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Towards Next Generation Tracking & Tracing

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1. BACKGROUND AND MOTIVATION

Distribution is no longer about moving cargo over road or via air from A to B, but is a complex process based on intelligent systems for sorting, planning, routing, and consolidation that supports faster transportation, different transportation modes, fallback scenarios in case of failures, value added services such as time sensitive deliveries and tracing of products throughout the supply chain or transport network. Many large logistics companies have developed solutions for delivering these services in order to meet the requirements of their customers and to improve their services.

Whereas larger companies have developed solutions for delivering these services in order to meet the requirements of their customers and to improve their services. Smaller companies, however, cannot afford these investments and are mainly active in the 'old' point-to-point transportation market, or co-operate with the larger companies, using their respective systems.

The companies that have the necessary information systems in place to participate in the market for high-end transport solutions, normally offer their customers methods for tracing their consignments. Even though many customers would benefit from using this information in their own information systems, only few of them are doing this today because of the large investments in their systems required to adapt to the proprietary interfaces of the transport companies. However, these systems typically have two major drawbacks:

- They do not normally work across company boundaries.
- They do not provide accurate 'life' information about location and, particularly, the status of individual units or items.

Continuous information about the current position or status of transport goods (in the sense that the exact geographic position can be queried at any time) at item level is not commonly available today. Typically, this information is provided – if at all – at a vehicle or container level only. Existing tracking solutions are typically based on scanning bar codes at process or control points. Furthermore, very few companies have true global or even European coverage. In daily business, products are frequently shipped by subcontractors of the transport company. If the subcontractor does not provide a point-to-point service, tracing is no longer possible. Only in a few cases do carriers exchange tracing information, but in most cases the costs for adapting the proprietary systems to each other are prohibitive.

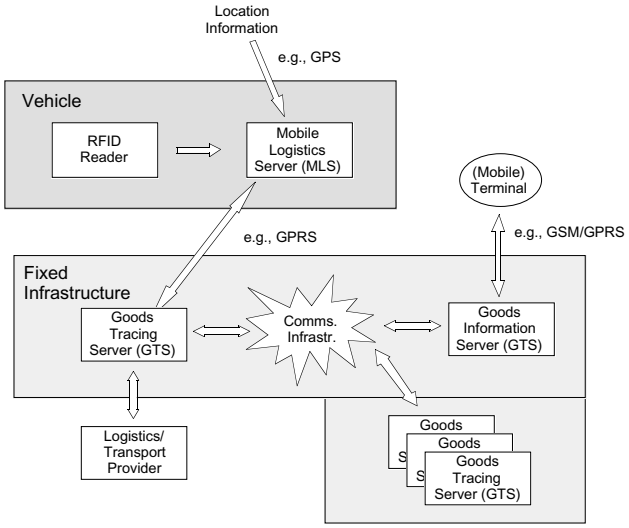
2. THE PARCELCALL PROJECT

ParcelCall is an R&D project funded under the European Commission's Fifth Framework Programme (FP5) on Information Society Technologies (IST). It is developing and trialing an information technology system to improve business processes in transport and logistics through a real time, seamless integrated tracking & tracing system that operates 'end-to-end' across different carriers and transport modes at the individual parcel/item level.

The key idea of the ParcelCall project is to provide relevant services on top of open and standardised communication protocols, potentially including e.g., GPRS, ISDN, GSM/UMTS, and TCP/IP. Easy adaptation of legacy systems, operated by the individual carriers, to the new information infrastructure is another key design criterion. Seamless interoperation between these systems on the one hand and the new tracking & tracing system will be guaranteed.

Figure 1 shows the general architecture that is being be implemented.

Figure 1: The ParcelCall Architecture



Information on individual items, including position and status, are collected by a *Mobile Logistics Server* (MLS) located on board a vehicle. The former type of information is obtained via the Global Positioning System (GPS), 'intelligent' tags are utilised to collect the latter. These 'Thinking Tags', which are also being developed within the project, form ad-hoc networks that can be applied to self-adapting hierarchical packing schemes or to active status monitoring of critical freight contents. Alarm messages are actively generated if, e. g., an item enters a critical state (temperature, humidity, pressure, acceleration, etc.). It is also conceivable that in-vehicle shelves themselves are equipped with intelligent devices, such that the fine-scale location of an object within a vehicle can be determined.

The MLS sends the compiled information to a *Goods Tracing Server* (GTS). Every participating delivery company needs to install at least one GTS, which also serves as the interface between the respective internal IT system and the track & trace service. Thus, the set of GTSs forms a highly distributed data base

holding the information available to the end-users (subject, of course, to appropriate access rights and successful authentication). The individual servers are interconnected via public networks (as e.g. the Internet or ISDN). A user accesses the information via a *Goods Information Server* (GIS).

It should be noted that even very small companies which do not have their own tracking & tracing system can utilise the ParcelCall service, as a GTS (typically a PC) and a few 'thinking tags' are pretty much the only additional pieces of hardware required (for more detailed information see e.g. [Busbo 00]).

To be effective the system must be acceptable and attractive to the fullest range of players operating in the transport and logistics industries. ParcelCall therefore also takes into account socio-economic issues that arise in association with the potential uptake of a new technology.

3. SOME SOCIO-ECONOMIC ASPECTS

The success of a new technology depends on more than simply its technical efficacy; it must also be matched with its socio-economic context. In some cases this means tailoring technology to the existing environment, in others the market and context may need to be 'created', alongside the technology, by the technology's developers. Most obviously a technology must address the requirements of its various users. Typically, it is important that current needs, as seen in existing business practices, are taken into account. However, although existing practices provide a starting point, gaining the full benefit of new technology often depends on its more radical application.

Above all, a technology that involves inter-organisational data exchange depends heavily on the success of standardisation efforts and on the willingness of firms to work together. These issues may affect the technical choices adopted in the design and configuration, as well as the commercial strategies for its promotion. Strategic thinking on these lines is embedded in the architecture and strategy of the ParcelCall project [PCall 00].

3.1 The Challenge for a Tracking & Tracing System Today

To be successful, any tracking & tracing must achieve neutrality between the different actors. In the first instance this relates to transport and logistics operators. However, if we want to understand the business case and broader commercial context for tracking & tracing we must also address the wide range of players in the logistics system. In particular we must look beyond the immediate 'users' of the technology and address the logistics requirements of their customers. The enormous diversity of business models and 'users' of the network throws up a key problem in relation to establishing user requirements and the business case.

It is particularly instructive to refer to recent developments in electronic commerce. With Business-to-Consumer (B2C) we see an atomisation of the market into many suppliers and many buyers, where issues of trust are increasingly important, and likely to be the preserve of intermediaries in the commercial transaction, such as the third parties providing the transport, or the third parties that hold the money whilst the physical transaction takes place. When 'B' may represent anything from a multinational to a single-product, single-person company, and 'C' from a single person upwards, this creates a wide variety of business models to be supported, demanding not only flexibility, but also that costs scale as linearly as possible with volume and weight.

Though B2C e-commerce has grown rapidly over recent years, it has been predicted that B2B revenues will exceed B2C revenues by an order of magnitude in 2003 [Well 00]. This implies an increase in activities to help trading partners improve responsiveness to customers, reduce supply chain costs, increase manufacturing efficiencies and reduce inventories at every point in the supply chain from order to delivery. These Internet-based supply chain services are also planned to provide 'multi-tier demand, supply and inventory visibility, multi-tier constraint management and vendor collaboration, and improved material release stability.'

4. CONCLUSIONS

In this paper we presented the ParcelCall approach towards an open architecture for tracking & tracing in transport and logistics, as well as some of the socio-economic aspects associated with the design of such a system.

The chosen de-centralised architecture has several attractive features with respect to the requirements listed above. Most importantly, this architecture scales extremely well; it is no problem to install additional servers if need be. Almost as important, there is no need to modify existing corporate IT infrastructures. The only thing that needs to be done is specify and implement an interface between the infrastructure and the GTS. Moreover, small companies can compete on a more level playing field.

Internal details, such as change of transport mode or use of a sub-contractor are hidden from the end-user, to whom a virtual global delivery system is presented. The GIS holds the individual user profiles, checks and verifies a user's identity, forwards the query to an appropriate GTS and returns the response to the user's current end system.

A number of general design suggestions can be derived, for example:

- Use cheap, generic web or mobile phone-based interfaces so that SMEs are not deterred.
- Retain options for barcodes and scanners to ensure that those without RFID capability are not excluded, and to provide back-up in case of system failure.
- Avoid system requirements that will not be compatible with legacy systems.
- Where possible seek alignment with industry standard solutions.

Overall there is a key strategic choice about what one could call 'thin' and 'thick' concepts of what information will be transferred within the system. The 'thick' model implies to try and encompass and support the complex needs of diverse sets of players who will be receiving data about the parcel in the course of delivery. The 'thin' model implies that only limited data will be exchanged within the system itself, and that this will be supplemented by information provided by the internal systems and procedures of the different players.

Given the necessity to develop specific system, the socio-economic analysis mandates in favour of the 'thin' view of the system. Designing ParcelCall based on a 'thick' concept of business processes runs the risk that an inflexible approach will be 'hard-wired' into the technology, which will not be suitable for all the potential users. The 'thin' model allows diverse business users room to elaborate their own information strategy around the system.

These strategic considerations are also in line with pragmatic questions. The need to develop and agree on standards regarding the structure and meaning of messages, as well as rigorous security protocols regarding the release of information to particular players, mean that what can be developed in the lifetime of the project is likely to be a 'thin' implementation.

Ultimately, however, it is most likely that the success of a track & trace system will be determined by the actions of the companies with the most influence in the logistics process. If a number of the large, integrated express/logistics companies can be en-

rolled, then this will develop momentum for ParcelCall in two ways. First, these large companies can insist that their subcontractors become compliant. Second, the additional service levels provided by the system will raise the standard expected industry-wide, placing pressure on others to adopt as well.

5. REFERENCES

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