Project no.: 033512

Project acronym: TraSer

Project title: **Identity-Based Tracking and Web-Services for SMEs**

Start date of project: 01.06.2006
Duration: 36 months

Sixth Framework Programme
IST Call 5
Fp6-2005-IST-5
ICT for Networked Businesses
Priority 2
Specific Targeted Research Project

**Getting Started with TraSer – from Requirements to a Solution**
# TABLE OF CONTENTS

Table of contents......................................................................................................................2

1. Introduction........................................................................................................................3

2. Overview of your project........................................................................................................3

3. Identification of the problem ................................................................................................5
   3.1. Tracking and Tracing .....................................................................................................5
   3.2. Problem Archetypes ......................................................................................................5
   3.3. Technologies You Need to Know ...................................................................................6
       3.3.1. Barcode ................................................................................................................6
       3.3.2. Radio Frequency Identification (RFID) .................................................................6
   3.4. The Economics of Tracking ............................................................................................6
       3.4.1. Return-on-investment (ROI) ..................................................................................6
       3.4.2. Investment payback time ......................................................................................7

4. Building Your TraSer Application ......................................................................................7
   4.1. TraSer in a Nutshell .......................................................................................................7
   4.2. Installing and Configuring TraSer ...................................................................................8
   4.3. Developing your own applications ..................................................................................9

5. Communicating and Interfacing with Your Partners ........................................................10
   5.1. TraSer ..........................................................................................................................10
   5.2. ASN ..............................................................................................................................10
   5.3. ONS and DS ................................................................................................................10
   5.4. EPCIS ..........................................................................................................................10

6. Resources and Further Reading .........................................................................................10
1. INTRODUCTION

TraSer aims to be the most user- and developer friendly, open source tracking and tracing solution. However, building a successful application is more than just software, it involves requirements analysis, planning, design, technology selection, implementation, deployment, testing and some training. While TraSer was designed from the very beginning to make this process as simple as possible, this document is meant to help you with the rest of the process, provide you with examples, ideas, and show you the way to a successful application.

Since this document can benefit a lot from your feedback it is also shared online in “wiki” format. Please check the TraSer online resources¹ for a live version of this document, contribute your questions, advice to other TraSer users and your user experience.

2. OVERVIEW OF YOUR PROJECT

In Figure 1 you can see the flowchart of a typical tracking project. Independent of your application most of the steps shown in the figure will be relevant to you. While there may be significant differences between tracking scenarios, this figure should help you to think about a number of issues, steps you need to take and also their timing.

Observing the figure and the TraSer documentation you should see how the TraSer philosophy is affecting nearly all the tasks in your project. E.g. at a very early stage you need to define at least one basic tracking scenario. TraSer already has many of these defined, so you can pick one similar to yours and use it for preliminary communication in your project. Also, when you initially consider a basic cost-benefit model the openness and free of charge availability of TraSer resources will have a significant impact on the choices you make. Open and free software provides you with many new possibilities, especially when you consider information exchange with business partners or when you aim at the rapid evolution of your processes. Innovative ideas can find their way into your TraSer application orders of magnitude faster than in case of many commercial and closed-source software.

Consultants in the field of tracking usually say that the first part of the project – in Figure 1 this is the “Go?” decision – is the most difficult and decisive from the point of view of overall success. To put TraSer in context and be able to compare cost and involvement implications it is possible to ask for a commercial offer for a similar solution. The most important comparisons to consider are:

1) total cost of ownership (TCO, the sum of all project costs including hardware, software, consulting, training, communications)
2) interfacing and collaboration with business partners (e.g. is it realistic to persuade them to buy the same software?)
3) functionality (can they provide and later modify software easily and for a reasonable price)
4) hardware compatibility (i.e. can you pick any RFID readers and tags and how difficult is it to set them up?)

As the TraSer community is maturing you should see more and more real world examples and case studies of projects similar to yours. We encourage you to contribute your own experience and learn from others, this way the quality and efficiency of tracking projects and the TraSer software itself will continue to improve. If you are a software provider you can also develop your TraSer expertise and build a business model on open source software similar to that of RedHat or MySQL. In the next sections you will learn about problem identification and relevant technology solutions, and also the basics of the TraSer architecture and its application.

¹ www.traser-project.eu and http://files.traser.emi.sztaki.hu/Wiki
Figure 1 Example of a tracking project
3. IDENTIFICATION OF THE PROBLEM

3.1. Tracking and Tracing

Even if tracking and tracing are quite often used interchangeably, tracking is usually perceived as the following of the location of an entity in transit, while tracing is defined as locating the entity when needed. Tracking systems are based on check-points that register the movements of tracked items. When a tracked item arrives at a checkpoint the arrival is registered and a message considering the arrival is transmitted to a tracking database. The main function of tracking systems is that they connect physical material flow with information systems. The identification of the tracked item at different points in the supply chain is usually done with automatic identification technology such as bar codes and radio frequency identification (RFID).

Most of the tracking systems are designed to increase the visibility of the supply chain considering the goods that are flowing. The simplest versions of goods tracking are the applications of automatic identification of incoming shipments that e.g. Wal-Mart has. In the more advanced tracking systems, the tracking information is used more widely and eventually shared across company boundaries.

While the goods tracking implementations get the most publicity, there are also many successful asset tracking implementations around the world. E.g. returnable transport items (RTI) such as reusable crates, totes, trays, boxes, roll pallets, roll cages, barrels, trolleys, pallet collars, racks, lids and refillable liquid or gas containers are assets, which have significant value and are vulnerable for shrinkage. In many cases, it is easier and economically more justifiable to start to develop a tracking system to track RTI’s instead of tracking goods they are carrying.

3.2. Problem Archetypes

Improved possibilities to track and trace products increase the visibility in the supply chain. This increased visibility helps in solving e.g. the following practical problems:

- To enable real-time coordination of goods in transit.
- Announces the forthcoming potential troubles.
- Helps to find lost product.
- Improves administrative processes
- Improves companies’ ability to develop metrics to evaluate the supply chain effectiveness.

Real-time coordination and building many logistics services such as multimodal transport or merge-in-transit is extremely difficult without tracking systems. A good tracking system is also developed in a way that it generates exception notices, when something unexpected happens. When the tracking system users get these notices as early as possible, they have better abilities to resolve the problem or at least time to react for changed circumstances and minimize the damages. Tracing functionality of tracking system helps to find lost product, if the system fails to prevent the confusion. Tracking system can introduce paperless and less paper system, which improves efficiency in administrative processes and reduces waste. Tracking system database can also be used as a potential source of meaningful measurement data, which can be analyzed to find out e.g. cost factors and places where the biggest profits are made.
3.3. Technologies You Need to Know

3.3.1. Barcode

Bar code technology has a long time been the best known and widest tracking technology. It is an optical machine-readable representation of data. Originally, bar codes represented data in the widths (lines) and the spacing of parallel lines and may be referred to as linear or 1D (1 dimensional) barcodes. But they also come in patterns of squares, dots, hexagons and other geometric patterns within images termed two dimensional matrix codes or symbols. In spite of there being no bars, 2D systems are generally referred to as barcodes as well. The most important feature of barcodes is that to read them the reader device needs optical visibility, and this differentiates them most prominently from RFID, the subject of the next section.

3.3.2. Radio Frequency Identification (RFID)

RFID technology consists of two primary components, tags and readers, in your project you, or your experts will need to select both of these. An RFID tag has a microchip and antenna. The microchip stores object information (such as serial number), while the antenna enables the microchip to transmit object information to the reader.

An RFID tag can be in a form of sticker, label, card or implant, which is attached to an object requiring recognition. There are several kinds of RFID tags, active and passive the most well-known. Active tags have their own power supply such as a battery, while passive tags have no outside power supply, they simply reflect the energy they receive from the reader (hence their more limited read range). Active tags are easier to read, but the power supply has limited life-span, requires changing or recharging and also cause other complications, e.g. regulatory problems emerge when you ship them by air etc. Therefore active tags are more expensive to buy and more complicated to use and maintain.

An RFID reader creates an electromagnetic field with the tag antenna, and the tag uses this electromagnetic field to transmit object information to the reader.

A RFID tag can be used for the same purposes as a barcode, but a RFID tag has some extra features that traditional barcodes do not have:

(i) RFID reading does not require visual contact
(ii) the information of RFID tag can be changed while reading, which also enables the reuse of RFID tags
(iii) several (hundreds of) RFID tags can be read at a same time
(iv) the information capacity in RFID tags are bigger than in traditional barcodes, and
(v) RFID tags are far more durable than barcodes.

In case of any project the selection of hardware components requires some domain knowledge and also some expert advice. For tips and discussions look for the online resources of TraSer.

3.4. The Economics of Tracking

3.4.1. Return-on-investment (ROI)

The most common way to evaluate the usefulness of investment is to made return-on-investment (ROI) calculations. These calculations are made by estimating, how much time it takes that increased profits caused by improved supply chain visibility are bigger than capital costs incurred in tracking system investment and development. The shorter the ROI time is, the better the investment is.
However, ROI is not always a proper alternative to estimate the usefulness of investment. In some cases supply chain visibility is a lifeline to your company. E.g. Wal-Mart has forced – or “mandated” - its main suppliers to put RFID tags on their product to maintain Wal-Mart as a customer. In this case, for example, the company has to invest RFID tracking system regardless of ROI calculations, if it wants to have Wal-Mart as a customer. Also in some businesses companies need to have certain reliability in its shipments to be respectable. This reliability can be too difficult to obtain without good tracking system. The other issue that usually does not favour ROI calculations is the difficulty to evaluate the real profits. Even in the most obvious cases such as searching lost packet the real costs are underestimated, because usually some parts are missed when evaluating the total time needed to solve the problem. And usually the most important factors are also the most difficult to evaluate. E.g. how to evaluate improved customers service?

3.4.2. Investment payback time

Similar way to evaluate the costs and benefits of tracking system is investment payback time. In the cases, when investment causes new continuous costs, e.g. administration costs; it is not possible to calculate return-on-investment. Instead, these continuous costs have to subtract from profits and calculate the investment payback time similarly than ROI.

4. BUILDING YOUR TRASER APPLICATION

4.1.TraSer in a Nutshell

Once you made up your mind about having a tracking and tracing application for the benefit of your company or organization you need to understand the opportunity TraSer provides you with. Many of these opportunities are based on its architecture, therefore a quick summary is provided here and also Figure 2 explains the basics.

TraSer consists of nodes that can act as servers, clients or both in the same time – this is part of its distributed nature. Some of the functionality used by both clients and servers is included in the “common” library that you can use to develop tracking applications on your own. In the TraSer architecture Auto-ID readers (meaning RFID and barcode readers) are attached to client applications that also handle all user interactions. Servers on the other hand only store information and communicate with the user via clients.

Since servers and clients communicate over the Internet using Web-Services technologies the TraSer platform utilizes secure communication. Partner links, security keys, communication and resolving of numbering schemes to unify occurrences of entity references expressed in different numbering schemes, in other words services that span over a network, are handled by the TraSer library.
When you are planning your tracking application you should be able to think in terms of these “nodes” or “agents” that run on computers, handhelds and RFID readers. Once you know how many such nodes do you need and what functionality and data do you want them to provide you already have defined your TraSer application scenario. The next step is the installation and configuration of your first TraSer node.

4.2. Installing and Configuring TraSer

After downloading and unpacking the TraSer package from the official Sourceforge site www.traser.sourceforge.net – or the binary package from the TraSer web-site software downloads page http://www.traser-project.eu under the software > download section – you need to run the server.bat file on Windows, or the server.sh script on Unix (Linux, MacOSX, FreeBSD etc). This script starts the server, you are ready to go.

The general client application contained in binary bundles of the TraSer software let you configure your software and view & manage item information not only locally, but on remote servers too. With the help of the general client application you can get a hands on view on the data of your items in a raw format, a format that helps to get a grasp on the physical processes behind the scenes.

To see the general client running go to your browser, type the address of your server – in most cases it is your “localhost”, i.e. http://localhost:8080/traser – and configure it. You can find more details in the TraSer user manual that can be downloaded from the project web-site http://www.traser-project.eu under the software > download section.
4.3. Developing your own applications

As TraSer relies on the ID@URI notation, the implementation can automatically retrieve the internet address of the server storing information about an item. This makes it possible to use the services of TraSer through a façade that directs all your commands to the appropriate server.

Figure 3 shows the main TraSer components and their relation to each other and external systems/components. If you decide to develop your own tracking application using TraSer you have 3 possible ways to do so. You can develop your own system that sends and receives proprietary XML messages and you adapt your TraSer server with XQuery definitions telling it how to handle the messages. Another option would be to develop an application that supports the TraSer messages and thus can connect to your TraSer server directly or can even act as a TraSer server if needed. But the most comfortable way of implementing a tracking application using TraSer is to use the TraSer library.

In addition to being an interface to Auto-ID readers, the TraSer library provides you with appropriate tools to convert identifiers read from labels or tags to meaningful data by resolving the network address of the TraSer server storing information about the item. If the item is hosted on a remote server and the TraSer library is configured well, it even handles the details of the communication over a secure channel established on the network.
5. COMMUNICATING AND INTERFACING WITH YOUR PARTNERS

5.1. TraSer

For TraSer users the easiest and most efficient way to interface with others is by TraSer itself. It is free and easy to use, so it should be an attractive option for your partners. However, in case of other requirements you still have an easy time interfacing with others, with minimal programming and configuration work you can use existing standards, some of the most prominent ones are briefly introduced in the next sections.

5.2. ASN

Advance Shipment Notice (ASN) is one of the most common standard electronic messages in logistics. It uses the common EDI (Electronic Data Interchange) standard document format and can be understood as an “electronic packing list”. Integration tasks like this can be done with TraSer in a matter of hours. Many commercial and open source tools are available for converting XML messages and EDI formatted ASNs.

5.3. ONS and DS

The Object Naming Service (ONS) and the Discovery Service (DS) are EPCGlobal standardization initiatives. The ONS already exists, it provides pointers to authoritative data about products with serial numbers. The DS is a work-in-progress worth following, as it aims to solve the problem of distributed information across organizational boundaries.

5.4. EPCIS

EPC Information Services (EPCIS) is a recent standard providing a publish-and-subscribe interface for data repositories. When TraSer was started this standard didn’t exist, but in the near future it is likely that some of your customers will demand an EPCIS interface or it’s integration. With the legendary flexibility of TraSer it is a very small programming task to carry out this integration.

6. RESOURCES AND FURTHER READING

- TraSer home page: www.traser-project.eu
- TraSer Developer Resources: www.traser.sourceforge.net
- TraSer Wiki: http://files.traser.emi.sztaki.hu/Wiki
- TraSer Java Documentation: http://files.traser.emi.sztaki.hu/javadoc/
- Wikipedia is useful for getting started with RFID and barcodes: www.wikipedia.org
- EPCGlobal standards at www.epcglobalinc.org/standards
- Product Lifecycle Management: www.cl2m.com