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Initiating a state of the art system for real-time supply chain coordination

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ABSTRACT

Intelligent Wireless Web (IWW) employs the capabilities of high speed wireless networks and exploits the parallel advancements in Internet-based technologies such as the Semantic Web, Web Services, Agent-based Technologies, and context awareness. Considering its great potentials to be applied in business systems, we have devised an innovative model, based on the IWW services, for a typical mobile real-time supply chain coordination system which has been developed and tested in a real operational environment. Our article investigates the proposed system in this way: at the start, the building blocks of the IWW are discussed in detail. Then, we fully explain the basic concepts of mobile real-time supply chain coordination and concentrate on the motivations to implement such a modern system. The vision of intelligent wireless web services, as discussed in this paper, centers on the need to provide mobile supply chain members highly specific data and services in real-time on an as-needed basis, with the flexibility of use for the user. In this regard, we investigate nine enabling technologies of the IWW for our system and discuss how, by exploiting the convergence and synergy between different technologies, it has become possible to deliver intelligent wireless web support to mobile real-time supply chain coordination. Afterwards, a practical framework is clearly established in four phases. This initiative system has been implemented in the laboratory and has passed the evaluation processes successfully. Further details will be announced in near future in another research article.

1. Introduction

A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers [1]. The International Center for Competitive Excellence [2] defined it to be "the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders". Effectively integrating the information and material flows within the demand and supply process is the main concern for Supply Chain Management (SCM). The potential for improved productivity, cost reduction, and customer service are enormous [3]. Of course, the benefits are based on effectively employing the right processes and supporting information technology. This is a higher priority than ever before [4,88].

The global extension of many supply networks means that their members are increasingly geographically dispersed working across time zones, numerous organizational boundaries, and a variety of cultures. These teams are often quickly brought together and coordinated in nearly real-time to deliver a production project or a special service within limited time and resources. At the same time, the coordination processes that chain members are engaged in, have increased in complexity in the recent years and have become more information-intensive. Very often chain members are involved in several supply processes at the same time. Under these circumstances, communications and real-time coordination between mobile and distributed supply chain members is difficult, making the need for an efficient communications infrastructure that provides reliable on-demand access to both supply process information and related personnel more acute [5].

Recent trends towards the convergence of wireless communications and Internet-based technologies have the potential to open new avenues of mobile collaboration, thereby minimizing the impact of the physical dispersion of supply chain members. In the recent past, a wide range of portable wireless devices have emerged based on personal area networking (e.g. Bluetooth), Local Area Networking (e.g. IEEE 802.11), and Wireless Wide Area Networking

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(e.g. GSM, GPRS, 3G). Parallel advances in other Internet-based technologies such as the Semantic Web, Web Services, Agent Technologies, coupled with the improved wireless bandwidth and the ability to better capture context information can efficiently be used to support *mobile real-time supply chain coordination*.

Intelligent Wireless Web integrates artificial intelligence and wireless technology into the World Wide Web in order to make it more powerful and more tuned to the real needs of the user [6].

This paper starts by inquiring into the vision of the intelligent wireless web-based services. In Section 2 we have provided the building blocks and envision of the IWW. In Section 3 the reader can further enhance his knowledge of what "mobile real-time supply chain coordination" is and what is expected from it. In the following section, in nine sub-sections, we have presented the results of our research on the role of the IWW as the most appropriate enabler of MRSCC and discuss its implementation impacts, coordination mechanisms and strategies. It provides the necessary understanding for the realization of intelligent wireless web services applied in our framework for a typical MRSCC architecture in Section 5. In that section, the suggested architecture will be explained and discussed in full details from different points of view. Both technological and semantic integration concerns are covered, a practical, comprehensive scenario to implement the MRSCC system is specified, and a discussion on the aspects of intelligent response is provided. Our paper ends with the concluding remarks regarding this futuristic subject matter.

2. The Intelligent Wireless Web (IWW)

2.1. Building blocks

IWW is defined as a "network that provides anytime, anywhere access to information resources with efficient user interfaces and applications that learn and thereby provide increasingly useful services whenever and wherever needed" [6]. The idea of IWW goes beyond merely connecting mobile devices to the Internet. It encompasses the creation of a pervasive, user centered mobile work environment, which has the ability to provide highly specific data and services to users on as-needed basis (i.e. in real-time), by intelligent interpretation of the user context. Table 1 illustrates the key building blocks of the IWW [86].

2.2. The envision of World's next generation web–IWW

To envision the future of the web (i.e. *IWW*), perhaps it would just take some basic knowledge, a little imagination, a dash of adventure, and pinch of insight. We might find that it is as easy as one, two, and three [6]:

Table 1
Building blocks of the IWW

	Building block	Role
1	Existing desktop based infrastructure	Separation of data from presentation and applications
2	High bandwidth wireless technologies	Provide the vital communication between the wired back-end and the wireless front-end
3	Semantic intelligence	Enabling knowledge description (using ontologies) and knowledge access
4	Web services	Ensure dynamic discovery of resources and resource integration
5	Agents	Plays the key role in addressing issues such as security, negotiation, personalization and procurement

(1) we merge the Next Generation Internet (NGI) with Internet2,
(2) we experiment with interactive intelligent programs, and
(3) we improve the user interface with speech recognition, while extending connectivity through wireless devices.

That is the future of the web—a combination of broadband delivery, innocuous interfaces, and ubiquitous access—and all with interactive intelligence. Eventually, all this is not only possible, but highly likely. However, foreseeing such an end point 1–5 years in the future is one thing, and developing a credible scenario for achieving that result is something else. Let us try to put together some of the pieces to fashion the necessary credible scenario.

2.2.1. Merging Next-Generation Internet (NGI) and Internet2

The Next-Generation Internet (NGI) initiative is a multi-agency Federal research and development program that is developing advanced networking technologies, developing revolutionary applications that require advanced networking, and demonstrating these capabilities on test-beds that are 100–1000 times faster, end-to-end, than today's Internet.

The key distinction between the NGI initiative and Internet2 is that NGI is led by and focuses on the needs of the federal mission agencies, such as DoD, DoE, NASA, NIH, and others, while Internet2 is university based through grants.

However, the NGI program focuses on some of the same emphases as Internet2 [6]:

- Advanced infrastructure development (i.e. networks that can perform at much greater levels than today's commercial Internet).
- Advanced applications development.
- Research into technologies that will enable advances in infrastructure and applications.

The NGI and Internet2 will help ensure that advanced networking services are available on interoperable backbone, regional, and local networks that are competitively provided by multiple vendors. Progress in this area is proceeding rapidly and we are likely to see significant results in the next 1–3 years.

2.2.2. Experiment with interactive intelligent programs

For the most part, the web can be considered to be a massive information system with interconnected databases and remote applications providing various services. While these services are becoming more and more user oriented, the concept of smart applications on the web is still in its infancy. So, how will adding intelligent agents, smart applications, and Artificial Intelligence (AI) programs to web sites, contribute to the development of the Intelligent Web?

2.3. Developing the IWW

Developing the Intelligent Wireless Web requires the compatibility, integration, and synergy of the following five technology areas [9]:

User Interface – from mouse and keyboard to speech;
Personal Space – from wired to multifunction wireless devices;
Networks – from wired to an integrated infrastructure;
Protocols – from Internet protocol (IP) to the Mobile IP; and
Web Architecture – from HTML/XML to Semantic Architecture.

Table 2 describes these technology areas in details [87].