

DISYC - Distributed Intelligent Information System in Construction

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ABSTRACT: This paper will focus our attention on an advanced communication service concept for the construction industry. The main idea behind *DISYC* is the development of a sophisticated information infrastructure for the co-operative and evolutionary construction process, which can be used by every user to handle and to automate the information flow according to his own working method. Our system is based on a Distributed Agent Architecture, where the cooperation between users are organized as agent actions.

1. INTRODUCTION

The world is witnessing an enormous advance in telecommunication and information technologies. With this advance in global information infrastructure it is hoped that a new industrial and social development will be enabled. Sophisticated telecommunication technologies are already available, but they are very often not adapted to domain specific requirements. Also, users are often confronted with a rapidly changing telecommunication technology, so that it is difficult to integrate these new technologies into their work and to use it efficiently.

The basic idea of *DISYC* is to develop a sophisticated information and communication system in an industry sector, with strong domain specific requirements and an essential need of efficient communication tools - the construction industry.

DISYC comes as a complete integrated package. The provider takes care of building up the basic transportation network and the installation and the maintenance of the necessary hard- and software components. The provider guarantees the working and the reliability of the system, offers additional services and charges the user monthly.

DISYC is a fully distributed system. All the project related data is stored on site. Every user is responsible for the organization, representation and access rights of the information. This reduces redundant information, makes easier the handling of different versions and leads to a better security control.

2. INDUSTRIAL CONTEXT

The use of telecommunication services can only be promoted by the creation of an advanced, easy to use information system that fulfils domain specific requirements and that is offered as a fully provided service.

There are many reasons that make the construction business area especially appropriate for the intelligent use of telecommunication applications.

2.1 Quantity of Information

Unlike other industry areas, in the construction industry we typically do not find mass production. Nearly every building is planned and realised from scratch. With the trend toward complex and intelligent buildings, the complexity of

materials, planning and production methods leads to a strong increase in the quantity of information.

2.2 Extensive Information Flow

Another exceptional feature of this area is the decentralised, co-operative planning process and highly dynamic consortia. The result is an uniquely extensive information flow between a big number of planners, manufacturers, suppliers and customers. Every participant in the construction process has different methods and tools to support his work and individual requirements regarding his communication needs.

3. PROBLEMS

Although the information is frequently created digitally using computer aided tools, „manual“ information exchange (snail mail, planning meetings, etc.) is currently predominant. Simple electronic communication tools like the telephone, facsimile and data modems do not fulfil the conditions and requirements of an efficient workgroup. These communication services are used independant from each other and do not offer either multi-media support or the capability of any kind of automated information flow.

Since there is no integrated intelligent information and communication system there are many problems regarding the access, selectivity and relevance of information. Some of the most serious problems are:

- Information is not available when needed
- Selectivity problems due to a lack of transparency of the project
- Restricted and difficult access to distributed information
- Communication tools do not support quick decision processes
- Version control problems due to highly redundant information

4. OBJECTIVES

Considering all the domain specific requirements and the disadvantages of the already used and existing communication services, we can figure out a profile for an integrated information system. Because it will be fully provided, we have to consider two views: the user's and the provider's view. The primary user demands are:

- Multi-media support
- Support of dynamic consortia
- Integration of already existing information services
- User friendliness
- Good security mechanisms (identification, authentication) and optional confidentiality

- Reliability
- Support of Computer Supported Co-operative Work (CSCW)
- An open and expandable generic system architecture
- Adaptability to the users project and to his working methods
- Automation of the information flow

The primary provider requirements are:

- Good exploitation of his equipment
- Compatibility with international standards
- Capability to offer additional commercial services
- National/international wide access network

5. SYSTEM ARCHITECTURE

Both sets of requirements make large demands on system design and realization. To achieve this we will define an open communication infrastructure, that is adaptable to the users' communication requirements and can support future communication technologies.

5.1 Virtual Private Network (VPN)

The provider builds up a national/international wide access network, which allows the setup of virtual project workgroups (Fig.1). The members of the workgroup are the participants of the consortium. It is possible to get access to the virtual workgroup via any media, which carries IP-traffic, but special consideration will be given to ISDN dial-up and leased lines.

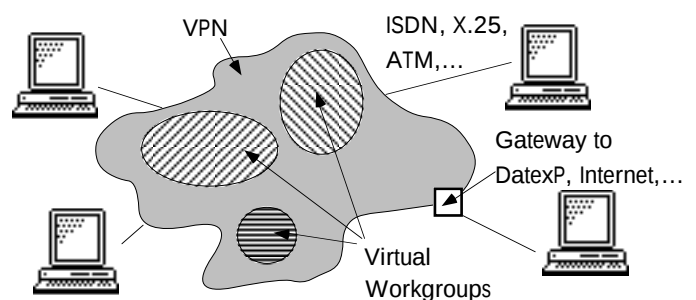


Fig.1: Virtual Workgroup

This virtual private IP-network guarantees a free flow of information within the group while barring, at the same time, any access from outside. This access security is done by identification of a workgroup member using the Smart-Card technology, thus insuring complete security against any intrusion from the outside. The provider also maintains gateways to existing networks and services.

5.2 Distributed Agent Architecture/ Communication modules

Based on this network infrastructure, we will offer a set of several communication modules, embedded into a Distributed Agent Architecture (DAA). These modules provide the following communication services to the users: presentation and browsing hypermedia information, e-mail/EDI, file transfer, database access and an intelligent common user interface to control the complete system.

Figure 2 shows the four communication modules: Information Server, Information Client, File Transfer application and an advanced e-mail system.

Beside the capability to visualise hypermedia data and to access any kind of database information, the information client offers a common GUI to control the complete functionality of the system. Monitoring and control of the agent activities as well as the handling of the e-mail system will be done using the Information Client.

According to the users requirements, it is possible to use these modules easily, either independantly or integrated into a complex communication application using the agent technology.

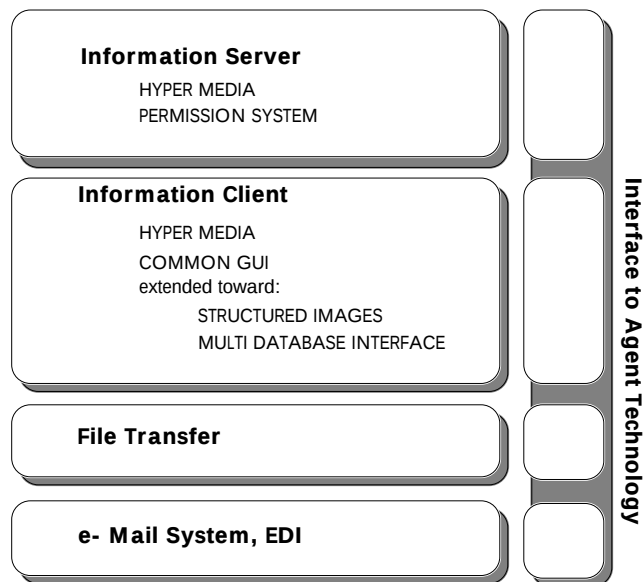


Fig.2: Communication modules

These basic communication applications have interfaces to the DAA. The DAA allows the implementation of intelligent software agents, which are able to migrate to all machines inside the network and can interact with local applications. Agents are something like executable software elements, which can perform tasks in the distributed environment. With the help of agent-technology, the

user can automate in the network any task as well as create special agent based applications that undertake more complex tasks e.g. project monitoring tasks, CSCW, etc, thus making it possible for the system to adapt to users requirements, rather the other way round.

In the DISYC project we will develop some generic agent templates, which fulfill domain specific tasks. After being instantiated they are ready to use. The most important agent templates are: Information Retrieval Agents, Guardian Agents, Scripting Agents and Control/Service Agents. The implementation of new agent based applications could be done by the user or could be offered as a special service by the provider or a third party.

5.3 Security System

Security in our fully distributed environment must fulfill the following user requirements:

- Protection against illegal access to resources in each individual domain as well as protection in global networks with cross-domain access
- A transparent access and permission system in the distributed environment
- Confidential and reliable transfer of security parameters, with special emphasis on cryptographic keys
- Optional data confidentiality
- Interfaces for flexible selection of security mechanisms and services.

In order to meet these stringent requirements, security must be designed and implemented in a modular way. Individual modules must be combined dynamically, when needed by users, agents or applications. Basic functions of this security system are: registration and authentication of users and resources, controlled and authorized usage of distributed system resources through an distribute access control system, encryption and decryption, creation and verification of integrity codes, and authenticated and authorized access to resources based on digital signatures.

6. CONCLUSIONS

In this paper provide a short, non-technical overview of *DISYC* . The authors believe that this service concept points out a new approach to both managing the extensive information flow during a construction project as well as to increase the co-operation between the involved partners. The idea of a fully distributed environment connected dynamically together to project related virtual workgroups enables a close co-operation between all the partners of a project.

The modular nature of the system and the use of intelligent agent technology facilitates the automation of communication tasks, the implementation of good workflow and perfect

adaptation of the system to the individual communication needs.

As every building is a prototype, a better collaboration during the planning and realisation process will significantly increase the productivity. At the same time this will help to avoid construction failures and in general allow better product quality.