Cost-effective e-Government Services
Export Control System phase 2 (ECS2)

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Bulgaria-Korea IT Experts Workshop
Sofia, Bulgaria, 25.2.2010
Outline

- Who We Are
- What is ECS2
- Tools and Technologies
- Data Model
- Model-Driven Generation
- System Architecture
- Business Process Modeling and BPMS
- XPath-based DSL (Assignments, Rules and Conditions)
- GUI Generation and Features
- Deployment Model
What is ECS2
What is ECS2?

- Trans-European system involving 31 countries
  - Coordinated by DG Taxation and Customs Union (TAXUD)
  - Client: Bulgarian Customs Administration (BCA)
- Strict timeline. "Only" 6 countries were late. BG ECS2 was deployed on time on 1 July 2009
  - 11 months from start to production (some national functionalities finished 3m later)
  - Including Conformance Testing with EC (and fixing bugs in the CT!), deployment and training with BCA
  - Used intensively: currently handles 80-100,000 export movements (500,000 messages) per month.
  - Users: 3500 customs officers, 200,000 potential traders
  - Bulgarian Industrial Association is teaching traders how to use Electronic Declaration (paid trainings)
- Large project: 45 message types averaging 100 fields each, 50 Elementary Business Processes (EBP), 30 man/years of effort. Subsystems:
  - ECS2 Core: message processing (in/outflow), business process, persistence
  - ECS2 Web: customs officers data view/entry
  - DTI B2B: Direct Trader Interface for system-to-system electronic declaration processing
  - DTI Web: trader portal for interactive entry of electronic declarations (manual or XML from file)
  - Messaging: EU (CCN/CSI communication, Redix), DTI (db/webservices), BICIS (webservices)
  - Routing between ECS1 and ECS2 (complex transition period!)
  - Processing Reference Data, Customs Office List, Unavailability (RD/COL/UNA)
  - External system integration (BICIS, CAS, RA, SDM, EORI/AEO, TARIC, other gov agencies)
  - Printing (Single Administrative Document), Reporting
  - Administration (Core and DTI)
The Legacy: ECS1

- Big problems with project organization and software architecture
  - System development continued for 14 months after deployment, some parts never deployed
  - Big problems with stability, performance and bugs.
  - ITT was subcontractor, so we knew the business and all problems first-hand
- Problems with the tools used
  - Process Server: heavy XML munching leading to bad performance
  - Therefore no long-running processes and human tasks used → used as a data flow engine, not a real BPMS
  - Message Broker: used only for XML-XML conversion → not worth the overhead
- Architecture is not modular
  - Disparate technologies used for Core and DTI, different GUI technologies
  - All message munching is left to Process Server (Websphere Integration Developer)
  - Common steps such as validation, object construction, etc are not modularized
  - 50 disparate processes ("phases") of ~40 steps each: huge complexity, no reuse
    → Impossible to modify or extend

➢ Together with the client made the hard decision to rewrite ECS1, instead of trying to build on a shaky foundation
Our Approach

• Immediately (first 3 months) ran an architectural pilot
  • Evaluated IBM vs open source
  • Picking tools was the "easy part": trust nothing, try everything, be modern but not bleeding edge

• Finding the architectural approach was the hard part:
  • Too complex data → generation of as many artifacts as possible is key to consistent implementation.
  • Too much data → share sub-objects, copy/pass references only
    • Share data beans (stateful Hibernate session) between all core components
  • Too much processing → strict code modularization and factoring
    • All process-independent steps are done outside of the BPMS
    • Screens are reused between core and DTI systems as much as possible
  • Too many Rules & Conditions (250, revised daily) → invented XPath based DSL, the same R&C are used in offline and GUI interactive validation
  • Complex processes (and some unclear/buggy TAXUD specs) → design processes visually, clarify with client numerous times, implement in BPMS
Tools and Technologies

Selected Open Source or inexpensive tools, instead of proprietary expensive ones
Tools and Technologies

• Servers
  • JBoss AS 5.0.1: application server
  • JBoss Messaging: message queuing
  • jBPM 3.3: business process execution
  • Informix Dynamic Server 10 FC8: database server (client requirement)

• Tools
  • JBoss Tools 3.0: development IDE
  • Hudson: continuous integration
  • CheckStyle: static analysis, coding conventions
  • Subversion source control, EclipseSVN
  • TestNG 5.8: unit testing
  • DBUnit: database testing
  • MS Project: planning
  • Jira: task tracking
  • Visio: process modeling
  • Word: specification writing
  • Wiki: engineering notes / collaboration

• Frameworks/libraries
  • JBoss Seam 2.1: application framework, IoC container
  • EJB 3.0: object model
  • JPA/Hibernate 3.3.2: persistence and O/R mapping
  • JSF 1.2: web framework
  • Facelets: JSF templating engine
  • RichFaces 3.3: JSF AJAX library
  • JiBX 1.1: XML/Java binding (serialization/deserialization)
  • Dozer 4.4.1: object graph cloning (deep copy), used sparingly
  • JXPath 1.2: DSL for message assignments, R&C validation
  • Saxon 9: XSLT transformations
  • Jasper reports 3.1.3: reporting, printing
  • Single Admin Doc
  • Log4J: structured logging
Deployment Model

- Open Source operating system: RedHat Enterprise Linux
- Database: Informix
- Open Source Java Enterprise Edition stack: JBoss, JEE 6, EJB 3, JSF
- Centralized (ECS1 was semi-distributed)
- Dedicated servers (ECS1 shares server with 4-5 other applications, sometimes crashed)
Deployment Model
ECS2 System Architecture
ECS2 Backend Architecture

- All process-independent data munching, scrubbing and washing is done in one place, outside BPMS
ECS2 at Bulgaria-Korea IT Experts Workshop, 25.2.2010 (Sirma Solutions & Sirma ITT)

**BPM Specification (BPMN/Visio)**

Very well received by client

**etc**
BPM Implementation (jBPM)

- Implementation in jBPM follows closely the process specification.
- Most importantly, it is at almost the same level of abstraction (2-3x the nodes) because:
  - It doesn’t indulge in low-level data munging
  - All common steps are outside of BPMS
Model-Driven Generation
Generation Architecture

- Red: manual work
- Black: generated
Model-Driven Architecture

• The ECS2 architecture is heavily model-driven
  • The models are highly pragmatic and specific
  • You don't need expensive or heavy tools
  • All you need is Excel and a couple of good hackers

• UML models
  • We used sequence and activity diagrams for complex module design, class diagrams for illustration only
  • Message definitions are given in MS Access database: we want to use it directly, not transcribe it in a UML tool (would be too much work for too little gain)
  • Transcription leads to bugs like "n..5 is maxInclusive=5" that stop ships (ECS1 example)
GUI Frontend

Web 2.0 (JSF+AJAX), useful features, lots of generation, integrated Business Rules validation
GUI as Single Administrative Document (SAD)

- "Business payload" data laid out similar to paper form. Customs officers and traders know it by heart
- Pages split to Common (1) and Goods Item (up to 999)
- Layout made in Excel and the client can edit it
- Fields generated and laid out automatically
- Borders, backgrounds, fully zoomable
GUI: Generated from Excel

• Best news: the GUI is generated
• Presentation attributes from schema.xls, validations from R&C metamodel, layout from forms.xls, lists of values/links from codelist.xls.
• Very flexible and powerful. The client can edit any visual aspect. The client loves it.
Validation: Business Rules

Consider this rule:

Implementation in jxpath:

At the GUI: box 25 doesn't start with [257] so the field is Required (yellow). In this way the user can see all erroneous fields at a glance. AJAX implementation: submits & receives only the changes.

If the user hovers over the field, the tooltip gives error description (red text) and all details about the field (tag name, box number, description, format, even code list)

If an incoming message has this defect, the same rule implementation returns appropriate error message:

- The error description (ErrDes) is Bilingual:
  - BG in DTI messages to trader
  - EN in Common Domain messages
GUI: Features

- Hired a Usability consulting company (still most of the ideas are our own)
- Context-dependent "navbars" show important info
  - User, office, role
  - Number of movements per state in the current office, which are Quick Search links (*from CL9058*)
  - Currently selected movement (*sticks even if you switch office type*), with links to its data

- Full type, length, regexp, requiredness, codelist, rules validation (yellow: required unfilled, red: erroneous). Tooltip with details about the field (tag, name, description, box number, error)
- Electronic signatures (digital certificates) used for trader access and document signing

- The *same* forms are used for Customs Officer (ECS2 Web) and Trader (DTI Web)
  - The navbars ("chrome") vary per user kind (customs officer, trader) and roles/permissions
- Goods Pager: efficiently handles up to 999 goods, add item [+], direct jump, erroneous list
GUI: Features

- Highly interactive using AJAX triggers: changing a field causes *partial* submission, rules recalculation and *partial* refresh
- Web optimizations:
  - The GUI is fully zoomable, ensuring optimal use of screen resolution
  - CSS compliance, using a cross-browser CSS framework
  - XHTML doctype tagging, ensuring best browser compatibility mode
  - All resources (CSS, JS, images) are properly marked for caching, ensuring the browser caches them for 1 month and reduces traffic
  - Resource merge: all CSS and all JS files are merged, ensuring faster page processing time.
  - Resource versioning: the build date is added to each resource filename, ensuring the browser will refetch it.
  - HTTP compression: main pages (business content) are gzipped to reduce traffic. The largest page zips to 10kB.
- Web traffic optimization was critical to enable centralization of ECS2 Web
  - BICIS is distributed (120 instances across the country).
  - ECS1 Web is also distributed, while ECS1 Core is centralized, creating weird timeout problems
  - ECS2 is centralized and ensures fast response time, even though some remote Customs Offices have bad connectivity (64-128 kbps)
  - *Client's sysadmin loves it*. We love it too, it simplifies new version deployment immensely.
Direct Trader Input (DTI)

e-Services for Traders and other Government Administrations
DTI Channels and Architecture

- Two electronic channels:
  - DTI Web is a web portal where smaller traders can submit declarations interactively, receive replies, etc
  - DTI B2G is a system-to-system web-services interface

- Complies with BCA Security Policy
  - Connections can be initiated only from inside
  - Security zones that are strictly delineated through firewalls
  - Message queues transport data from outer to inner zones
  - B2G channel is protected by VPN that each trader must connect to

- About 80% of the software architecture of DTI is shared with ECS2 Core
  - Data model, data access layer, classes/objects
  - Backend architecture: message processing pipelines
  - GUI general layout, business forms and generation technology
  - Great wins in consistency and savings of effort
DTI Deployment Architecture

Level 1

Web Portal
Linux
Application Server
JBoss 5.x

DTI_ONLINE
DTI_Core

Level 2

Check Server
Linux
Application Server
JBoss 5.x

DTI_B2B

Level 3

Server
ECS2 Core

Firewall
HTTP(S)

VPN Server
HTTP

VPN Client
B2B Application
Trader System

External Domain

ECS2 at Bulgaria-Korea IT Experts Workshop, 25.2.2010 (Sirma Solutions & Sirma ITT)
DTI Scope: Actors, Messages

- Trader Declarant
- Office of Export
- Office of Exit
- Trader Carrier at Exit
- Trader Representative at Exit
- Person Lodging Summary Declaration
- Other Govt Admin
- Office of Lodgement

Connections:
- 515, 528
- 513, 504, 505
- 514, 509
- 560, 529, 551
- 582, 583
- 906, 599
- 599
- 507, 521, 561, 522, 525, 547, 548, 549
- 613, 605, 604
- 906
- 615, 628, 906
DTI Scope: Trader Processes

- Trader Declarant
  - communicates with Office of Export
- Processes
  - Declaration
  - Correction
  - Cancellation
  - Followup
DTI Scope: Trader Processes

• Person Lodging Summary Declaration and Trader Representative at Exit

• Trader Carrier at Exit
  • Export Operation
  • Exit Manifest
Successful processing of sendMessage WS call
DTI GUI: Forms as in ECS2 GUI

<table>
<thead>
<tr>
<th>Обект</th>
<th>Описание</th>
</tr>
</thead>
<tbody>
<tr>
<td>Идентификация</td>
<td>Акт от неправомерен или ненадлежащо използване на информация</td>
</tr>
<tr>
<td>Копия на дадена транспортна документация</td>
<td></td>
</tr>
<tr>
<td>Споразумение номер</td>
<td></td>
</tr>
<tr>
<td>Пазарен брой</td>
<td>Вид на товара</td>
</tr>
<tr>
<td>Опис</td>
<td>Направена услуги</td>
</tr>
<tr>
<td>Ул.</td>
<td>Назначение</td>
</tr>
<tr>
<td>Тел.</td>
<td>Детайли за услуги</td>
</tr>
<tr>
<td>Фактура</td>
<td>Назначение</td>
</tr>
<tr>
<td>Дата</td>
<td>Детайли за услуги</td>
</tr>
<tr>
<td>Реквизит</td>
<td>Разглежда работата</td>
</tr>
<tr>
<td>Имена</td>
<td>Детайли за услуги</td>
</tr>
<tr>
<td>Номер на задължение</td>
<td>Разглеждане работата</td>
</tr>
<tr>
<td>Дозволени за(Clone)</td>
<td>Разглеждане работата</td>
</tr>
<tr>
<td>Дозволени за(Clone)</td>
<td>Разглеждане работата</td>
</tr>
<tr>
<td>Дозволени за(Clone)</td>
<td>Разглеждане работата</td>
</tr>
</tbody>
</table>

| 56 | Общо бройна тегла | 134.000 |
| Hampton | Всичко се отговаря лична |
| 57 | Други тегла | 11 |
| Hampton | Стойността трябва да бъде число със знак, състоящо се от нула или повече числа, отделено по избор от десятична запетая и десетици числа, напр. 118.23 |
| Hampton | Общо бройно тегла (tota gross massa, TgGroMassFAC07, 35) |
| Hampton | Общо бройно тегла | 0 |

Формат числото със знак, състоящо се от общо 11 числа, максимално 3 от които след знака
DTI GUI: Message List

- Search by various fields
- Message status is indicated with an icon
- Trader can see only messages that "belong" to him
- Trader can review message as form or download XML content
DTI Security

- Requires prior registration with electronic signature, including Power of Representation
  - Shared for DTI Transit and DTI Export
- Uses electronic signatures for trader identification and document signing (non-repudiation)
- Supports any certificate provider with PKCS#11 API (Charismatic, Siemens, SafeNet, Datakey, ActivCard Gold, Setec SetWeb, Gemplus, Utimaco SafeGuard, ActiveKey, Aladdin, …)

- Ensures that traders can:
  - Only read messages that "belong" to them
  - Only send messages in their own name
  - Both Web (browser) and B2G (WS-Signature)
DTI G2G: Other Administrations

- G2G web service allowing other administrations to receive information about completed exports
  - National Revenue Agency (NRA): for VAT payback
  - *The only system-to-system connection between NRA and BCA*
  - National Agricultural Fund: CAP-related exports
- Store-and-forward (like an email box), Uses server certificates for security
- Defined XML message BG599B (225 fields/groups): replaces the paper document
Conclusions

• ECS2 is an example of a substantial eGovernment system developed in an efficient manner, with little fanfare and not a lot of money
  • The ECS2 project costs 750k EUR, of which DTI is 10% (75k EUR)
  • ECS2 DTI scope includes 28 messages grouped in 7 trader processes, so this represents between 7 and 28 services, depending on how you count it
  • Compare this to 30M EUR spent on central eGov projects and 13 services

• ECS2 DTI is a real eGovernment service in heavy use: 80-100,000 export movements (500,000 messages) per month
  • ECS2 saves significant time to both BCA and traders, eliminating manual data re-entry and incremental chasing of errors

• Key success factors:
  • Real needs and (more or less) clear specifications mandated by EC TAXUD
  • Excellent collaboration between the Developer (Sirma) and Client (BCA)
Who Are We
Who Are We (Company)

- Sirma Group Holding is one of the largest private Bulgarian software development and IT consulting holdings
  - 18 years of history, 450 staff, 9 daughter companies, 5 Joint Ventures. Offices in 5 Bulgarian cities and 3 overseas. See more at www.sirma.bg (BG), www.sirma.com (EN)
- Sirma Solutions Corp is the backbone of Sirma
  - 150 staff, government and private projects, outsourced development, incubation of new ideas and units. Inherited Sirma's history and goodwill at corporate reorganization (when the holding was setup)
- Sirma ITT specializes in complex e-Government projects
  - 5 years of history, 40 staff (Ruse 30, Sofia 8, Varna 2), young (average age 23)
  - One of the few BG companies who raises its own staff through cooperation with universities
  - Focus on JEE, SOA, BPM, RUP, UML.
- Sirma bought ITT in late 2007 to add its experience and management practices
  - Several joint projects in the customs/excise area
  - Teams shared between Solutions and ITT and fully integrated
Who Am I (Author)

• Sirma Group founder and CTO of Sirma Solutions
• Starting up *Sirma IT Consulting* unit
• MS and PhD degrees in computer science, PMP certification
• 18 years of IT experience
• Lecturing in IT Project Management at the Masters Level:
  • University of Ruse: MS in Software Engineering program (sponsored by Sirma)
  • Varna Free University: MS in Software Engineering program (sponsored by Sirma)
  • New Bulgarian University: MS in IT Project Management (joint with Bulgarian Academy of Sciences)
• Returned home after 12 years in Canada
• My dream is to see more effective IT use, efficient eGovernment and less corruption in Bulgaria
  • These goals are inter-related
  • So far eGovernment projects have spent a lot of money, but have had little effect
  • So far the emphasis has been on strategies, legal framework and central infrastructure, and NOT on rich and varied services
ECS2 for IT Project 2009

• Nominated in Computerworld Bulgaria annual competition
• Top 3 amongst 9 submissions in the Government area
• Pictured: IT vice-minister Parvan Rusinov, Sirma CTO/PM Vladimir Alexiev, Sirma ITT CEO Yavor Djonev, BCA PM Teodor Martev
Thanks for your time!

• Questions/discussion?
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