Electronic commerce is a generic term that encompasses numerous information technologies and services used to improve business practices ranging from customer service to inter-corporation coordination. One of the most common instances of electronic commerce is the exchange of goods and services over the Internet but there are many other forms of electronic commerce such as controlled electronic purchase or virtual malls. Electronic commerce is not a futuristic dream; it is happening now with many well-established success stories. However, the electronic commerce services that are established so far are still far from being mature. There is no real integration of the underlying technologies, and the provided services lack many important but also more challenging features.

In all of its forms, electronic commerce makes use of information technologies from very different areas: databases, transaction processing, interoperability of heterogeneous information resources, intelligent agents, multimedia systems, security and workflow systems. In this paper, the current-state-of-the art as well as research issues related with enabling information technologies for electronic commerce are briefly discussed.

Electronic commerce, in its most general definition, refers to selling and buying on the net. In this context it is not an entirely new activity: Traditional electronic commerce through such means as electronic document interchange (EDI), bar code and interenterprise messaging has been an exciting and growing aspect of information and communication technology for several years. However since traditional electronic commerce relied for the most part on value-added networks (VANs) and private messaging networks which are relatively high cost and offer limited connectivity, the traditional electronic commerce never became a killer application.

On the other hand, the Internet has worldwide connectivity, is growing phenomenally in every aspect of our society, can be interactive, and is relatively inexpensive and is thus making the most exciting development for commerce in this century possible. The European Commission, in its Information Society initiative, sees Electronic Commerce as an all-embracing approach to conducting business electronically. Electronic commerce is based on a variety of technologies, most notably: interoperability; electronic catalogs; intelligent agents; workflow and process automation; and, security protocols.

However, electronic commerce services that are established so far are still far from being mature. There is no real integration of the underlying technologies, and the provided services lack many important but also more challenging features.

Moreover, each of the underlying technological areas poses significant open research challenges by itself. Major progress in the above mentioned key technology areas is necessary to bring electronic commerce to a more advanced form that should be promoted as a ubiquitous service. In this paper the current state-of-the-art and future research directions in the enabling technology areas are briefly discussed.

Electronic Commerce Business Models

There are several business models for electronic commerce (Timmers, 1997) some of which are:

- **e-shop**: Electronic marketing of goods or services of a company or a shop through an electronic catalog which usually includes the possibility of ordering and paying for the product as well as stock control.
- **e-mall**: E-mall is a collection of e-shops. Most of the electronic commerce tools (like, Microsoft’s commerce
server, or IBM’s commercePoint) contain facilities to build e-mails.

• E-commerce: E-commerce involves electronic tendering and procurement of goods and services usually practiced by large companies and public authorities. E-commerce may include electronic negotiation, contracting and ultimately collaborative specification of work.

• 3rd party marketplace: In this business model, the companies leave the Web marketing end of the operations to a third party. In its basic form this is a user interface to the companies product catalogues.

• value chain service provider: They specialize on a specific function for the value chain, such as electronic payments or logistics, with the intention to make that into their distinct competitive advantage.

• value chain integrators: They focus on integrating multiple steps of the value chain, with the potential to exploit the information flow between those steps as further added value.

**Interoperability**

The progress and wider dissemination of electronic commerce will be hampered by self-contained, closed markets that can not use each others services and incompatible applications and frameworks that can not interoperate. As an example, there is usually a need to access catalogs from different vendors. Furthermore, the catalog information need also be integrated with other computer applications like order entry, shipping, invoicing, inventory control, etc., to create a seamless electronic commerce system for the business. The differences and heterogeneities in such systems requires the handling of the interoperability problem. The interoperability architectures to be developed should be open and preferably be based on the mediator/wrapper paradigm where information sources are “wrapped” so that their interfaces to the outside world are uniform. Object-oriented technology can be used to realize mediator/wrapper paradigm. An object-oriented “communication bus” following Common Object Request Broker Architecture’s (CORBA) Object Request Brokers (ORBs) can be used in conjunction with the Internet environment for this purpose (CORBA 2.0 and IIOP with HTTP, HTML and Java).

Indeed, these set of technologies constitute the basis of some of the major electronic commerce platforms like Netscape ONE (Open Network Environment), Oracle’s NCA (Network Computing Architecture), IBM’s CommercePoint and Sun and JavaSoft’s Java Electronic Commerce Framework. Yet such systems must also interoperate at a business application level. A consumer or business should be able to shop for, purchase, and pay for goods and services offered on a different framework. CommerceNet, an industry consortium, has proposed the Eco System, a framework of frameworks for this purpose (Tanenbaum, 1997).

**Electronic catalogs**

Electronic catalogs integrate graphical front ends with product databases to allow users to browse merchandise using their computers. Electronic catalogs have the following advantages over their hard copy equivalents:

• They provide a company access to global markets without requiring physical presence.

• They save enormous amount of developing, printing, and distribution costs - Electronic catalogs can be updated as frequently as necessary with information about product announcements, special sales and inventory status in contrast to hard copy ones which become out dated shortly after their distribution.

• They are available to the customers 24 hours a day, 7 days a week.

• Electronic catalogs can be integrated with other electronic commerce applications like order entry, shipping, invoicing, or inventory control.

• They can contain full specifications of the products and can facilitate better customer service.

In the following the features commonly found in electronic catalogs are summarized:

• User Interface: Most electronic catalogs use the Web for their user interface but some use or plain text.

• Shopping Cart: Electronic shopping carts are analogous to their real-world counterparts. A customer may add or remove items from the cart, which usually keeps a running price total of its contents. In some cases, the electronic catalog can store the contents of a customer’s cart between sessions, or even provide the merchant with a profile of the customer’s buying habits. Shopping carts are a useful way for customers to keep track of purchases throughout the many pages of a Web catalog.

• Search Mechanism: Although products are usually arranged in categories for convenient browsing, most electronic catalogs include search tools to help the customer to find a product. Searches by keyword or product number are common. The most common forms of search are: List Method, Menu Tree, Database Query Form and Parametric search (Danish, 1998).

In the list method, a user is presented with a list of product numbers hyperlinked to a Web page. The user clicks
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