approaches are inherently very complex, i.e., difficult to design, implement and optimally use.

This way, a serious challenge we encounter today is to design very performant and complex applications but a main requirement is to provide in the same time friendly features for the customer (user), i.e., a simple and efficient way of use.

Technically, we have to offer friendly user interfaces and, as much as possible, simple maintenance and generally low TCO (total cost of ownership).

So, the premises for the cognitive CIT approaches reflect the state of the art (very high) scientific and technological actual level but more and more they must include and reveal new ingredients (requirements) referring to an optimized management of user interfaces and experience – these new issues being also objectives for standardization.

As a better understanding is possible by examples, without intending, in this paper space, to analyze more than partially, we can shortly overview some of the mentioned CIT cognitive approaches.

The cognitive wireless communications (CWC) were the first opening to the cognitive CIT approaches.

The CWC concept, in order to solve the consequences of limited available spectrum, is based on spectrum sensing devices (receivers) which provide accurate and real time information about the electromagnetic environment, i.e., the extend to which the frequency channels in the operating band is occupied (used by other communicators) [1].

Eventually, CWC could offer and use, in real time, refined “knowledge” about the current infrastructure status, useful in many other applications.

The actual information could be then processed to allow for a secondary user to transmit in the free channels as long it does not disturb the primary user.

Obviously, the CWC are more complicated than this, because, in the real applications, a diversity of other requirements must be fulfilled, including prior protocols between primary and secondary users.

Beyond this issues, CWC applications become more complex and performant by using data bases with a diversity of environments (specific areas) and types of signals (standards), along with adaptive management systems (user friendly) and spectrum politics.

As a similar approach, the cooperative/collaborative communications (CC) consist of improving the performance and operational efficiency by using, in real time, the possibilities of users and environmental networks to joint their available communications resources and information, in order to complement, in specific conditions, the communication needs [2].

A prominent feature of CC is providing and using the cooperative data dissemination, as base for a diversity of hosted or cooperative applications, in areas like emergency, crisis management, security and a diversity of resources managing applications.

The context-aware communications (CAC) represent a new approach of CIT, referring to the use of all available information from the area of communications (the user real time area/position), in order to improve and extend the CIT services which could be offered instantly to the users [4].

Before any other details, it is important to notice that the “available information” is supposed to be generated by other communications devices which are present in the area, usually intended to offer a diversity of information that could be useful for the users in specific applications (exemples could start with the old GPS information and extend to

weather, emergency, security, traveling, tourism, culture, education, healthcare, commerce, finances, billing or any web/Internet service).

Notice that, like CWC, CAC are also a very powerful approach, due to its potential to extend and improve along with the CIT performances, especially as ubiquitous CIT services.

Among other cognitive approaches, referring to more specific families of applications, we may include those which could generate further powerful development, as the quality of user experience management (QoEM), integrated context management (ICM), smart grid networks (SGN), distant learning (DL) etc.

QoEM is one of the new and promising cognitive approaches of CIT, due to its growing influence on the general development of CIT. This influence is achieved by the specific mechanism of growing CIT services as the user feedbacks leverage this growth.

Perhaps the most relevant example for QoEM importance and functionality is generated by the consequences of the exponentially growth of CIT products and services by families as smart phones, notebooks, tablets, gaming stations, TV-s and similar gadgets, along with all web/Internet applications, including more and more content services.

So it become clear that the development of such applications must include principles and mechanisms which could provide, along with customer satisfaction requirements, the self-growing features that insert the user experience (satisfaction), some time in real time, as a leveraging factor of progress (efficiency) [5].

Notice also that is very difficult to express and quantify the user experience in order to accurately influence the CIT products and services design, development, deployment, operation, prices or maintenance.

ICM are referring to specific approaches that tend to maximize the efficacy and efficiency, by integrating mechanisms which are approximately similar to CAC.

SGN cover a very special and important field, referring to green industry and beyond (virtual power plants), addressing the vital Earth challenges of resources (energy) fading and CO₂ emission [8].

Applications of SGN already proved their efficiency and today we may speak about the amazing optimization of electric power consumption at distribution grid level, i.e., concrete ways to spare, in real time, amounts of electric energy that could be equivalent with virtual power plants [6].

Although DL is not a new field of CIT applications, its potential along with the new CAC features may provide impressive results in a growing “market” of users.

3. With cooperative and inventive people towards KBS

Perhaps the DL importance, similar to home working/“mobile office” and generally to all cognitive CIT approaches, will prove step by step to be enormous for the KBS, as all these approaches will provide along with remote operation and mobility, in addition to considerably efficiency for the individual, enterprise or government (by sparing time, energy and other office resources), an optimized frame to leverage people’s cooperation, efficiency, creative potential and prosperity.

On the other hand, the road of IS to KBS is long and full of challenges, including a progressive contribution of CIT, which have an impressive potential to generate improvements in all mankind activity fields and beyond – in all Earth processes [3].

The pace of CIT growth, as the most dynamic factor of KBS progress, is subject to many debates, as the technological progress brings also “secondary effects” for the mankind and Earth (climate changes and Earth resources fading being the most prominent).

About the pace, there are analysts which believe that some premises could lead to the risk of slowing down the global growth and finally the progress and prosperity too.

In this context, CIT remained the most dynamic field, by it is important to analyze with attention all the evolutions and select the most efficient and versatile solutions, because the mankind is traversing a complex and difficult period, where predictions are more and more unreliable.

Unfortunately, the actual crisis has, among other, as causes, a slowing down of innovation processes. More than this, it is important to observe that CIT too could get into a vicious circle anyway, because one of the crisis main consequences is the slowing down of investments, including research and development and then innovation.

That is why we have to find new approaches for the development, in order to leverage, with minimal costs (i.e., a better use of people’s creative potential), the innovation processes.

So, a better resource management, irrespective the application and field of activity, is more than desirable and that is why cognitive CIT approaches and all their mentioned implications represent valuable contributions to refined knowledge, stable progress for KBS and prosperity for the mankind.

Of course, the real processes, at Earth scale, are more complicated, but one of the subtle side is given by the complex mechanisms where the cognitive CIT approaches operates through their products, services and eventually the involved people (simple users or specialists), finally providing better results in all areas, along with refined knowledge.

We consider that the main ingredient of this subtle side is the refined design of CIT applications, which is continuously improved by the mechanisms the new cognitive approaches include, i.e., by all the context factors and eventually people’s creative potential.

4. Conclusions

The CIT cognitive approaches and further implications of their products, services and principles in IS represents long term and powerful instruments to optimize the resources management, including people’s potential, in order to continue and improve the innovation processes and refined knowledge generation towards KBS.

Very important is to notice that the cognitive approaches provide for CIT (and beyond) the versatile features that generate progressive matching processes in an ever-changing environment, either technological, economic, financial or social.

These new approaches also express a new and impressive step in the CIT evolution, which provide accurate instruments, with performance that could not have been imagined till now, useful for CIT, IS and Earth, in order to face the actual and yet to come challenges.

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