Logistics Informatics and Its Practice in China

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Outline

- The University and the School
- Logistics in China
- Logistics Information Technologies
- Logistics Information Systems
- A Case: Container RFID Systems in Chinese Port
- Some Observations
Beijing Jiaotong University (BJTU) is a university with over 100 years history known for its subjects in logistics, traffic, information, communications, management and etc.

School of Economics and Management (SEM) at BJTU is one of the largest school in China in these areas, in the sense of consisting of over 180 faculty and staff members and 4000 students (over half are post-graduated).

SEM at BJTU is one of the oldest school in China in these areas, which may be traced back to the beginning of 20th Century.

The subject of logistics in SEM at BJTU, was ranked number 1 in China in 2006 & 2007.
The University and the School (2)

- **Call for Papers**
  13th International Conference on Enterprise Information Systems (ICEIS2011)

- **Venue**
  Beijing, China

- **Important Dates**
  Conference date: 07-10 June, 2011
  Regular Paper Submission: January 25, 2011
  Authors Notification (regular papers): March 25, 2011
  Final Regular Paper Submission and Registration: April 04, 2011

- **Sponsor**
  ICEIS is sponsored by INSTITCC – Institute for Systems and Technologies of Information, Control and Communication

- **Local Host**
  Beijing Jiaotong University
In 2007, the foreign trade of China reached US$2.17 trillion, with a growth rate of 23.6%, which was 4.3 times the number of 2001.

In 2007, the containers throughput in Chinese ports reached 100 million TEU, ranking world No.1 in 5 consecutive years.
China - ROK

- In 2007, the bilateral trade volume reached US$160 billion, with a growth rate of 19% compared to the previous year. China is the ROK’s No.1 trade partner and export market.
- The machinery and electrical products are the most important import items for ROK.
China Overview – Agricultural, Industries, Commercial, Economic

Logistics in China (3)

North West China
- Agricultural Products
- Dairy Products
- Minerals
- Low end manufactures
- Raw Materials, cotton
- Plants, forests

North China
- Home Appliances
- Garments, Textiles
- Auto, Motor Cycles
- Coal, Minerals
- Raw Materials, wool
- Agricultural

Central & S.W. China
- Home Appliances
- Garment, Textiles
- China Wares
- Dairy Products
- Agricultural Products
- Raw Materials, cotton
- Minerals
- Plantation ……

South China
- Hi Tech Products
- Garments, Apparels
- Auto Industries
- Agricultural
- Light industries

North East China
- Heavy Industries,
  Ship Building
- Auto and parts
- Agricultural

East China
- Hi Tech Products
- Hi-end
- Garments, Toys
- Auto Industries
- Agricultural

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Current Economic Development – Zones

Bohai Bay Area (BBA)
- Beijing
- Tianjin
- Shijiazhuang
- Qingdao
- Dalian
- Xian
- Jinan

Yangtze River Delta (YRD)
- Shanghai
- Ningbo
- Suzhou
- Wuxi
- Kunshan
- Nanjing
- Hangzhou

Pearl River Delta (PRD)
- Guangzhou
- Yantian
- Dongguan
- Zhuhai
- Zhongshan
- Hongkong
- Shenzhen
- Macau

Bohai Bay Area – around 20M TEU
Yangtze River Delta – around 20M TEU
Pearl River Delta – nearly 50M TEU
What Is the Future of Chinese Logistics?

- Green SCM
- Green Logistics
- Green Industrial Cluster
- Agricultural Technology
- Standardization & Systematic Improvement
- Servicing Industry & Industrial Chains Integration
- Sourcing Optimization, Integration ……
- Code of Conduct & Corporate Governance
- Electronic Commerce
- Service Science
- Much More …………..

Logistics Information Technologies and Systems!
Logistics Information Technologies and Systems!

- Efficiency is the Goal
- Benefit Is the Result
- Logistics Information is not only a technology or system, but more importantly, a new management mode.
Logistics Information Technologies (1)

Logistics Information Technologies = IT + Logistics
Smart Dust

- A self-contained, millimeter-scale sensing and communication platform for a massively distributed sensor network.
- The device will be around the size of a grain of sand and will contain sensors, computational ability, bi-directional wireless communications, and a power supply, while being inexpensive enough to deploy by the hundreds.

Applications
- Logistics
- Smart living space
- Remote terrain traffic monitoring
- Entertainment
- Building, large structure monitoring
- Battlefield, natural resources monitoring
## Logistics Information Technologies (3)

### WSN Standardizations

<table>
<thead>
<tr>
<th>Standard</th>
<th>Standardization Body</th>
<th>updates</th>
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<tbody>
<tr>
<td>802.15.4</td>
<td>IEEE</td>
<td>Initial version 2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last Revision 2006</td>
</tr>
<tr>
<td>ZigBee</td>
<td>ZigBee Alliance</td>
<td>Initial version 2004</td>
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<tr>
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<td>Last revision 2007</td>
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<tr>
<td>6lowPAN</td>
<td>IETF</td>
<td>Published draft RFCs 2007</td>
</tr>
<tr>
<td>WirelessHART</td>
<td>Hart Communication Foundation</td>
<td>Released 2007</td>
</tr>
<tr>
<td>SP100.11a</td>
<td>ISA</td>
<td>Draft standard 2007</td>
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<tr>
<td></td>
<td></td>
<td>Released expected Q1 2009</td>
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<td>Z-Wave</td>
<td>Z-Wave Alliance</td>
<td>Released</td>
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<tr>
<td>Wavenis</td>
<td>Wavenis Open Standards Alliance</td>
<td>Alliance launched 2008</td>
</tr>
<tr>
<td>WiBree / Bluetooth Low Energy</td>
<td>WiBree Forum / Bluetooth SIG</td>
<td>Specification expected 2009</td>
</tr>
</tbody>
</table>


Light Wight TCP/IP Stack
Seamless Connection of WSN and Internet
Global Positioning System

GPS determines location by computing the difference between the time that a signal is sent and the time it is received. GPS satellites carry atomic clocks that provide extremely accurate time.
Geographic Information System

GIS is a System of computer software, hardware and data, and personnel to help manipulate, analyze and present information that is tied to a spatial location –

- **spatial location** – usually a geographic location
- **information** – visualization of analysis of data
- **system** – linking software, hardware, data
Vehicular Communications

- WiMAX / IEEE 802.16
  - 4.2.1 WiMAX Development in the World
  - 4.2.2 Technology Specification of WiMAX and WiBro
  - 4.2.3 WiMAX Testing and Certification
  - 4.2.4 WiMAX/WiBro Future Prospect

- MBWA / IEEE 802.20
  - IEEE 802.20 Mission and Project Scope
  - IEEE 802.20 Related News

- DSRC - Dedicated Short Range Communication

- AD HOC

- The Applications for Vehicular Communication Systems
Logistics Information Technologies (8)

- Bar-Code
- …...
- EDI, WebEDI, XML/EDI
- Internet
- …...
- RFID
- EPC
- …...
- Toll-Road passive transponder
- Consumer product identifier
- Drug/Food shelf-life and identification
- Quality goods identification
- …...

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A Survey of RFID Priority Application Areas in China

Percentage of interviewee

<table>
<thead>
<tr>
<th>Application Area</th>
<th>Percentage</th>
<th>Priority</th>
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<tr>
<td>Inventory Management</td>
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<td>Warehouse Management</td>
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<td>Indent Management</td>
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<td>18</td>
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<tr>
<td>OOS Management</td>
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<td>Transportation/Logistics Tracking</td>
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<td>23</td>
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<tr>
<td>Capital Tracking</td>
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<tr>
<td>Cargo Burgling Management</td>
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<td>Requirement Planning</td>
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<td>Customer Requirement</td>
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Logistics Information Systems (1)
Logistics Information Systems (2)

- MIS, MRP / MRP II, QR / ECR, EOS, TQC, CIM, BPR, ERP
- CRM, KM, DW / DM, AMT, JIT, SCS, ESCM
- WMS, TMS, DRP
- VMI (Vendor Managed Inventory)
- SMI (Jointly Managed Inventory)
- CFAR (Collaborative Forecast And Replenishment)
- CPFR (Collaborative Planning, Forecasting and Replenishment)
- SAAS, SOA
- Grid Computing / Grid Management

Information Replaces the Inventory
Logistics Information Systems (3)

Tracking of Cool Logistics Chain

- Cold chain food
- Cold storage, boxes
- Cold warehouse
- Production enterprises
- Logistics enterprises
- Retail enterprises
- Government agencies

RFID, 802.15.4...
Sensor network

Internet
3G, 3S...

Browser, client, mobile, in-vehicle equipment, handheld computer

- Transport
- Storage
- Monitoring
- Tracking
- Warning
- Forecasting
- Analysis
- Optimization

Finance management system
Decision support system
Video management system
Transportation management system
RFID/DPS management system
GPS management system
呼叫服务中心系统

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Roadside Communications for Road Haulage Operations
Logistics Information System in Chinese Post

Parter Information System

Client Information System

Postal Logistics Website

Cnpl.com.cn
邮政物流网站

185 Call Center

185物流呼叫中心

中国邮政物流综合信息网

中国邮政物流区域信息中心

Regional Information Center

GPS Controller

GPS控制中心

中国邮政物流全国信息中心

中国邮政物流区域信息中心

Regional Information Center

National Information Center

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RFID System

**RFID Hardware Domain**
- Tags
  - Device consisting of an electronic circuit and integrated antenna
  - RF used to transfer data between the tag and the antenna
- Antenna
  - Receives and transmits the electromagnetic waves
  - Wireless data transfer via air interface
- Readers
  - Communicates with the tag via antenna
  - Provides power supply to passive tags
  - Translates radio waves into digital information

**RFID Middleware Domain**
- "Middleware"
  - Reads/writes data from/to the tags through the reader
  - Filters, stores and evaluates obtained data against business process
  - Links the transceiver to applications, e.g. ERP

**Business Application Domain**
- Business Applications
  - Owns master data and business logic
  - Drives business process

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Logistics Information Systems (7)

RFID Applications

I: Material Processing
- Suppliers
- Assembly
- Fabrication

II: Supply Chain
- Shipping & Wholesale
- Distribution
- Warehouse

III: Storefront
- Receiving
- Sales Floor
- Point of Sale

IV: Consumer
- Home Appliances

V: Public Places
- Shopping Mall
- Airport
- School
- Hotel

VI: Enterprise
- Asset Management
- Tolls & Parking
- Smart Credit Cards
- Environment Monitoring
- Laundry
- Staff Location

VII: Specialized Uses
- After-Market
- Manufacturing
- Retail

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文献资料查询界面

在法国高铁GIS图上点击查询LGV东南线

在德国高铁GIS图中点击查询柏林站

Data Base of High Speed Railway
Logistics Information Systems (9)

Logistics Information Systems of Ports
A Case: Container RFID Systems in Chinese Ports (1)
“2 Ports & 1 Line” Container RFID System

------- First Line of Containers with Full RFID System in China and maybe in the world

• This subject team has formally started the industrial trial named as “2 ports & 1 line” on Dec 3, 2005.

• The first line of containers with RFID----”Zhehai 325 Shipping” in China has been formally started.

• This line from Shanghai Port to Yantai Port has absolutely shown automatic identification and real-time information exchange in container shipping.

• By Jan 19, 2006, the container throughput of this demonstrative line has reached 5294TEU.
General frame of the demonstration line

Application & demonstration line of “2 ports & 1 line” 5000TEU

E-seal

Container RFID automatic identification system

Middleware

Make out standard

Information real-time exchange system

Tag

Reader

Antenna

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The first regular container ship "Zhehai 325 Shipping " with RFID drive to Shanghai from Yantai
Structure of RFID automatic identification application system

- Real-time Information Exchange System
- Wired or wireless Communication System
- Container RFID Automatic Identification System
- Data Input System of Container Stuffing Point
Port safety management technology based on RFID automatic identification system

- Establish multi-level safety system as required by container RFID demonstration system and establish safety certification system and log analysis system;
- Research on information transmission safety technology at aerial connector between tags and reader, realize information encrypt storage and transmission and identify authorized write when read-write operation to tags;
- Research on encrypt technology of information communication between the reader and host computer;
- Research on safety insurance technology of information transmission between wireless communication systems
- Research on safety supporting system in container information real-time exchange system.
Key Technology & Equipment

- Choice on frequency range
- Anti-impact design of RFID in container
- Reliability analysis on reader
- Container Tag
- Container E-seal
- Equipment for information transcription
- Fixed reader
- Wireless reader
- E-Sentinel
- Middleware of RFID system in container
Container tag

- Adopt ISM 2.4GHz for working frequency range
- Active tag, its operating distance 0~30m is adjustable and readable, memory capacity is 32k byte
- Unique super-low power consumption technology with a life span of 10 years
- High safety data transmission system, dissymmetry encrypt/deciphering
- Solid sealing and reliable anti-dismounting
Logistics information contained in a RFID tap

- information of container
- information of cargo
- other information: information of ship, port, cargo agency...
- on-off time of container
- address of container when open/closed (connect with GPS)
- physics information of container, such as temperature, humidity
Container E-seal

- First time to realize data carrier of multi-source amalgamation of container logistics, information flow and safety flow
- Adopt ISM 2.4GHz for working frequency range
- Support trespass on and automatic monitoring & event record of door opening & closing
- Support sensor units such as bus extended temperature, humidity, vibration, etc.
- Encrypting calculation and certification to ensure data safety and prevent from wiretapping or data breaking
- Adopt frequency range seclusion to avoid interferences among multiple equipment
- Advanced anti-collision technology
- Possible to equip with microwave module working mode and radio frequency software is adjustable
- 5-second mount and dismount without tools at container gate
Equipment for information transcription

---- Adopt portable computer or hand-held PDA

- Adopt ISM 2.4GHz for working frequency range
- Read/write module adopts PCMAC interface mode and notebook to realize both-way communication or adopts CF interface mode and PDA to realize both-way communication.
- Encrypting calculation and certification
- Adopt frequency range seclusion to avoid interferences among multiple equipment.
- Anti-collision technology to support multi-label read and write
- Possible to equip with microwave module working mode and radio frequency software is adjustable
An Illustrative Case: Container RFID Systems in Chinese Ports

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- Adopt ISM 2.4GHz for working frequency range
- Support RS232/485 wire mode and upper machine communication
- Encrypting calculation and certification to ensure data safety and prevent from wiretapping or data breaking
- Anti-collision technology to support multi-label read and write
Wireless reader

- Adopt ISM 2.4GHz for working frequency range
- Support wireless mode and upper machine communication, match with bridge of container RFID system for use
- Support wireless visiting in local area space under sentinel mode
- Encrypting calculation and certification to ensure data safety and prevent from wiretapping or data breaking
- Adopt frequency range seclusion to avoid interferences among multiple equipment
- Anti-collision technology
- Possible to equip with microwave module working mode and radio frequency software is adjustable
Middleware of container RFID system

- Application process
- Afford logical data and event
- Middleware
- Receive original REID data
- Realize filtration, release and message
- Tags
- ID, content & message

- Reader
- Visit tags
- Wireless channel

- Reader

- Wireless channel
Three technical standards related to port RFID in container has been completed.

1. Technical specifications on RFID in container
2. Specification of memory information coding of container RFID
3. Technical specification of container shipping information in domestic trade

We are authorized by National Standard committee of China to draft out “Container RFID Technology Criterion in domestic trade” (20067084-T-469). We will establish the National Standards based on the practical and proof-tested data of the trials.

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Sequelae

- “Shanghai port in China - Savannah port in the USA” container RFID application line in June, 2007, which is supported by the project “Logistics Service Demonstration Application of Modern Port” (2006BAH02A17) of National Key Technology R&D Program of China.

- “Shanghai port - Chongqing port” container RFID application line in July, 2007, which is supported by the project “Container RFID Technology Development and Application” of National Westward Construct Program of Ministry of Communication of China.

- “Shanghai port in China – Europe port” container RFID application line in the last months of 2007,
Port to Port

堆场 yard

装船 Loading

卸船 Unloading

进出/道口 Enter Port

进出/道口 Gate

服务器 Server

港口 port

堆场 yard

服务器 Server

港口 port

进港日期 2010/9/17
A Case: Container RFID Systems in Chinese Ports (20)

CFS to CFS

Container stuffing point

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New generation intelligent container RFID tag

- Ability to store supply chain related container information including: carrier, container ID, owner, terminals, Customs, inspections etc.
- Ability to automatically store time and date of sealing and unsealing
- Ability to automatically store the location of sealing and unsealing (this is achieved through the location of the reader that captures the sealing and unsealing event, including PDA)
- Multi-frequency
New generation intelligent container RFID tag

The e-tag we designed can be used with the original mechanical seal without any infection.
Handset and PDA with GPS function

- Can read and write tags
- Integrate GPS, and can write its geography position information into tag
New trends in Chinese Logistics Informatics

• Logistics information systems will be developed by closely combining with the true situation of Chinese logistic companies, and WMS, TMS will become the hot areas in near future.

• Logistics information systems will be “uniform” and “centralized” instead of “isomerous” and “dispersive”.

• The integration and development of third-party logistics information systems will play a key role in logistic customer service area.

• Security approaches against disastrous failures of logistic information systems will become more and more important in logistic companies.

• RFID technologies and products will be widely applied in logistics industry.
Some bottlenecks in Chinese Logistics Informatics

• Low level of the application of information technologies and systems, especially in the small/middle size Chinese enterprises.
• Lack of logistics information technologies and products with own IPRs.
• The developers of logistics information systems can hardly make benefits, because most of the systems are independent and dispersive.
• The infrastructures for basic information and public service platform develops very slow.
• Lack of development stratagem.
谢谢！

Thanks!