

**Integrated Virtual Logistics Network for
Quick Responses**

By

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Working Paper
on
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Integrated Virtual Logistics Network for Quick Responses

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Abstract

Trucking is a vital segment of the transportation system that supports Indian Manufacturing. Trucking companies are attempting at providing such non-traditional trucking services as warehousing, distribution, inventory management, picking and packing - assembly operations and return goods management as part of their value added services thus making manufacturing (brick and mortar) activity competitive in the information (click) age. The major stakeholders in this exercise are (i) manufacturing industries (particularly Small and Medium scale enterprises - SMEs), (ii) logistics service providers (transportation, warehousing, clearing and forwarding agencies), and (iii) government and financial agencies (Central Excise and Customs, Regional Transport Organizations, Surface Transport Agencies and Banks etc). The present scenario warrants an integrated quick response mechanism to extend complete logistics solutions in a seamlessly integrated manner to reduce costs rather than extending the services in a disjointed way. In this context, this paper attempts at

1. Study of the present IT architecture, business processes of different agencies, involved in providing and using logistics industry's services in India, like Transportation sector (Trucking agencies, trucking brokers and 3PL service providers), Customs & Central Excise of India internal processes and their external interactions with EDI partners (like Airports Authority of India, Port Trusts, Banks etc.), Manufacturing Companies' IT infrastructures [Small and Medium scale industries enterprise resource planning (ERP) and supply chain management (SCM) platforms], and
2. Developing a framework for **“Integrated virtual logistics network for Quick Responses”** which would factor in the existing processes, systems and organizations' roles and the government's proposed investments in the e-commerce and e-governance infrastructure, and designing a technology transformation road map.

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1.1 Introduction

In the information age, with information symmetry, customers compare prices, delivery schedules, and product information with an ease that was never possible with traditional storefronts. These capabilities impacting not only all the customer touch points of an organization, but also, send shock waves through the entire value (supply) chain. Organizations are forced to cut inefficiencies in every aspect of procurement, distribution, manufacturing, sales, service, and marketing. Time to market pressures and responsiveness to customer demands have never been so great. Established brick and mortar companies are reinventing themselves and leveraging the new technologies. These organizations are becoming more competitive through improved information sharing, manufacturing on demand, and using real-time collaboration throughout their supply chain. Their goals are increased efficiencies, reduced fulfillment costs, and enhanced time to market.

1.2 Indian Road Transportation Scenario

Surface transport consisting of Rail and Road account for 97% of the total freight traffic movements in India [Gawhane 1998]. Roads in India are broadly classified as Class I category of roads comprising National Highways, State Highways and Major District Roads and class II category of roads which include other district roads and village roads. Class I category of roads play a very prominent role in the freight movement across different regions of the country. The percentage share of freight traffic between Rail and Road is presented in Figure 1.

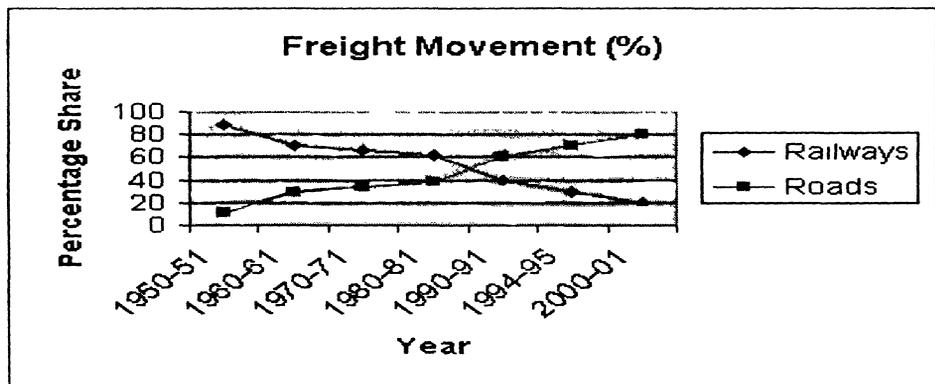


Figure 1: Percentage share of freight movement by Rail & Road

[Economic Survey, 2000, Gawhane 1998]

The share of Trucks in freight movement is continuously increasing due to their flexibility in operation, customer tailored services, easy maneuverability, door to door service, better suitability for hilly and inaccessible areas, in addition to low capital costs and better returns on investment.

During the last five decades, there are spectacular changes in the growth of road network and vehicle population. The growth of vehicles, population and road lengths are presented in Table 1.

Year	Road length in million Km	Total vehicles (million)	Commercial vehicles (millions)	Population in (millions)
1951	0.40	0.30	0.08	360.11
1961	0.65	0.66	0.17	430.92
1971	0.92	1.87	0.34	548.16
1981	1.49	5.34	0.54	683.33
1991	2.04	20.31	1.41	846.30
1999	3.70	40.00	2.04	1000.00

Table 1: Growth of Vehicles, Road network and Population [CMIE, 2000]

However, the National Highway, which account for bulk of freight movement in tonne-Kms constitute less than 2% of the total road network. In addition, the truck traffic through movements is hampered by a large number of check posts situated near state boundaries. Most of these check posts are not computerized and transactions at these check posts result in enormous avoidable delays. This process also increases the cost of inventory and reduces considerably the productivity of trucks.

1.2.1 Ownership pattern of trucks and trucking operations in India

Even though the total trucks plying on Indian roads exceed 2 million, individuals spread over the entire country own them. There are about five big trucking companies and another 9 to 10 medium trucking companies. But they account for less than 10% of the total fleet [Kareem, 2000]. Most of the trucking operations are through individual truck owners having one to four trucks. The data presented by the Ministry of Surface Transport indicates that most of the truck owners drive their own vehicles. As such, brokers / agents play a major role in the engagement of truck, utilization of the truck and over all profitability of trucking operations. There is no accurate data on brokers / agents engaged in trucking operations but their number exceed more than 10,000 [Sundar & Ramanayya, 2001]. These brokers / agents are ill equipped with modern technologies and this is resulting sub optimal utilization of trucks. In most of the cases, the trucks return with half load or even less as the brokers reach is limited to the place where he is situated and brokers / agents are not well connected.

1.2.2. IT Penetration in the transportation sector in India

Historically Indian transport sector is burdened with low end IT solutions, stand-alone applications, very labor-intensive operations and lack of standard equipment usage across the transportation companies. The low skill level of the workforce is also a major impediment in transforming this industry into exploiting IT services. Besides these, the low profit margins, lower yield miles per truck per month due to bad conditions of the roads are discouraging trucking companies from exploiting the possible IT enabled services. The government agencies involved in facilitating the material movement, like central excise and customs, regional transport departments, toll and tax collection agencies are not yet moved into E-Governance paradigm creating a major void in transforming the whole logistics industry into information age.

1.2.3 Indian Government Services

1.2.3.1 Indian Customs EDI System (ICES)

In the mammoth undertaking of regulating flow of trade across India's borders, computerization of operations has emerged as something of a necessity. The primary aim of Information Technology support for Customs operations is to enable the Government to perform the delicate balancing act between regulation of trade and generation of revenue on the one hand and trade facilitation for a growing economy on the other. It was with this aim that the Department set about developing the **Indian Customs EDI Systems (ICES)** as a pilot computerization project at the Delhi Air Cargo Complex in 1995. The system is currently operational at 23 locations across the country. Instead of a mere replication of existing manual systems, the implementation of ICES has been accompanied by a streamlining of existing procedures. While on the one hand certain processes have been simplified, on the other hand entire steps in document processing have been done away with. Some of the features of the automated system are the service center, remote filing, automated streamlined work flow, accountability and monitoring, transparency, automated drawback disbursement, limiting frequency and points of interface needed for any paper documents to be filed with Customs. [Sundar & Krishnan, 2001]

1.2.3.2 Linkages with Banks

As part of the computerized system connectivity has been provided between customs and banks for the purpose of duty / cess collection. Each Customs station has a bank specially designated for the purpose, which is provided a computerized extension counter at the site with linkages to the Customs system. Since, duty payment is an intermediate step in document processing, the bank was the first **external agency** to enter the basic workflow of the Customs computerized systems.

1.2.3.3 Electronic Data Interchange (EDI) Gateway

The Indian Customs is adopting Information Technology to attain global standards in speeding up flow of goods, thereby reducing turnaround time and inventory carrying costs so as to impart vital competitive edge to Indian trade and industry. The key strategy for achieving this is to enable EDI with other agencies involved in international trade such as Custodians of cargo (Port Authorities, Airport Authority of India and Container Corporation), Custom House Agents and Shipping Agents, Banks, Export promotion agencies such as the Apparel Export Promotion Council (AEPC), other Government Agencies such as the Directorate General of Foreign Trade (DGFT). The EDI gateway is still at design stage [Sundar & Krishnan 2001].

1.2.4 Inhibitors

Apart from the technological challenges of information integration, there are three main inhibitors:

Trust: In the traditional world of business, it is important to know the trading partners, to establish mutual trust, and to build long-term relationships. In the world of e-business, trading partners may change with every transaction, they are often strangers, and there is no history on which to base the trust. This represents an enormous shift in mind set for many organizations.

Credibility: For most supply chain partners, maintaining their credibility as a high quality and responsive provider is extremely important. The cost and associated complexity of adopting the necessary infrastructure to conduct e-commerce effectively can be considered too high a risk when their credibility may suffer as a result

Immature Solutions: For most well established companies, their IT organizations are struggling to evolve from internally focused systems and applications to one that extend the enterprise into the world of e-chains. Their systems are often poorly integrated even internally and not easily modified to allow integration with external systems. The root causes for these ills are inadequate business process reengineering, mapping legacy systems in to IT solutions, government departments' procedures and policies. And then there are the new businesses that have come into existence as the intermediaries of this new age, known, as e-Market Places and Infomediaries and they are breaking up the traditional distribution channels and creating downward price pressures, upward fulfillment pressures, and leveling the playing field for smaller businesses that were unable to compete effectively before.

1.2.5 Need for Integrated Logistics Modal and Applications

Mobile transaction processing capability coupled with a proper combined electronic business management model helps in integrating the manufacturers, transport service providers, financial institutions along with government agencies like regional transport departments, central excise and customs. warehousing. Interviews with truck drivers/Fleet operators reveal that the losses at check posts for larger trip lengths of more than 1500 km. constitute 30 to 35 percent of the total journey time [Sundar & Ramanayya, 2001]. This could be reduced by 10 to 15 percent if the virtual logistics model is implemented by all the agencies in its totality. The present scenario is described in Figure 2.

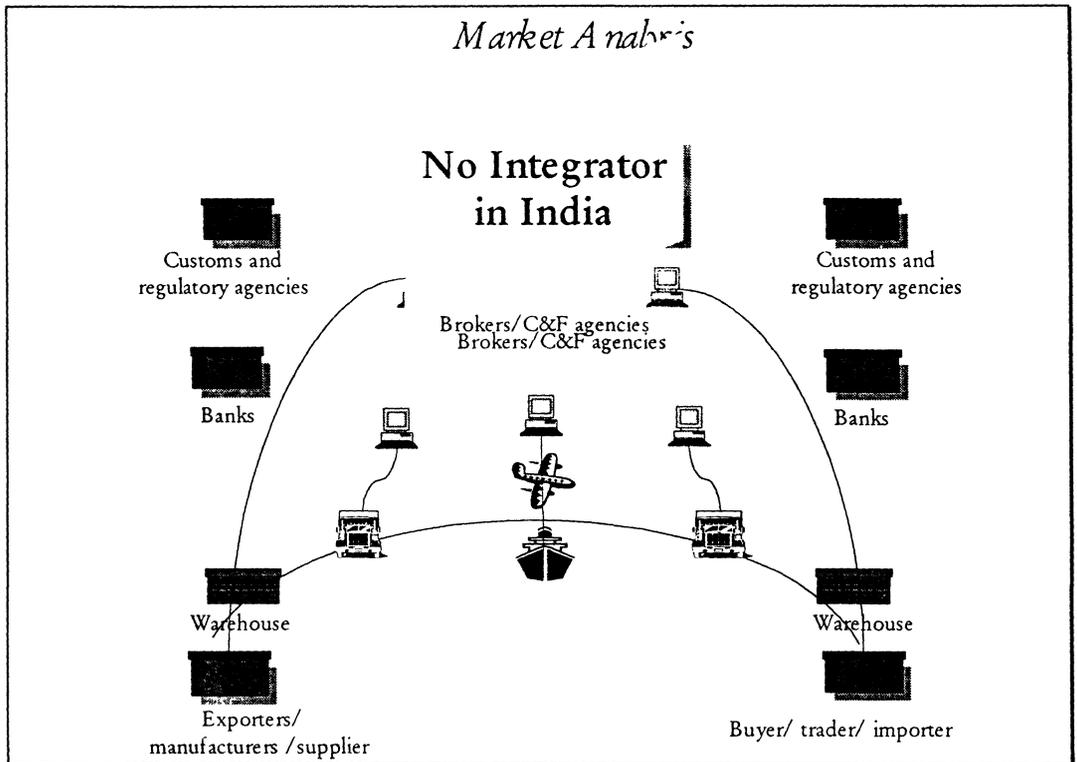


Figure 2: Information islands

2. A Framework for Virtual Logistics Network

In this paper, we describe the building blocks of a virtual logistics network that integrates all the entities shown in Figure.2 and some of the enabling technologies and concepts that are developed and tested in this context. The approach is comprised of *Solutions*, which are built on *Services*, which are, in turn, comprised of *Competencies* as shown in Figure3.

2.1 Competencies

Competencies are the basic building blocks that enable an organization's service offerings. Typically, a given competency plays a role in more than one service but, in some instances, a competency may also be a service in its own right (for example, shipment tracking).

2.2 Services

Services are the market needs. These are the comprehensive capabilities that customers want and understand. In the following discussion the terms *shipper* and *carrier* have fairly inclusive meanings. *Shipper* includes Third Party Logistics Providers, Freight Forwarders, Demand Aggregators and any party who needs to ship goods. *Carrier* represents Truck Load carriers, less than Truck Load (LTL) carriers, Intercontinental carriers/Ocean Liners, Small Package Carriers, Cargo Airlines, and Rail. Some of the services' configuration is described in the following sections.

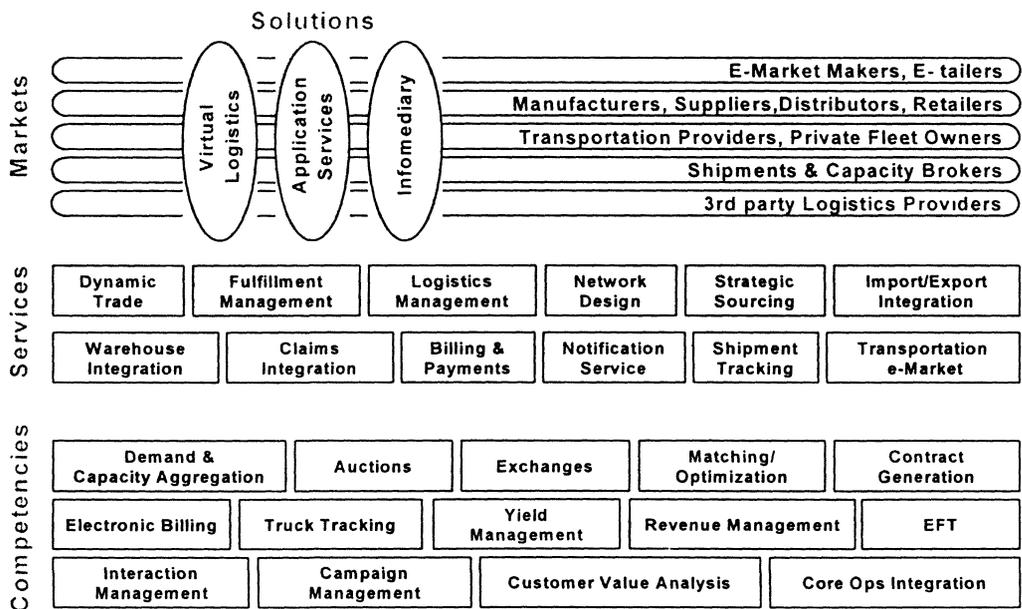


Figure 3 Markets-Services-Competencies-Solutions framework for Virtual Logistics Network

2.2.1 Transportation e-market place

This is the electronic market place for transportation capacity trading. Shippers have shipments that need to be moved from one location to another. Carriers have excess capacity (such as trucks) that can be used for moving the shipments. The Transportation e-Market service will find the best match between shipment and capacity. The objective is to maximize the capacity utilization for the carriers and minimize the shipment cost to the shippers. The main features of this service are: (i) Shipper and Carrier Registration, (ii) Shipper profiles addressing aspects like preferred carriers, carriers to avoid and carrier selection criteria relative ranking, (iii) Carrier profiles providing information about preferred shippers, shippers to avoid, and preferred product categories and products, (iv) Shipper credit worthiness and Carrier pre-qualification, (v) Shipper and Carrier feedback, (vi) Shipment and Capacity capture, (vii) Matching of shipments and available capacity and optimization of carrier capacity utilization, (viii) Assignment and acceptance capture, (ix) Contract generation, (x) Shipment in-route tracking, (xi) Exception and status notification, (xii) Invoicing and funds transfer, (xiii) Activity and savings reporting.

2.2.2 Shipment Tracking

This service provides the advantage of knowing the status of the shipment at any given time. Different events are collected from the driver, truck or the carrier, from the point of pickup to the final delivery, and made available for all the interested parties. This service can provide information on the basic events or serve as the basis for a sophisticated exception tracking mechanisms. The main features of this service are (i) Basic events such as pick up, delivery, last known location, and estimated time of arrival, (ii) Exception events including missing items, delays, damage, and bill of lading errors.

2.2.3 Notification

The notification service is built on the notion that customer needs to know some types of information as soon as possible. Customer may want to have reports showing that all his shipments arrived on time and intact and customer want to be notified immediately if an import shipment is delayed or damaged. The intention is to empower individuals with highly selective, actionable knowledge rather than providing volumes of information to wade through. The features of this service are: (i) Choice of what events should generate alerts and notifications (such as, all events,

critical events, and exception events), (ii) Choice of conditions (such as delays of more than 1 hour), (iii) Choice of notification channel (such as e-mail, phone, or pager)

2.2.4 Billing and Payments

The purpose of this service is to automate billing and payment for the shippers and carriers. This service focuses on streamlining the process, minimizing errors, and enabling faster settlements. The main characteristics of this service are: (i) Electronic submission of invoices, (ii) Consolidated billing to the shipper, (iii) Consolidated statements to shippers and carriers, (iv) Electronic funds transfer, (v) Potential escrow arrangements

2.2.5 Claims Management

The Claims Management service handles claims for damages and disputes. The purpose is to streamline this process and reduce operational inefficiencies. The features of this service are: (i) Electronic submission of claims, (ii) Electronic notifications, (iii) On-line decision tracking, (iv) Electronic settlements.

2.2.6 Warehouse Integration and Management

This service extends efficiencies of storage and distribution locations. The objective is to integrate these points with the transportation system and minimize loading and unloading of goods as well as damages. The main features of this service are: (i) Advance notification to facilitate appointment scheduling, (ii) Event notification to manage real-time changes in appointments, (iii) Faster loading and unloading of goods, (iv) Reduced handling and therefore reduced damages to goods, (v) Electronic documents, (vi) Electronic settlements.

2.2.7 Import/Export Integration

This service facilitates cross-border and international transportation. The intention is to integrate with Freight Forwarders to streamline this process and enhance efficiencies. The main features of this service are: (i) Advance notification to facilitate appointment scheduling, (ii) Event notification to manage real-time changes in appointments, (iii) Electronic documents, (iv) Facilitate forms, clearances, duties, and customs, (v) Electronic settlements. As EDI gateway is under development and implementation in India, electronic filing for central excise and customs clearance is a reality in the near future. [Sundar & Krishnan, 2001]

2.2.8 Strategic Sourcing

The Strategic Sourcing service is focused on helping organizations with longer-term transportation needs. When companies have goods that need to be moved through a set of static routes (repeatedly used routes with the same origin and destination combinations) they can enter into pre-negotiated contracts with carriers to gain committed capacities at competitive prices. The Strategic Sourcing service is a mechanism to facilitate this process, increase efficiencies and fast track the process. This service intends to assist both the shippers and the carriers. The main features of this service are: (i) Constructing RFP and RFQ for static routes, (ii) Carrier short listing and RFP facilitation, (iii) Assisting carriers to understand the total cost of business, (iv) Facilitating on-line bids and auctions, (v) Evaluation of the responses, (vi) Recommendations on best matches, (vii) Electronic documents, (viii) Contract Generation [Sundar & Manish, 2001].

2.2.9 Logistics Management

The Logistics Management service is the most comprehensive service addressing the entire inbound and outbound logistics needs of organizations. The service takes complete responsibility of the transportation, warehousing, and distribution needs of the client. The advantage of this service is that it is a complete outsourcing option for organizations

2.3 Solutions

Solutions address the designed and developed approaches to meet the market needs. These are predefined selections of services that are designed to match different market segments and different sets of customer requirements. In the following sections the details of services and solutions are described. To provide the services listed in the above section, there is a “bottom-up” e-transformation solutions (Gloor, 2000) need to be provided, which can be grouped as (i) Infomediary services, (ii) Application services, (iii) Virtual logistics services

2.3.1 Infomediary Services

This solution facilitates spot transactions allowing companies to find carriers for shipments, track their shipments, and subscribe to notification services. It allows transportation providers to find shipments, track vehicles, and sign up for electronic settlements and other services. There are no huge costs to participate. Neither does it require members to have multi-year contractual agreements. This is the fastest way for carriers to enhance their capacity utilization and for shippers to find cost-effective ways to transport goods. The current alternatives for shippers and carriers are

cost and resource intensive. Traditionally, this is handled through last minute telephone calls to find a carrier or shipper. Though brokers as well as and some portals provide similar capabilities, their commissions are high and the reach is local. The fee structure for this solution would be fixed per transaction or percentage of value.

2.3.2 Application Services

This solution is provided for Third Party Logistics Providers, Fleet Managers and Private Fleet Owners. These organizations have a fully developed organization to perform the operations and are in need of a technological solution to enable their operations. The standard industry solutions are not comprehensive in most cases and hence these organizations try to develop the software in-house. A robust logistics environment that is reasonably priced will be readily embraced. In the later sections of this paper we discuss “tracking” and “aggregation & consolidation” services from the technology point of view.

2.3.3 Virtual Logistics

This solution is intended for organizations that are willing to have a third party manage their entire transportation, logistics and fulfillment needs. The primary customers for these organizations are the ones who desire to focus on their core competencies and let the experts handle the rest. The target market would be manufactures that intend to outsource logistics and virtual companies that intend to outsource their entire fulfillment process

3. Technology Description for “tracking and aggregation”

The major problem faced by most businesses is how to capture data at its source with minimal errors and then make it available for application in the business processes. With the introduction of the **Simputer**, a generic, low cost handheld, mobile platform with rich features developed by the Bangalore based Simputer Trust [Garg 2001], it is now possible for us to use cost-effective technology for mobile transaction processing in the field. The Simputer has certain built-in features such as analog modem, smart card and USB interface that make it a powerful front-end client platform for deployment of applications that need connectivity with back-end services. The analog modem built into the Simputer will be used to dial into a remote access server or an Internet Service Provider to quickly update the enterprise databases. The smart card can be used to protect sensitive data and for enabling various secure transactions to take place across an essentially unsecured network. The device is simple to operate and ideal for form filling and data capture applications. It also consumes very little power and is extremely lightweight. The Simputer is

another example of the power of embedded technology and is designed for uniquely local solutions to uniquely local problems. The Simputer uses the Linux operating system, a reliable open source OS with many advanced communication features which has been customized for the computing resources of the Simputer. In addition, the Simputer has the capability to incorporate additional peripherals through the USB bus. This enables the Simputer to be useful in a diverse range of applications that might require different hardware functionality than was envisaged by the designers. One such unique requirement is in the Logistics Industry that is an integral and important constituent of any e-chain.

The Logistics Industry has tremendous potential to benefit from the use of appropriate embedded systems technology. One such technology that can help in improving the efficiency of its movable assets is GPS-based tracking. A GPS-based tracking device can be mounted on a truck or other vehicle and can continuously monitor and record its location via a system of satellites called the Global Positioning System. The GPS system consists of 24 earth-orbiting satellites, which are continuously beaming down certain signals that can be detected by any GPS receiver to determine precise spatial (latitude, longitude and altitude) and temporal information by a process of trilateration

Trilateration is a basic geometric principle that allows us to find one location if we know its distance from other, already known locations. The heart of a GPS receiver is the ability to find the receiver's distance from 4 (or more) GPS satellites. Once it determines its distance from the four satellites, the receiver can calculate its exact location and altitude on Earth. If the receiver can only find three satellites, then it can use an imaginary sphere to represent the earth and can give us location information but no altitude information. This is shown below in a simple pictorial form, Figure 4.

An interesting addition to the GPS receiver is a communication module, such as GSM, which can then be used to periodically report positional data to a central monitoring location. A logistics service provider can now track all its vehicles from a central place. This can then become a powerful tool because precise information about each movable asset is now available. This is a wonderful example of how embedded technology can improve transactional efficiency and quality of service. Additional services can be provided to consumers and the scope of such services is virtually unlimited. The Simputer, with a GPS/GSM module integrated into it, is now a powerful tool capable of being deployed in major areas like sales force automation, tracking and aggregation & consolidation with route optimization.

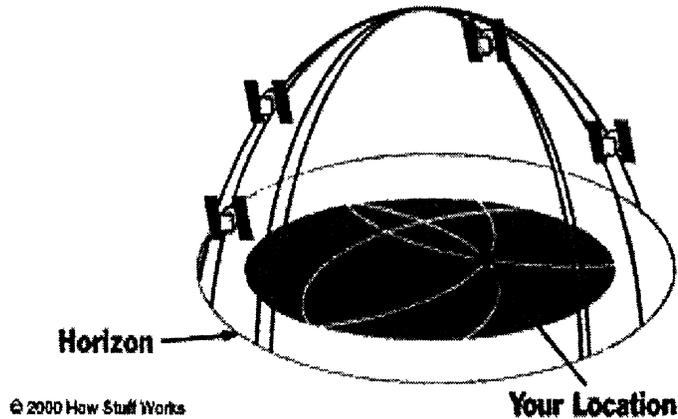


Figure 4. Trilateration

3.1 Sales-force Automation

The Simputer gives the mobile field force the ability to collect and disseminate information in the field and automatically upload it to a server, thereby increasing the responsiveness to the clients. The traveling salesman can also use GSM to communicate with the head-office. The smart card enables a set of security and authentication features to be provided on the Simputer. Form-filling applications can minimize the errors in data entry and data can flow in from the field in real time.

3.2 Tracking

The GPS receiver in the Simputer obtains the geographical coordinates of the movable asset, which are then converted to a physical location on a GIS map of the region. The built-in GSM phone then periodically sends this positional information to a centralized master control center, which can then incorporate this data into other applications, in real time. In addition, the same GSM link is also used to send other data that might be generated by strategically located sensors in the target vehicle. For example, a vehicle carrying perishable commodities, such as food and medicines, needs to maintain a recorded temperature profile to ensure the sanctity of the cold-chain. This temperature profile is maintained by the Simputer and periodically uploaded to the server over the GSM link. Preventive action can then be taken after the temperature data is analyzed. Various other sensors can be added to obtain different levels of functionality. Some examples are (i) Tyre pressure monitoring, (ii) Vehicle load monitoring, (iii) Cargo temperature monitoring, (iv) Fuel monitoring, (v) Vehicle and Cargo security, (vi) Emergency alarms.

3.3 Aggregation & Consolidation with Route Optimization

A major problem in Logistics is the optimal use of vehicles through the process of aggregation and consolidation along with the route optimization. The service provider has to ensure that his vehicles are optimally loaded on forward and return trips. At the same time, the shortest route is required both for reducing shipment time as well as fuel consumption. The GPS/GSM feature on the vehicle Simputer gives the service provider the ability to physically track the exact location of any vehicle at any given time. The operator can then effectively schedule the route for each vehicle as well as aggregate the payload based on the real-time information that is now available. Each logistics service provider can use a web-enabled client to economically obtain tracking and additional information about each vehicle in his fleet. This enables him to view the macro picture of an entire set of vehicles, as well as obtain specific micro views about each vehicle.

4. Conclusions

The “**virtual logistics network framework**” addresses services in the areas such as asset management, logistics productivity, global reach, inventory chain optimization, distribution management, reverse logistics, warehouse management, transport capacity matching, transport brokerage, and real time interface with federal agencies for speedy document clearance. The brokers/agents could make use of this portal and in turn advice their client’s i.e. individual truck owners/operators to increase the utilization of trucks at least in the return trips. In addition, if all the check posts are linked with concerned government agencies the delay could be considerably reduced. These processes in turn increase the productivity of the truck and enhance the profitability of operations.

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