**BTFS: The Border Trade Facilitation system**

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**System Description:**

We will demonstrate the Border Trade Facilitation System (BTFS), an agent-based bilingual ecommerce system built to expedite the regulation, control, and execution of commercial trans-border shipments during the delivery phase. The system was built to serve *maquilas* industries at the US/Mexican border. The BTFS uses foundation technology developed here at Sandia Laboratories' Advanced Information Systems Lab (AISL), including a distributed object substrate, a general-purpose agent development framework, dynamically generated agent-human interaction via the World-Wide Web, and a collaborative agent architecture. This technology is also the substrate for the Multi-Agent Simulation Management System (MASMAS) proposed for demonstration at this conference. The BTFS executes authenticated transactions among agents performing open trading over the Internet. With the BTFS in place, one could conduct secure international transactions from any site with an Internet connection and a web browser. The BTFS is currently being evaluated for commercialization.

In 1997 the AISL completed a prototype of the Border Trade Facilitation System (BTFS), a collaborative information processing environment that operates on the Internet and World-Wide Web. The BTFS comprises multiple autonomous software agents that assist human actors in conducting international shipping transactions by creating, documenting, monitoring, and coordinating shipment transactions in information space.

The BTFS prototype demonstrates a multi-agent approach to coordinating a complex, knowledge-intensive shipping process. We have demonstrated the following agent behaviors: elicitation, mediation between ontologies, negotiation, delegation, monitoring, goal satisfaction, and conduct of an authenticated negotiation protocol for commercial contracts. A typical trans-border documentation package includes one to two dozen Spanish and English forms. The BTFS allows a registered user to fill out the core documentation set and execute the border crossing paperwork.

The essential concept of the BTFS is that the physical trans-border shipment of goods and the required accompanying certification are entirely represented as a set of events in information space, the state of which both controls and certifies events in physical space. The BTFS information system contains a real-time transaction-centric model of the physical border-crossing process. The BTFS design is based on...
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three general concepts: (1) creation of a distributed object programming environment with an underlying secure network infrastructure; (2) a distributed object representation of a shipping transaction; and (3) insertion of knowledgable software agents at critical points in the information flow.

The BTFS is supported by the AISL’s distributed object programming system DCLOS (Distributed CLOS) that provides a seamless design methodology for networked object environments. DCLOS is essential to networking agents in a collaborative environment. DCLOS also supports a shared fragmented workpiece object. The information needed to effect a single shipment is captured in a complex distributed information structure with compositional semantics called the Maquila Enterprise Transaction (MET). The components of a given MET are distributed among the agencies involved in a particular shipment; no one agent or agency has access to all components. The MET is shared via proxy; when a given agent needs MET information, it is handed a MET proxy. Access is permitted based on task requirements and controlled by electronic signature. BTFS agents interact with the border-crossing process by collecting and organizing information and posting it in the MET. Control of the distributed computation is decentralized and opportunistic. Each agent computes new information components based on its internal knowledge base and the state of the MET. Changes in the components trigger computations in a manner reminiscent of blackboard systems.

The framework comprises two associated abstract classes: agent and agency. An agency identifies an independent locus of processes, activities, and knowledge typically associated with some natural partitioning of the application domain. Agencies are collectives of agents that have ongoing high-level goals stated in business terms. In particular, the BTFS is a distributed set of agencies specialized on the commercial functions of the various stakeholders in the border-crossing process. The underlying assumption is that the application is naturally modeled as a group of interacting agencies, certainly true for the BTFS.

An electronic commerce agency (ECA) is a specialized subclass of the agencies class that implements architectural features specific to ecommerce applications. An ECA has the additional attributes of transactions and organizations. The transactions attribute holds a collection of open and closed transaction objects. The organizations attribute holds a collection of public proxy objects pointing to agencies that represent trading partners.

The BTFS agent society comprises several federated ECAs analogous to the interested business entities. Each ECA is populated by a heterogeneous collective of speciated agents, each of which is able to perform a fragment of the information tasks needed to effect trans-border shipment. Their exact duties are based on the idiosyncratic business rules of the actual businesses involved, so an operational ECA must be tailored and situated for each business. Constructing the ECA and the agents that make it up consists in specializing agents from a set of standard agent classes constructed for commerce. ECA classes are also pre-defined for the various required roles: originator, receiver, transport provider, and import/export broker.
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Submitted for Demonstration:
The Border Trade Facilitation System (BTFS)

System Description:

We propose to demonstrate the Border Trade Facilitation System (BTFS), an agent-based bilingual e-commerce system built to expedite the regulation, control, and execution of commercial trans-border shipments during the delivery phase. The system was built to serve maquila industries at the US/Mexican border. The BTFS uses foundation technology developed here at Sandia Laboratories’ Advanced Information Systems Lab (AISL), including a distributed object substrate, a general-purpose agent development framework, dynamically generated agent-human interaction via the World-Wide Web, and a collaborative agent architecture. This technology is also the substrate for the Multi-Agent Simulation Management System (MASMAS) proposed for demonstration at this conference. The BTFS executes authenticated transactions among agents performing open trading over the Internet. With the BTFS in place, one could conduct secure international transactions from any site with an Internet connection and a web browser. The BTFS is currently being evaluated for commercialization.

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**Hardware requirements:**

A large (your choice, I recommend at least 17 inch) multisync monitor
Border Trade Facilitation System (BTFS)
Storyboard

1. Sign on to BTFS; opening screen
2. Initiate transaction for shipment
3. Contact transport firm; arrange for transportation
4. Fill out required forms (a)
5. Fill out required forms (b)
6. Initiate verified transaction; inspect open transactions

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The Border Trade Facilitation System is a WWW-based electronic commerce application whose function is to promote cooperation among U.S. agencies and their Mexican counterparts and to expedite traffic across U.S. borders.

Border Crossing Process

Process Roadmap

Maquiladora Enterprise Transaction
2. Initiate transaction for shipment

Border Trade Facilitation System

Maquiladora Enterprise Transaction

ACCEPT CONTRACT?
• YES  • NO

Date: 5/27/97

CARRIER: Contract Freighters, Inc.

Invoicing Number: T07478

ITV PROVIDER: Contract Freighters, Inc.

ORIGINATOR: Wire Components S.A. de C.V.

CONSIGNEE: New Mexico Motors, Inc.

ORIGIN: Industrial Park Plant

DESTINATION: West Albuquerque Warehouse

SHIPMENT MANIFEST

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Count</th>
<th>Container</th>
<th>Description</th>
<th>Qty./ Cont.</th>
<th>Net Weight (lb.)</th>
<th>Gross Weight (lb.)</th>
<th>Value($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25252-1</td>
<td>112</td>
<td>cartons</td>
<td>Wiring Assembly</td>
<td>200</td>
<td>392</td>
<td>443</td>
<td>77038.72</td>
</tr>
</tbody>
</table>

PLAN ROUTE:

Departure Date: 5/27/97
Departure Time: 0830
Departure Window: + or - 15 min

Arrival Date: 5/27/97
Arrival Time: 1300
Arrival Window: + or - 30 min

Driver: Abbot, Joseph

Ports of Exit/Entry: San Gerardo - Santa Teresa

Waypoints: Las Cruces → Deming → Silver City → Albuquerque

3. Contact transport firm; arrange for transportation
4. Fill out required forms (a)

**Iniciar un Nuevo Pedimento de Exportación**

- **Fecha de Pago:** 27/5/97
- **Tipo de Operación:** Z
- **Fecha Present:** 27/5/97
- **R.F.C.:** HPR841204JIN
- **Nombre:** Wire Components S.A. de C.V.
- **Domicilio:** 1281 Porque Industrial Juárez
- **Ciudad/Estado:** Ciudad Juárez, Chih.
- **Clave Pedimento:** 8776-700001
- **Carretera:** 7
- **Moneda Extranjera:** 1
- **Transporte:** Carretera
- **Peso:** 201 kg.
- **No. Pedimento:** M1
- **Tipo de Operación:** 2
- **Correo:** Al
- **T.C.:**
- **Aduana:** 072 Fact ox
- **Tipo de Moneda Extranjera:** 1
- **Fecha Factura:** 27/5/97
- **Importe:** $1250.00
- **Firma de exportador:**
- **Nombre:** New Mexico Motors, Inc.
- **Domicilio:** 2345 Eubank NE
- **Código:** 87123
- **Sellos:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Descripción de Mercancía</th>
<th>Precio Unitario</th>
<th>Comercial</th>
<th>Tasa</th>
<th>Impuesto</th>
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<tr>
<td>1</td>
<td>Ensamblaje de Cables</td>
<td>357.09</td>
<td>77538.72</td>
<td>0.9</td>
<td>0.9</td>
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**Contribuciones:**

- **DTA:** 0

**Sello:**

- **Firma de exportador:**
- **Nombre:** Jaime Gonzalez
- **RFC:** GOJH-560813
- **Firma de agente:**
- **Agregue 1 línea:**
- **Analice,** **Guarde,** **Termine,** **Resetea**
- **Desechar**

**Destino/Origen:** Frontera Mexicana
5. Fill out required forms (b)

**DEPARTMENT OF THE TREASURY**

**UNITED STATES CUSTOMS SERVICE**

**Entry/Immediate Delivery**

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Arrival Date</td>
<td>5/27/97</td>
</tr>
<tr>
<td>Elected Date</td>
<td>5/27/97</td>
</tr>
<tr>
<td>Entry Type</td>
<td>Single</td>
</tr>
<tr>
<td>Report Code/Name</td>
<td>New Mexico Motors</td>
</tr>
<tr>
<td>Location of Merchandise</td>
<td>Santa Teresa, NM (2408)</td>
</tr>
<tr>
<td>Manifest Number</td>
<td>112</td>
</tr>
<tr>
<td>Description of Merchandise</td>
<td>112 cartons of wiring assembly</td>
</tr>
<tr>
<td>Manifest Quantity</td>
<td>112</td>
</tr>
<tr>
<td>Total Value</td>
<td>77538.72</td>
</tr>
<tr>
<td>Other agency action required, namely:</td>
<td></td>
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</table>
6. Initiate verified transaction; inspect open transactions

<table>
<thead>
<tr>
<th>Trans.No.</th>
<th>Priority</th>
<th>Destination</th>
<th>Description</th>
<th>Status</th>
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<tbody>
<tr>
<td>EU-1923</td>
<td>URGENT</td>
<td>ACSA/Mexico</td>
<td>Eureka, Switches, Part No. 234455, for El Paso Distribution</td>
<td>NEW</td>
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<tr>
<td>EU-2324</td>
<td>HIGH</td>
<td>El Paso Distribution</td>
<td>ACSA, Wiring Harnesses NO. WH-345566.</td>
<td>NEW</td>
</tr>
<tr>
<td>T07478</td>
<td>Normal</td>
<td>Albuquerque</td>
<td>W.C.S.A. 112 cartons Wiring Assembly</td>
<td>TRAN</td>
</tr>
</tbody>
</table>

\[\text{Current Transactions}\]