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MULTI SERVICE COLLABORATION PLATFORM

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Abstract: *Future Internet collaboration platforms are described as multi service platforms connected with other external infrastructures and applications (e.g. Content repositories, Social networking, Learning Content Management Systems (LCMS), User management, Content Delivery Networks, Authoring tools, etc.), which support synchronous and asynchronous cross domain human - centric collaboration. The development of Future Internet collaboration platforms are facing a series of research challenges that are particularly closely linked with the problems of personalized approach to the use of services, interoperability of included infrastructures, provision of adequate security and privacy of users, efficient distribution of large amounts of data, interoperability with different technologies (e.g. mobile technologies), etc.*

Keywords: *Future Internet, Platforms, On-line Communication, Collaboration, Skills and Competences, Content Delivery, Privacy and Security, E-learning*

1. INTRODUCTION

The Internet, electronic mail, and the Web have revolutionized the way we communicate and collaborate - their mass adoption is one of the major technological success stories of the 20th century. The field of networking is facing a qualitatively different problem, information overload, that necessitates smarter and more fine-grained computer support user-centered and with high quality regarding the human factors demand in communicating and exchanging the networked information. The solution being envisaged in the development will blend the boundaries between personal and group data, while simultaneously safeguarding privacy and establishing trust. In other words, the current computing infrastructure does not really support users all that well: for example, sending a single file to a mailing list multiplies the cognitive processing effort of filtering and organizing this file times the number of recipients – clearly not scalable and leading to more and more of peoples' time going into information filtering and organization activities. This has recently changed: several new technology thrusts have now emerged which could dramatically impact how people interact and collaborate: The Web 2.0/3.0, P2P Computing, Online Social Networking, Mobile technologies with more powerful OS to support collaboration are examples to be considered.

Different pieces needs to interact to interact and provide the necessary collaborative services based on new design based on the architecture for the next generation future internet. According to the 2020 Collaborative Working Environments (Vision CWE2020) this way of working will be based on collaborative systems that include both the general collaborative infrastructures and specific applications for supporting the requirements for human-centric applications and services [7]. The collaborative infrastructures will be based on seamlessly integrated context-aware flexible support for distributed collaboration among individuals and will provide service-oriented reference models for massive collaboration. Pro-active support for pervasive human collaboration within their own communities and with other virtual communities is one of the goals to be pursuit. Collaborative infrastructure consist of system components that comply with the Service Oriented Architectures (SOA) allowing specific applications for group-driven composition of systems for provision of synchronous and asynchronous teamwork freeing users from routine and enabling the focus to be on creativity [12]. Converged networks and services,

context modeling and reasoning, high-level middleware / upperware and P2P infrastructures are becoming be part of the collaborative infrastructure needed for Collaborative systems as real pervasive collaboration over the networks offers enhanced knowledge sharing mechanisms, better decision making process and less burdensome group processes support in distributed, global networks of collaborators.

In accordance with the Vision of CWE2020 next generation collaborative environments / platforms are expected to increase the effectiveness of the service in both directions: horizontally among individuals and within communities and vertically among communities and different infrastructures. In that direction, several requirements and research challenges are indicated:

- Service composition and integration where the collaborative functions are offered as services (generic services, domain-specific services and context-specific services) either to the user or to the application developer. The combination of generic cross-domain services and tools with domain-specific ones enable building of application-specific collaboration environments, and a combination of generic and domain specific services with context-specific services are then providing situational specific collaborative applications.
- Incorporation of existing Web 2.0 social network platforms (e.g. Facebook, Twitter, LinkedIn, MySpace, etc.) and collaborative tools (e.g. authoring tools, tagging, ranking, ontology, wikies, blogging etc.) and the emerging WEB 3.0 applications into fully-fledged technology platforms leads to new way of operation of the distributed collaboration activities.
- Integration between synchronous & asynchronous cross domain communication / collaboration.
- Proactive collaboration aware artefacts and objects needed to transform static data so that the entire life cycle of shared artefacts is also a property to be supported.
- Since context information can be aggregated from many sources, it is a challenge to build a highly distributed context management environment in the paradigm of the Future Internet, where all relevant sources are taken into account.
- Building scalable collaborative working environments includes a multitude of architectural approaches that should be taken in account e.g. P2P, cloud computing and Client-Server paradigm enabling pervasive collaborative environments based on the new network architectures.
- Collaborative services need to be instantiated on a multitude of devices ranging from desktops to mobile devices such as lightweight SmartPhones and PDAs. This challenges several research issues, such as development of device with proper user interface accommodated to the new device and equipped with required applicable security and privacy mechanisms

2. RESEARCH PROBLEMS

According to directives addressed in the Vision CWE2020 in the process of design and development of Future Internet Collaborative Platforms (CP) this field of ICT application is faced with several research problems, which have not been yet adequately elaborated. For that reason we plan in the framework of the development of FI collaboration platform to focus on few of them as follows:

- Lack of interoperability of higher level services in existing collaborating platform with focus on systems for e-learning. Here main problems are related to enabling access, quality control and filtering of the open content from many sources integrated in the collaborative service and the related functionalities that depend from the platform and the system used
- Lack of functionality for searching regarding the user skills and competency needs, which becomes crucial for obtaining the most appropriate content. The research here is oriented into development of effective skill-based federated tools that allows search, access, re-use and recommendation of content (User-generated and user-improved content) to meet target competencies. Federated search as alone works fine, but combination of skill-based and federated search has not been enough explored and proved. Here skill -based metadata (skill and competency profiles as well as skill level tagging becomes a problem that needs proper solution).
- Lack of usable security and privacy services and mechanisms in the services enabling collaborative environments. A number of issues in that area have not been completely solved yet, including for example protection of users' sensitive personal data in social communities, seamless access to resources in heterogeneous collaborative environment, access control to certain types of content in P2Pbased content delivery systems, and usable authentication mechanisms for mobile users of collaborative platforms. The most crucial seems user friendly but secured and proper authentication

mechanisms for the Internet mobile devices enabling collaborative services.

- Lack of effective content distribution. In the context of collaboration among the individuals/communities that generate large amounts of multimedia content (e.g. video conferencing records, video/audio/text based documents) the problem of effective distribution of content to end users still has no proper and adequate solution. Content distribution of large multimedia content collection can present serious costs for service providers and thus limits the smaller, niche oriented and innovative players to enter in the market. Social aspects and end user long tail content contributions are often neglected and providers fail to enrich multimedia collections and content with their contributions.

3. STATE-OF-THE-ART

Integration (integrative platform)

Web services have bestowed newfound importance on Service-Oriented Architectures (SOA) by providing a standard-based approach to interoperability between applications. SOA provides a set of principles, patterns and practices to provide and consume services which are orchestrated to realize an agile infrastructure, being able to support a pluggable service infrastructure where providers, consumers, and middleware services can collaborate in the famous 'Publish -- Find -- Bind' triangle [2]. The requirements to provide an appropriately capable and manageable integration infrastructure for new Future Internet designed services are coalescing into the concept known as the Enterprise Service Bus (ESB). There are two key ideas behind this approach [3, 9]: loosely couple the systems taking part in the integration and break up the integration logic into distinct easily manageable pieces. The Enterprise Service Bus is an open standard based message backbone designed to enable the implementation, deployment, and management of these solutions based on SOA (Service Oriented Architecture). An ESB is a set of infrastructure capabilities implemented by middleware technology that enable an SOA and alleviate disparity problems between applications running on heterogeneous platforms and using diverse data formats. It supports service, message, and event-based interactions with appropriate service levels and manageability. In other words, the ESB provides the distributed processing, standards-based integration, and enterprise-class backbone required by the extended enterprise. The ESB is usually designed in such way that provides interoperability between larger grained applications and other components via standards-based adapters and interfaces. The bus functions as both transport and transformation facilitator to allow distribution of these services over disparate systems and computing environments.

Other research activities in the services foundation layer to date have targeted mostly formal service description language(s) for enhanced service definitions addressing, besides functional aspects, also behavioural as well as non-functional aspects associated with services [5, 7, 12].

Major research challenges recognised as being beyond State of the Art are related to: Dynamic connectivity capabilities, Topic and content-based routing capabilities, Enhanced service discovery, End-to-end security solutions, etc.

Content delivery and distribution

One of the most successful multimedia content distribution methods in the last decade are based on P2P technologies. The technologies have been developed through number or generations, enriching their features and pushing scalability, robustness and dependability to the limits. P2P technologies present a natural content distribution technology that could effectively support future Internet collaborative working environments.

The prevalent P2P technology today is based on BitTorrent protocol [15]. The reason for this is its orientation towards effective and scalable data transfer of a single data unit (file) or collection of units. Additional features were added for effective distribution in the past, like DHT, PEX and the others. Users can utilize the protocol with one of numerous BitTorrent clients. Current development trends in advanced BitTorrent clients like µTorrent, Azureus, Miro and Tribler, are oriented towards extending basic client functionality. Content search, rating and presentation are main features being developed. The integration of the P2P transport and presentation within a browser [1] (support for Wikipedia multimedia content distribution) and rich metadata and limited interactivity enable contribute to unified content distribution. While efficient content distribution is of crucial importance it is even more obvious that the user friendly and tailored consumption of the content should not be neglected. Content delivery networks based on this technical paradigm will be used in the integrated collaborative platform which implementation is described in the Work Program of this proposal.

Skill-based content search

Abundance of digital content puts a user in front of the problem of making the "right" choices from an expansive list when searching for content either for information, entertainment or e-learning and training. Finding the relevant resources remains an issue, because searching for example of learning content is based on keywords and metadata that often reflect a technical cataloguing perspective, rather than the needs of the users. Personalized skill and competence-based search promises to improve this situation. There are several reasons why skill and competence-based content search is almost inexistent today: skill and competence related data structures (e.g. IEEE Reusable Competency Definitions standard or HR-XML) do not support semantic relations; ontologies for skills and competences are missing, as well as extensions in learning opportunities standards (e.g. in CEN Metadata for Learning Opportunities specification [10]) for associating structured skills and competencies to learning opportunities; and quality of content metadata is low.

When developing a technical infrastructure that enables skill and competence-based services, such as federated search, we will base our work on the recently finished ICOPER and on-going OpenScout projects from the EU eContentplus programme. Search engine that is currently keyword based and content within the collaboration platform will be enhanced with improved structured skill and competence data that provide t better search and user required information. Defined data structures and developed search algorithm will also be applicable for personalization and search within l user profiles. This component will be developed within the collaborative platform and integrated with the other components.

Security and usability-based service

- **Graphical passwords-based authentication**

Research and practice in the past years have shown that security problems that arise because of low level acceptance of the end user can be solved only by considering the usability perspective of the user. In an attempt to create more memorable authentication mechanisms, several approaches based on graphical and image password have been devised where the authentication is based on image clicking as opposed to typing character based passwords. In general, two types of mechanisms exist for graphical authentication: recognition-based and recall-based. In recognition-based ones, a user is authenticated by challenging him/her to identify one or more images he or she chooses during the registration stage. Examples of such system are Passfaces, developed by the Real User Corporation [13], and the PassPoint system [14]. In recall-based techniques, a user is asked to reproduce something that he or she created or selected earlier during the registration stage. Examples of recall-based systems can be found in [8].

The effectiveness of a graphical authentication mechanism depends mostly on the acceptance and the easiness of use and is measured by its level of usability. However, the security is always respected as first factor of the design. Despite the existence of many solutions most have failed to achieve both aspects simultaneously. The main project objective in this area is to develop new graphical authentication system that is answering to the both demands: being secure according to the standard requirements and usable according to the end user set up usability. The system based on the research in this area which is considered as being Beyond State of the Art will be designed with focus on the mobile users of the collaborative platform.

- **Content access control**

As the collaborative platform of the Future Internet is based mainly on the infrastructure that uses P2P way of communication the problem of content protection of the content offered via the collaborative platform requires some basic solution [11]. The importance of security and the main security requirements for the emerging infrastructures in the Future Internet content delivery networks has already been emphasized, for example in [4]. According to access control on the content being shared can be achieved either directly or indirectly by: a) directly protecting the content; b) restricting the access in the network where the content is being delivered; or c) restricting the access to the peer that possesses the content. Zhang et al propose a mechanism that can be considered as digital rights management (DRM) mechanism for BitTorrent [15]. Another mechanism for access control on data that utilizes encryption is described in [6]. In this scheme, all peers that are involved in the content delivery process receive content encrypted with a same key for all peers. One form of providing access control on the P2P network itself is by using private tracker, as specified in a BitTorrent protocol's extension. An access control mechanism on each peer enables the peers to recognize the authorized peers and to avoid communication with the non-authorized ones. Such mechanism for a BitTorrent P2P network, called Closed Swarms protocol, is presented by Borch et al. [1]. Unfortunately, the protocol is not flexible enough for implementation of the project objectives (the integration of the collaborative platform).

4. DEVELOPMENT OF THE FUTURE INTERNET COLLABORATION PLATFORM

As a base for developing a Future Internet collaboration platform will be used the existing video conferencing platform VCC (Virtual Conference Centre), which was developed in cooperation with partners in the FP7 EU project Global. VCC platform currently provides only a limited set of services, mostly related to provision of videoconferencing facilities. The proposed development plan will upgrade the current facilities, add new ones and will integrate them in the envisaged collaborative platform which implementation is described as follows.

- Design and implementation of an interoperable and flexible, standards- and services-based infrastructure such as: Federated Content Mashups and Connectors, Social Metadata Mashups Component and Monitoring Facilities Component allows various systems (i.e. collaboration and social network platforms, content repositories, and LCMS) to be easily and efficiently integrated by use of the novel Future Internet infrastructures [2, 9]. Those services will be developed and provided by use of open source software where possible. Some original new solutions and components will be developed as well. These services will enable the users to create and store content in distributed repositories. They will also provide functionality for search, support, retrieval, packaging, reuse, sharing of resources and efficient content distribution.
- Design and implementation of competence metadata service that enables open content search based on skills, competences, and competence profiles and competence levels. In addition to the content application such as pre-defined curricula and use of pure bottom-up technologies which use emerging patterns we will first explore several solutions between these antipodes and will build the component based on these findings. The developed component will provide an open content mapping of competence to known and related taxonomies in particular area of application (e.g. management of education) [10].
- Ensuring that the integrated collaboration platform can be used in a way that is both secure, usable and in line with security standards for such systems.
- Design and implementation of user friendly image-based authentication mechanisms, particularly targeted at mobile devices with touch-screen interfaces, privacy protection mechanisms, and content delivery access control mechanisms. Most of security services will be built on the basis of individual security components that are either already available or are expected to be provided. We will integrate those components in such a way that it will provide confidence that the collaboration platform is safe to deploy and to use. With regard to novel security solutions developed, special focus will be put on graphical-based authentication mechanisms for mobile collaboration platform users, i.e. users with mobile devices with touch-screen interfaces. From the security point of view, the following evaluation criteria will guide development of the mechanism: secrecy, abundance, revelation privacy, and breakability. Secrecy measures the predictability of a graphical authentication key (passimage) that is determined during enrolment to the collaboration platform [13]. Abundance is related to the size of the authentication keys in two aspects: the number of available keys counterbalanced by the number of keys commonly used in practice. Revelation measures the disclosure level of the authentication key from a user and system perspective, while privacy the amount of private details required by the authentication mechanism. Breakability refers to how easy it is work around the security mechanisms in order to gain access to either the system or the algorithm. From the usability point of view, we will investigate the relevant properties of the developed system with usability testing for assuring acceptance of the service. The component to be developed in addition to graphical-based authentication will enable users to selectively share their artefacts and knowledge and control the visibility of their sensitive artefacts and relations [14]. The service to be developed will be based on the following known solutions: Single sign-on and Content access control.
- Design and integration of efficient content distribution management system which will enable usage of content delivery networks based on P2P architecture [6, 11]. The component will, support both PC and mobile devices.

5. CONCLUSION

The development of the platform is addressing several important and challenging research problems that are part of the Future Internet Networks and Enterprise Systems scientific agenda. The main contribution of the project will especially be in the development of new product based on the achievements that are beyond the state of the art as defined in the scientific agenda of future internet collaborative systems, content distribution systems,

privacy and new security solutions in advanced systems and networks. The impact will be in the development and adoption of new challenging technologies and services. The major importance is certainly in the investigation of a number of technological problems and the associated policy domains that have bearing on the network and service infrastructure elements of the Internet of tomorrow. The research will have impact in the area of the engineering and scientific field known as Future Internet Technologies, Digital Agenda but in same time the impact will be noticeable in the industrial environment as new competitive services to be put on the market will be enabled

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