

Network Enterprise Interoperability and Collaboration using E-mail Communication

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Abstract: In this paper we discuss how email communication can be used for enterprise interoperability, especially with a focus on SMEs. Existing interoperability solutions are suitable only for large enterprises and SMEs lack cheap, easy to integrate and easy to customize solutions. We believe such solution need to be built on top of existing ICT infrastructure (email, web) available in most of enterprises. We have developed a proof of a concept solution - ACoMA (Automated Content-based Message Annotator), which provides context sensitive information and knowledge in email communication. We evaluated the approach on an administrative application and we believe that such approach for interoperability can have significant impact by not forcing users to change working tool, by delivering interoperability solution exploiting existing ICT and by providing framework which can be easily customize for a concrete application. To completely achieve the customization objective the framework need to be extended and further developed.

1. Introduction

1.1 Enterprise Interoperability

Enterprise interoperability is addressed by research for a decade without real success and impact on SMEs. The market still lacks a cheap and easy to integrate solution. Each developed solution requires costly investments, extensive integration effort and changing working tools and systems on all involved parties. This is valid for both, solutions for interoperability as well as solutions for collaboration. Thus solution for inter-enterprise interoperability is present only in huge enterprises and SMEs around such enterprises, which are forced to use their solutions. Nothing so far has worked for SMEs or for loosely coupled collaborating SMEs.

According to an INTEROP discussion paper [8], a network of excellence project on interoperability issues, several hurdles need to be crossed by SMEs to adopt and use interoperability solutions. With proposed approach we address several of them:

- The expense of developing integrated systems
- The compatibility with legacy applications
- The low degree of integration of the e-processes with the remaining processes
- Shared Data environments
- Don't have the skills for administration and configuration of large ICT systems

The above statements are also related to the suggestion of the IST Enterprise Interoperability Research Roadmap [1], to address interoperability as a utility-like capability (Interoperability Service Utility – ISU) for enterprises, a capability that is:

- Available at (very) low cost,
- Accessible in principle by all enterprises (universal or near-universal access)

- “Guaranteed” to a certain extent and at a certain level in accordance with a set of common rules
- Not controlled or owned by any single private entity

These statements are especially important in the scope of SMEs. We believe that these can be addressed by providing ISU on top of existing ICT infrastructure email and web by delivering an open source modular system that supports it.

To address interoperability objectives, it is important first to set up basic technical interoperability such as defined standards, protocols and architectures built on top of protocols and interoperability standards in order to enable seamless communication; this also refers to the ability to connect systems by defining standard protocols (e.g. SOAP, HTTP, IP) and data formats (e.g. XML). A necessary technical requirement for interoperability is a common language for describing data.

We envisage following main architectures for interoperability:

- Service Oriented Architectures (SOA)
- Peer-to-peer (P2P)
- Meshup technologies based on Web 2.0

Any of above architectures or solutions for specific business sector cannot meet the interoperability needs of SMEs. Thus we propose to create an interoperability service utility (ISU) using standard ICT infrastructure email and Web. Communication channels, such as e-mail, already have some features typically required from interoperable solution as universal SMTP protocols.

1.1 Email Communication

Email repositories and an email activity are valuable assets for any modern Internet based business organization. In order to achieve organizational objectives or to successfully run a business process, goals, tasks or actions in any organization need to be communicated. Communication is an important part of interoperability and collaboration. In most Internet oriented businesses, email is considered as a primary medium for information exchange, and email also plays a major role in an SME business process. According to statistics, email is the second most used service of the Internet after WWW. Therefore Email can be considered as a good medium for detection of the user context / a problem, business process, task, customer or other related data and thus Email can be a medium for active information and knowledge provision needed for interoperability and collaboration tasks.

Communication is an essential part of a business process and collaboration. According to Habermas’s work [2], the categories of communication goals in organizations are:

- Commanding a specific action;
- Managing Collective Action;
- Influencing;
- Providing Information for Future Action; and
- Seeking Information for Future Action.

Therefore business email communication is action oriented, communication is clear and short and thus partially understandable for computers after text processing and an analysis. Even small companies can generate large e-mail traffic and thus fill e-mail repositories with high volumes of data since they use it to accomplish their daily tasks including interoperability and collaboration. Following features are common for use of emails in SMEs but also enterprises of all sizes [3]:

- Every organisation, without exception, will have an e-mail infrastructure before it reaches the stage of developing or adopting any interoperability solution.

- E-mail communication in a modern organisation is over 78% action-oriented, according to a study [4]. Organisations must converge to action, and communication is perhaps the foundation for most organisational action.[5]
- Managers, and knowledge workers of all kinds, interact with their e-mail systems on a daily basis.
- Managers are motivated to achieve successful communication.

When building a solution on top of email communication, an organisation does not have to change the way of doing its business, when such a solution is installed and set up in an organisation. Users simply receive emails in the same way as before, but with attached relevant information or knowledge to the interoperability or collaboration tasks, which email represents.

Some work to connect knowledge or context sensitive information with emails has been done in several projects such as the kMail system [3], which integrates e-mail communication with organizational memories, but also makes users use a special email client and lacks a closed knowledge cycle loop. Another related tool is Zimbra (www.zimbra.com), which offers a web-based client with functionality to detect objects such as phone numbers or addresses and allows performing an action on these objects. Similarly as kMail, Zimbra forces user to use their email client and server application and thus change existing ICT infrastructure in an organization on both the client and server side. Zimbra also detects general object in text with no relation to business task represented by email. Gmail (www.gmail.com), a webmail developed by Google, shows content sensitive advertisements and some actions as “add event to calendar” with the email.

In this paper we discuss vision and possibilities for interoperability solution built on top of email communication. We also describe the ACoMA system which was developed in scope of national project RAPORT and share this vision.

2. Vision and Objectives

The overall objective is to develop an adaptable platform for interoperability and collaboration for SMEs using existing ICT infrastructure – email communication.

Interoperability is built on top of existing communication channels so it does not require:

- To install new interoperability solutions on all involved enterprises
- Changing working tools in an organization

Interoperability is semi-automatic; always done or confirmed by involved workers

- Collaboration is based on sharing information and knowledge about services and common interest resources in working context detected from communication channels
- Thus workers do not need to search for information and knowledge needed for interoperability task represented by email, but this is proactively delivered
- Data and documents about services and resources needed for interoperability and collaboration are semantically processed in an organization and provided in context of communication channels.
- A solution for easy integration with existing proprietary systems based on standard interfaces (document repositories, databases, intranet systems and existing web services)

By building interoperability service utility using existing ICT infrastructure we can exploit useful properties of email such as action oriented communication, availability in all enterprises or asynchronous essence of email communication. The solution can be used complementary to existing interoperability architectures since automatic process based on SOA, P2P, Web 2.0 meshup architecture or protocols and standards as ebXML can be

started upon email is received by integrating and starting appropriate interoperability solution to process information and data extracted from the email.

On the other hand, if no system is installed on interoperating party site, received email will be human readable (e.g. by using XSL template within attached XML message) and an email message can be processed manually if needed. In addition, we can support interoperability tasks requiring human interaction, which can not be automated. This can be done by supporting an interoperating human with relevant information and knowledge in connection to enterprise systems and other organizational resources such as document repositories or intranets connected using different semantic integration tools.

3. Overview of the Approach

Use of emails enables us to provide knowledge in context. An email message serves as a context provider, since it represents an interoperability task. By attaching organizational or task information and knowledge to email, we allow a user to directly access needed information to fulfill the task.

The ACoMA system, which has been developed within the national project Raport (<http://raport.ui.sav.sk>), is connected to an email server and processes relevant email communication. A user receives email with additional information (text or html attachments) at the end of the email message (see Figure 1, right side). This additional information contains relevant information and knowledge, hints or links to business resources such as document repositories, databases or information systems needed in detected business context. Furthermore some suggestions for a user concerning possible next activities to be taken could be presented to the user if such knowledge is available in an organization in the form of notes [6]. Business context is detected from email using semi-automatic pattern based semantic annotation using predefined regular expressions patterns [7] (see chapter 4.1).

After email is received at the mail server, ACoMA analyzes the email message using semantic annotation [7] and sends detected context to an EMBET tool [6] in the form of ontological elements from the application model. Based on detected context, the EMBET tool retrieves all the relevant information from the organizational memory and sends them back to the ACoMA tool. This information is then formatted by the ACoMA tool and attached to the email message. Email with attached information is retained on the server. When checking new emails, a user will receive a modified email message, with embodied information. Sending emails works in a similar cycle (see Figure 1). Please note that text attachments are directly displayed in most of email clients and they appear as part of an email message, however they do not change the email message itself.

In the RAPORT project we distinguish between two kinds of emails: portal-generated emails (formal) and emails created by a user (informal). Formal emails are sent by a portal automatically (based on the activity in the business process), or they are sent based on the user requirements arising from the work on the portal (again based on the activity in the business process). Informal emails are created by users participating in the business process (urgencies, confirmation of sending documents, etc.).

Formal emails are also present in many cases of system-to-person communication for example when purchasing or ordering goods and services on the Internet, transaction, or status notification. On such formal email with fixed structure it is easier to analyze email content and provide relevant information in context. This can be achieved via pattern based semantic annotation method [7] described also in chapter 4.1. Such formal emails are often used in interoperability tasks in SMEs and currently need to be processed manually, while ACoMA enables to process them semi-automatically.

4. Technology Description and Developments

In Figure 1 we can see architecture of the system. ACoMA tool consists of two main components:

- ACoMA Core
- ACoMA E-Mail

ACoMA Core is the main component of the ACoMA tool. It provides an analysis of email using semantic annotation [6] and sends received context to EMBET tool [6] in the form of elements from an ontological application model. Knowledge is sent and received through XML-RPC (www.xmlrpc.com).

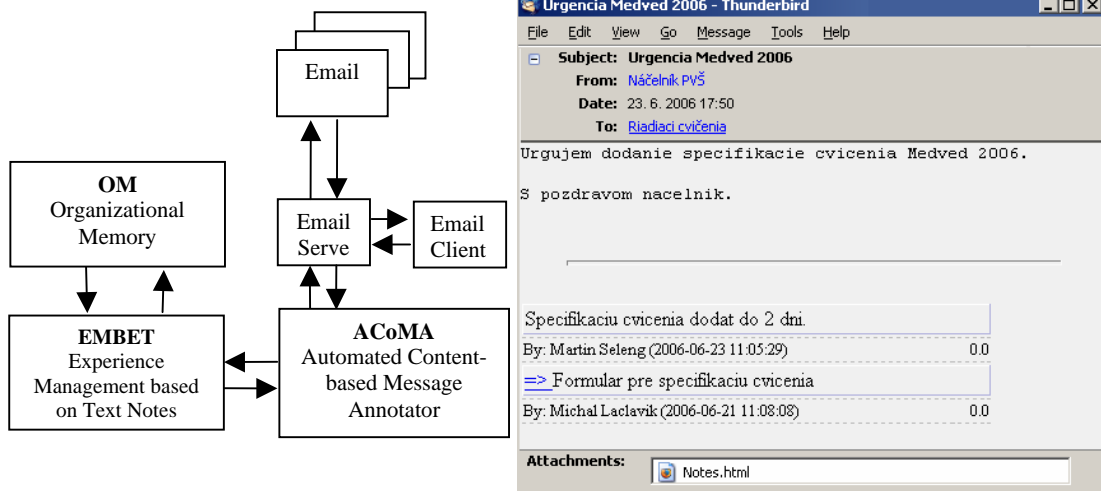


Figure 1: Left: ACoMA architecture; right: processed email with attached information

ACoMA E-Mail is designed for receiving, creating and sending emails with relevant information appended based on the email context. The ACoMA tool uses JavaMail API (<http://java.sun.com/products/javamail>) to work with emails. HTML attachments are created using XSLT (www.w3.org/TR/xslt/) transformation of text notes received from an organizational memory by the EMBET tool to an HTML document. This document is then attached to existing email using JavaMail API.

The EMBET tool [6] provides a knowledge base and context matching mechanism to return relevant information and knowledge in detected context.

In Figure 1 right, we can see an example of email with attached knowledge in form of notes with associated links to resources. Knowledge is provided in form of an HTML attachment inside of the email message.

4.1 Semantic Annotation

Semantic annotation used by ACoMA Core is one of most important tasks of email processing. It is built on top of pattern based semantic annotation tool - Ontea [7]. The idea is that regular expression patterns are applied to text in order to identify semantic elements in the text. For example we can define regular expression patterns to identify objects such as email addresses, company names, contact persons or telephone numbers to be matched with contacts in our knowledge base or to identify a problem or activities description by identifying activity relevant keywords. As already mentioned, semantic annotation based on regular expressions can be well applied also to formal email communication used to communicate interoperability tasks between/among organizations.

5. Results and Business Benefits

We have developed the ACoMA system which processes relevant email communication and offer information and knowledge: hints or links to business resources needed for detected business context such as document repositories, databases or information systems.

In a tested administrative application, the main information and knowledge linked to email communication, were links to related forms or produced documents related to business processes and activities. The other type of information was expertise shared among users for current business activity.

We believe that three main barriers hampering ICT adoption by SMEs can be addressed by such platform: economic, by delivering a lightweight platform able to interact with simple networked environments (e-mail); shortage of skill, by addressing self-adaptive and automatic organization knowledge base creation and maintenance; and cultural, by integrating with normal ways of working. To learn more on ACoMA solution please watch demo movie (http://raport.ui.sav.sk/video/email_based_interoperability_115MB.avi).

5.1 Evaluation

The developed ACoMA system was tested in an administrative application where it helped users to collaborate and interoperate with external and internal parties. The main advantage was acceptance by cooperating people and not forcing involved external collaborating parties to install new interoperability solutions.

We have not measured end user satisfaction yet, but from preliminary use of software we consider user feedback to be positive. This is mainly based on the fact that users do not have to change their ways of working. They simply receive and send emails as before but if necessary they can use attached information and knowledge to accomplish interoperability and collaboration tasks.

5.2 Possible Applications and Target Group

A target group of ACoMA is SMEs - including low technology SMEs - which make up a large market sector and which are in need of more systematic adoption of practices for ICT supported interoperability and collaboration. At the beginning it would be good to focus on micro SMEs in ICT area doing whole business through the Internet such as information providers, Internet service providers (webhosting, email services, etc) or enterprises interoperating with several businesses via internet.

We believe that good application for ACoMA can be also eGovernment, by solving the interoperability problem among different governmental offices. This is especially true in developing countries, where public bodies have basic ICT infrastructure as email and web but lack interoperability solutions.

5.3 Exploiting Results

The ACoMA tool is a proof of concept solution and it needs to overcome several problems to exploit achieved results and have real impact on SMEs interoperability solutions. The most important is to address the following:

- Modular and component based architecture
- Connecting existing SME infrastructure
- Customization tools

By a modular and component based architecture we mean creating basic building blocks for an email communication analysis and processing. Such building blocks are partially available in current ACoMA software but need to be decomposed for components with well defined and described interfaces. If we want to provide interoperability service utility (ISU)

above SMTP we need to redesign ACoMA to be modular and extendable. Such approach for interoperability was previously used in Genesis (www.genesis-ist.eu) or CrossWork IST projects [9] [10]. When the solution will have clear interfaces and a modular architecture, other parties will be able to develop new and exploit existing interoperability solution by wrapping it over SMTP protocol.

An important task is to connect existing SME infrastructure(s), document repositories and legacy systems using system connectors built on standard interfaces, such as web services, SQL-based database access, XML-RPC or file access. We need to develop connectors to access and feed data to intranets and internet applications using Web 2.0 technology, such as URI based access or wrapping of HTTP requests. Once developed, the connectors can be used by relevant interoperability modules and components to provide required connections to enterprise information resources. Security and policy concerning information access need to be considered and employed where applicable.

There is also need for easy to use customization tools which allow developers or service providers to customize existing modules or components for needed interoperability tasks or to connect it to existing SMEs information systems.

5.4 Potential Benefit and Impact on SMEs Interoperability

ACoMA approach can be leveraged by organisations of all sizes, since it does not impact upon working practices within an organisation, but sits on top of ICT infrastructure present in most organisations. This is especially important in SMEs. Adoption of ACoMA can both increase business opportunities for SMEs and reduce production cost, thereby to have significant economical benefit. Of course the adoption of full ACoMA interoperability software will require some investments, but these investments can be gradual, and justified by the expected reduction of the production costs. The success of the platform will ensure tangible exploitation potential for the project consortium and 3rd parties, including SMEs and ICT or service providers, which include:

- Possibilities for SMEs to interoperate with basic ICT infrastructure, email, web
- Adaptation to different interoperability standards or solutions by installing or using new modules for processing and application to data from email.
- New opportunities for service, information or knowledge providers to create businesses on ISU interoperability (module-based) solutions such as:
 - Adaptation of existing interoperability solution to function as an ACoMA module.
 - Information and Knowledge sharing databases of general interest.
 - Mash-up Technology interoperability solutions.
 - Open source or commercial Web 2.0 based ISU modules
- New opportunities for ISPs to provide email services with pre-installed interoperability modules for specific business needs

By creating an open source infrastructure for interoperability based on email communication, others will be able to use, extend or provide services based on it, either commercially or as open source. Thus, we believe in the delivery of an interoperability service utility for SMEs, which is not owned by any single entity and which provides low entry and minimal operating costs.

6. Conclusions

The direct intervention on communication channels – based on e-mail message processing – is the distinguishing aspect, which addresses interoperability and collaboration using existing ICT infrastructure and the way of working in SMEs. The generic interoperability and collaboration platform envisaged includes shared knowledge representation, business

services provision and e-mail analysis and processing to extract knowledge and provide support in terms of annotation, information integration and suggestions.

The developed ACoMA system was preliminary tested in administrative application giving first positive feedback by not forcing people to change their way of working in an organization.

In future work we will try to extend the solution with an easy user interface for setting up application specific patterns used for semantic annotation of communication. Now it needs to be done only by experts. We also try to address issues described in 5.3 which we believe need to be fulfilled to exploit the results

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