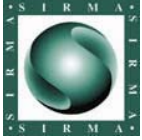# Cost-effective e-Government Services
Export Control System phase 2 (ECS2)

Vladimir Alexiev, PhD, PMP
CTO, Sirma Solutions Corp

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

- Executed during 2006-2007, deployed in Jul 2007
- 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
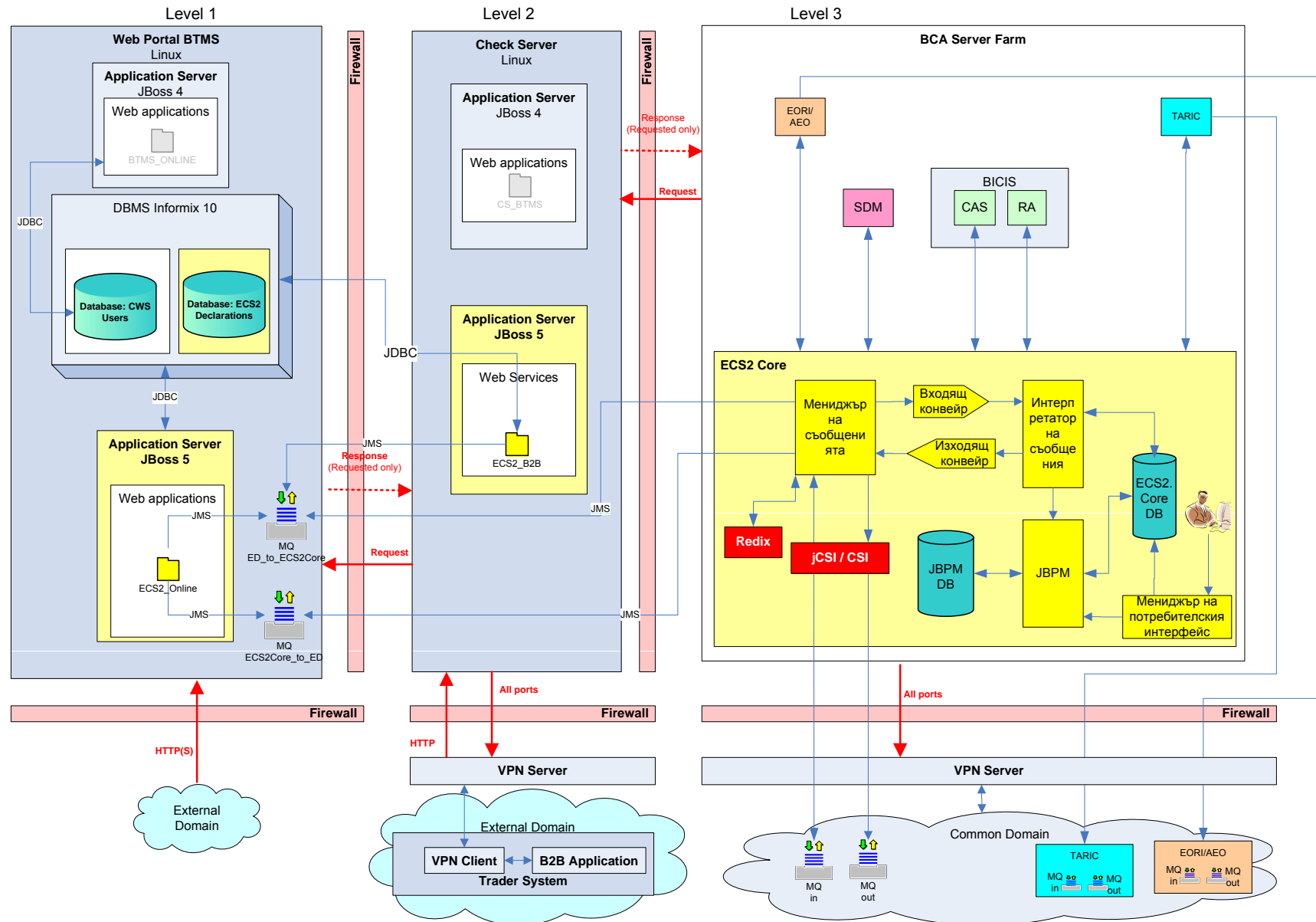
ECS2 System Architecture

ECS2 Backend Architecture
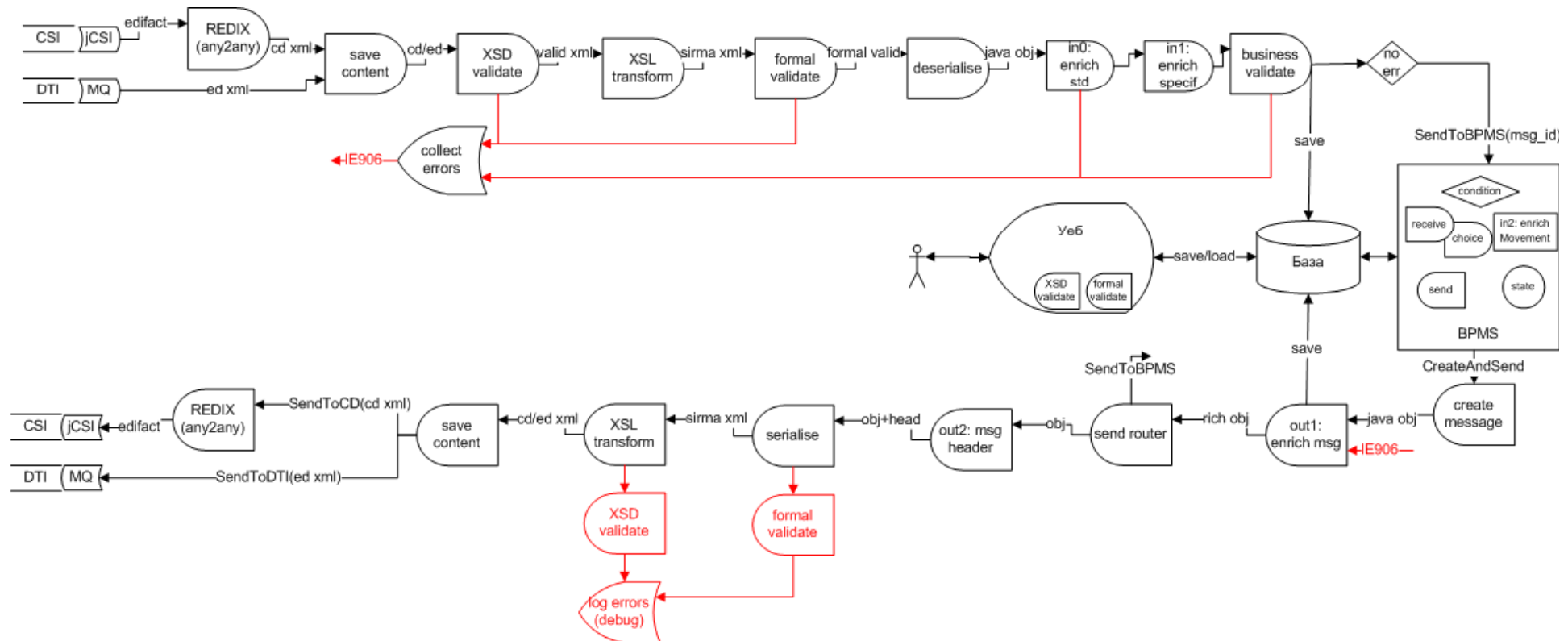
- All process-independent data munching, scrubbing and washing is done in one place, outside BPMS

BPM Specification (BPMN/Visio)
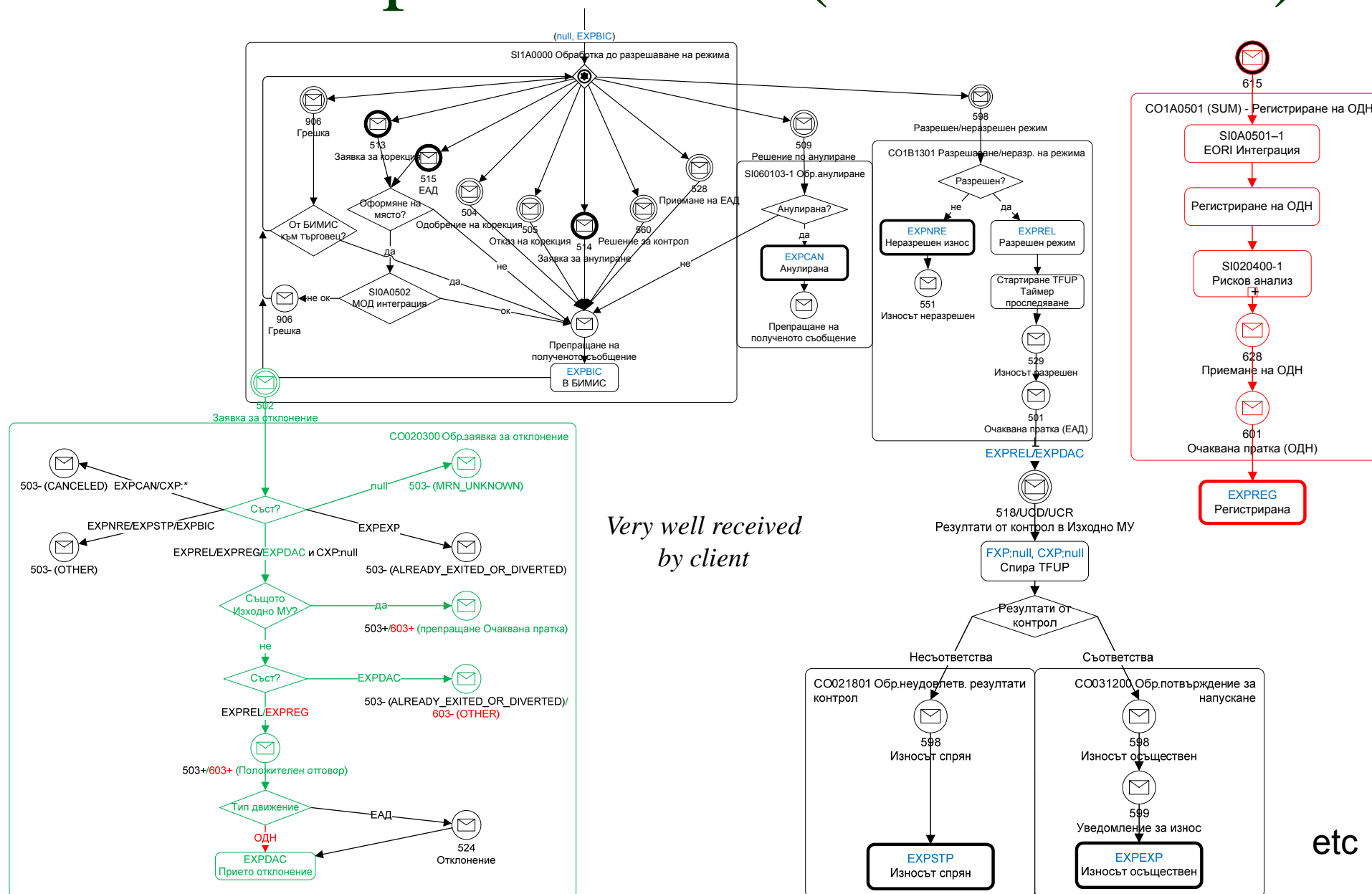
BPM Implementation (jBPM)

- 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
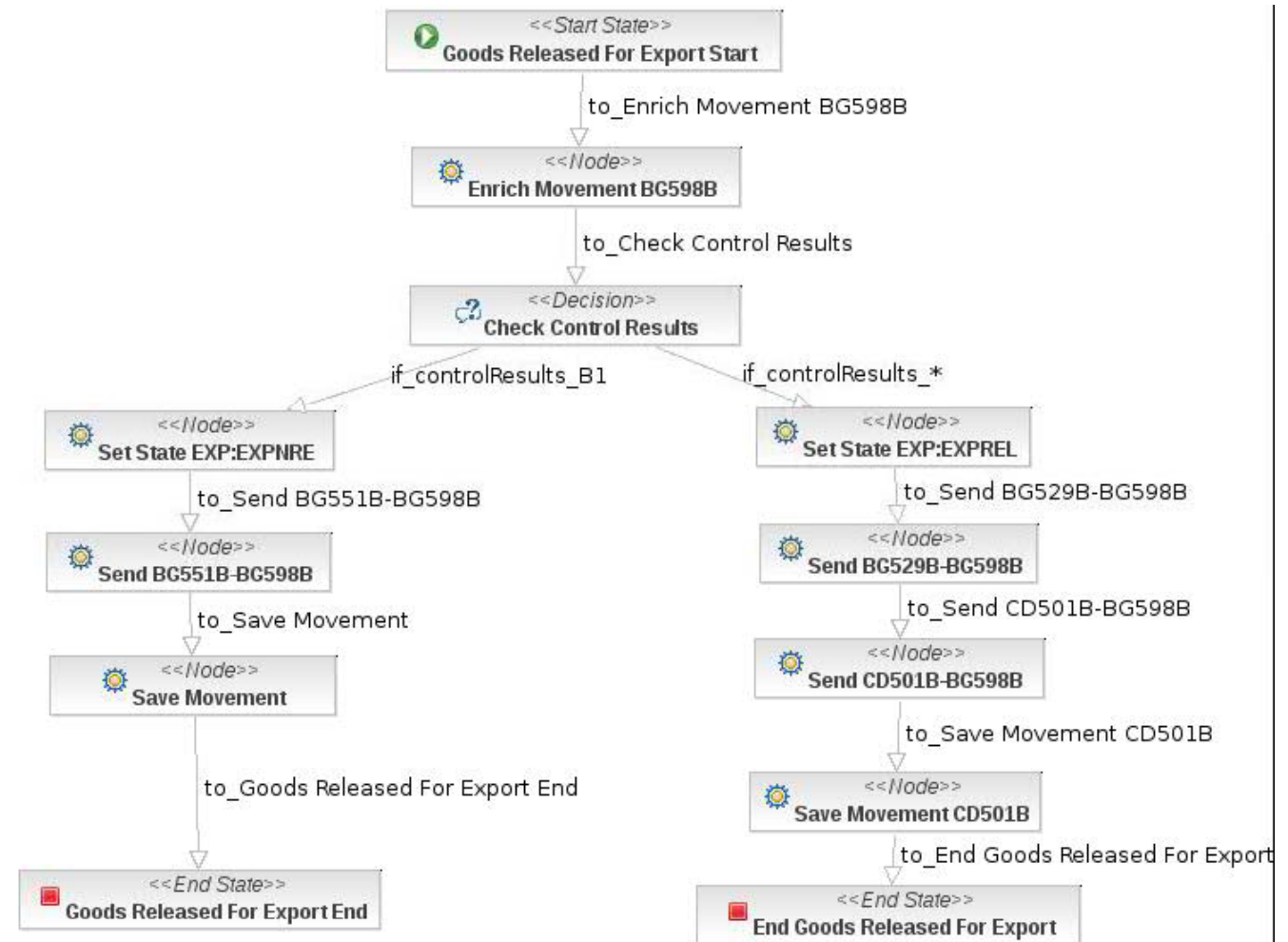
Model-Driven Generation

Generation Architecture
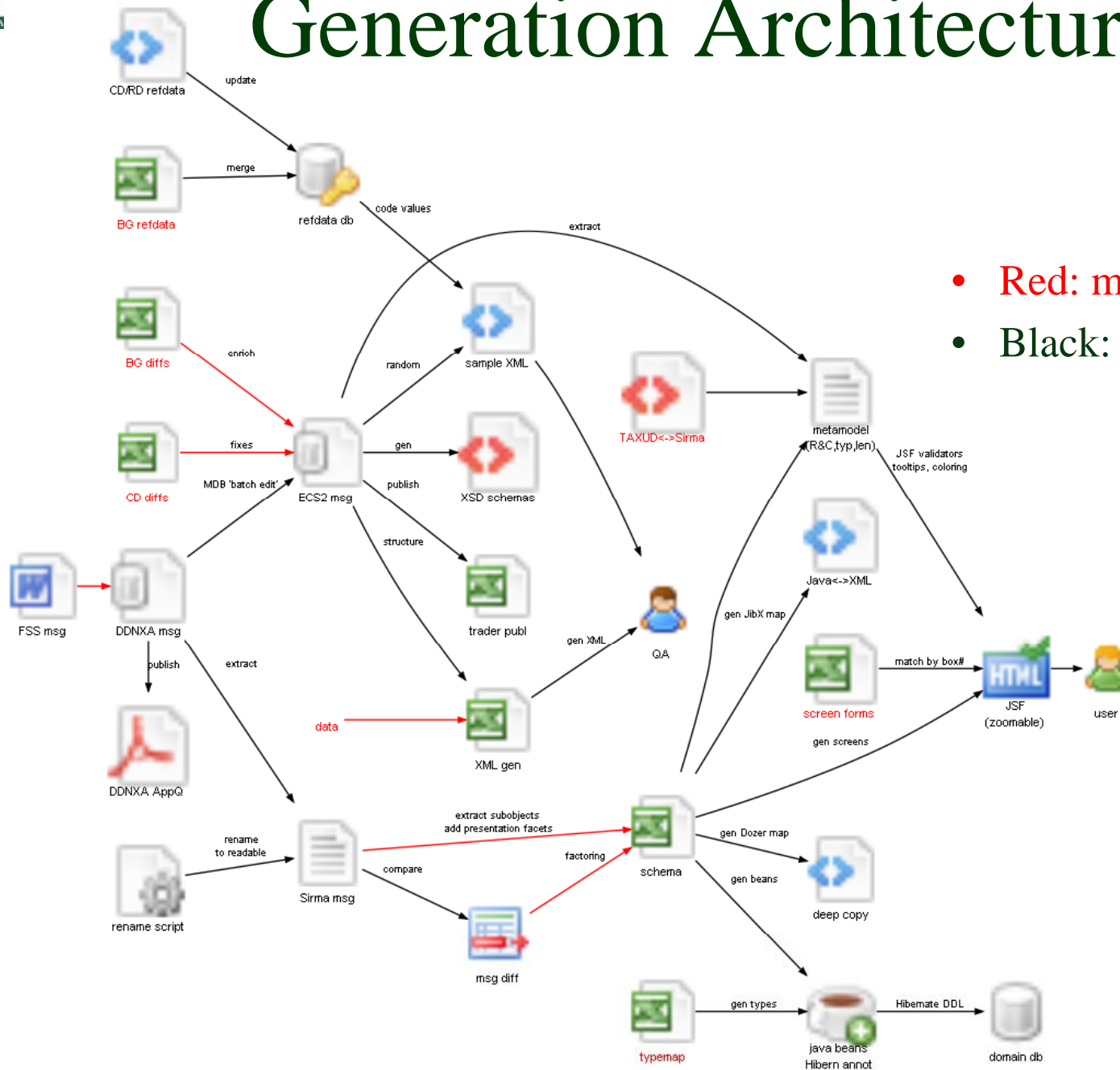
- Red: manual work
- Black: generated

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:

```
C010:IF first digit of "Transport mode at border" (box 25) = 2, 5 or 7
 THEN "Nationality crossing border" (box 21) is Optional ELSE Required

C010.shipment/nationalityOfMeansOfTransportCrossingBorder.R
not(sirma:RexexpMatch(../transportModeAtBorder,"^[257].*
 EN Required when "Transport mode at border" does not start with 2, 5 or 7
 BG Задължително когато "Вид транспорт на границата" не започва с 2, 5 или 7
```

- 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 codelist)

- 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

```
<BG906B>
  <MesSenMES3>NECA.BG</MesSenMES3>
  <SenIdeCodQuaMES4>BG005100</SenIdeCodQuaMES4>
  <MesRecMES6>TRA.*</MesRecMES6>
  <RecIdeCodQuaMES7>BGB8312225307ZZZ</RecIdeCodQuaMES7>
  <DatOfPreMES9>20091007</DatOfPreMES9>
  <TimOfPreMES10>1717</TimOfPreMES10>
  <IntConRefMES11>31d9fe70b34c11</IntConRefMES11>
  <TesIndMES18>0</TesIndMES18>
  <MesIdeMES19>31d9fe70b34c11</MesIdeMES19>
  <MesTypMES20>BG906B</MesTypMES20>
  <OriMesIdeMES22>69307e20b34315</OriMesIdeMES22>
  <FUNERRER1>
    <ErrTypER11>13</ErrTypER11>
    <ErrXPaER12>HEAHEA/NatOfMeaOfTraCroHEA87</ErrXPaER12>
    <ErrReaER13>C010</ErrReaER13>
    <ErrDesER15>Задължително когато "Вид транспорт на границата" не започва с '2', '5' или '7'</ErrDesER15>
  </FUNERRER1>
</BG906B>
```

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
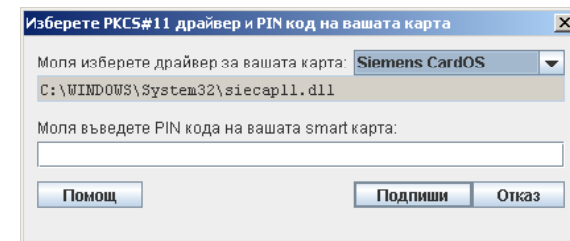
- The *same* forms are used for Customs Officer (ECS2 Web) and Trader (DTI Web)

  - 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
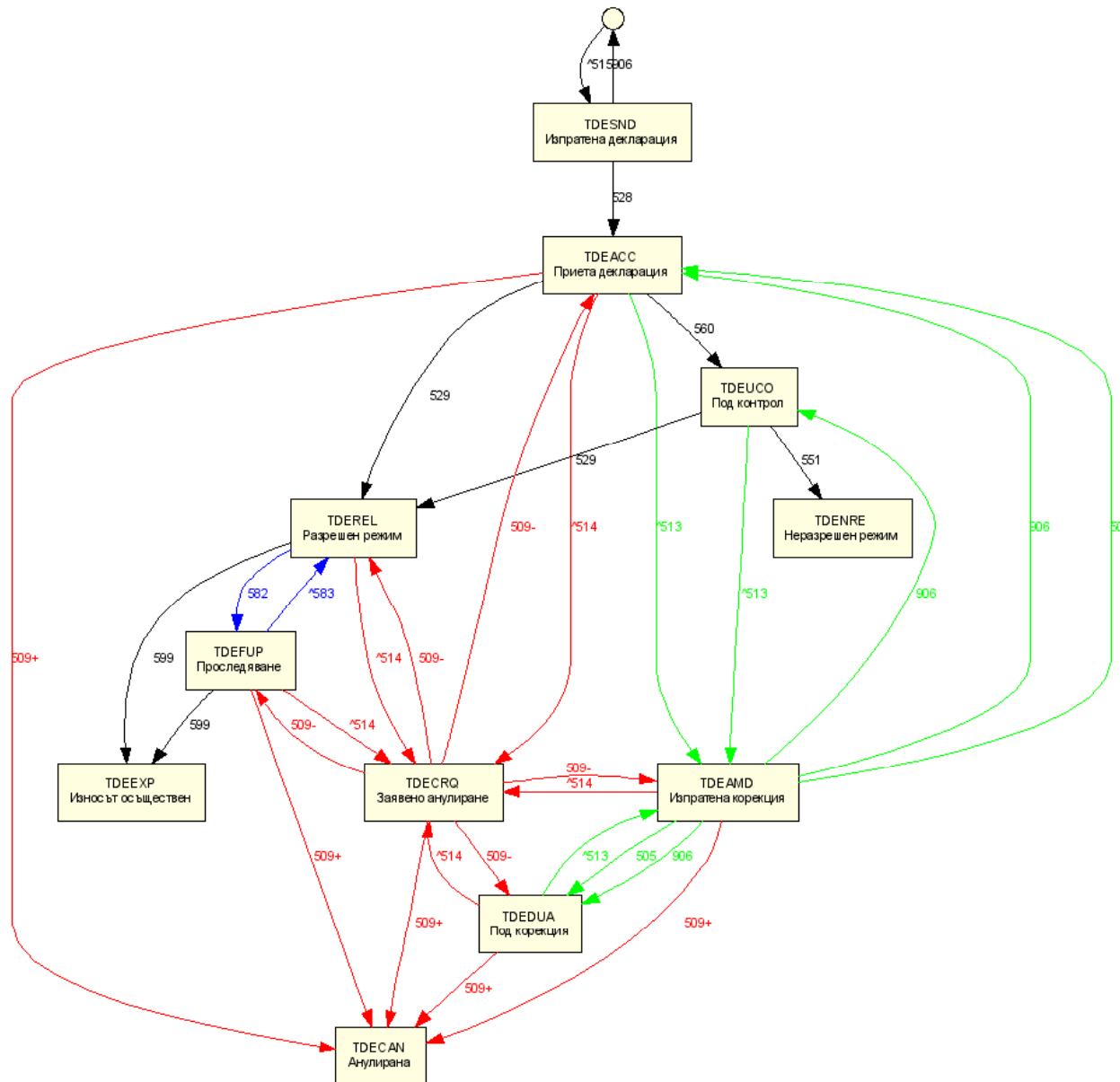
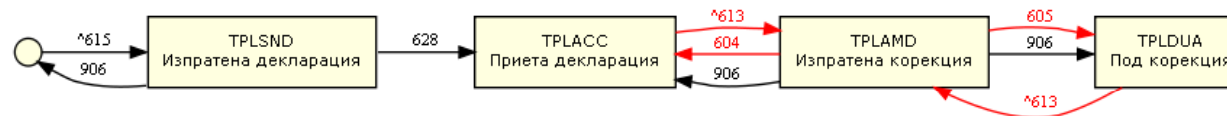# DTI Deployment Architecture
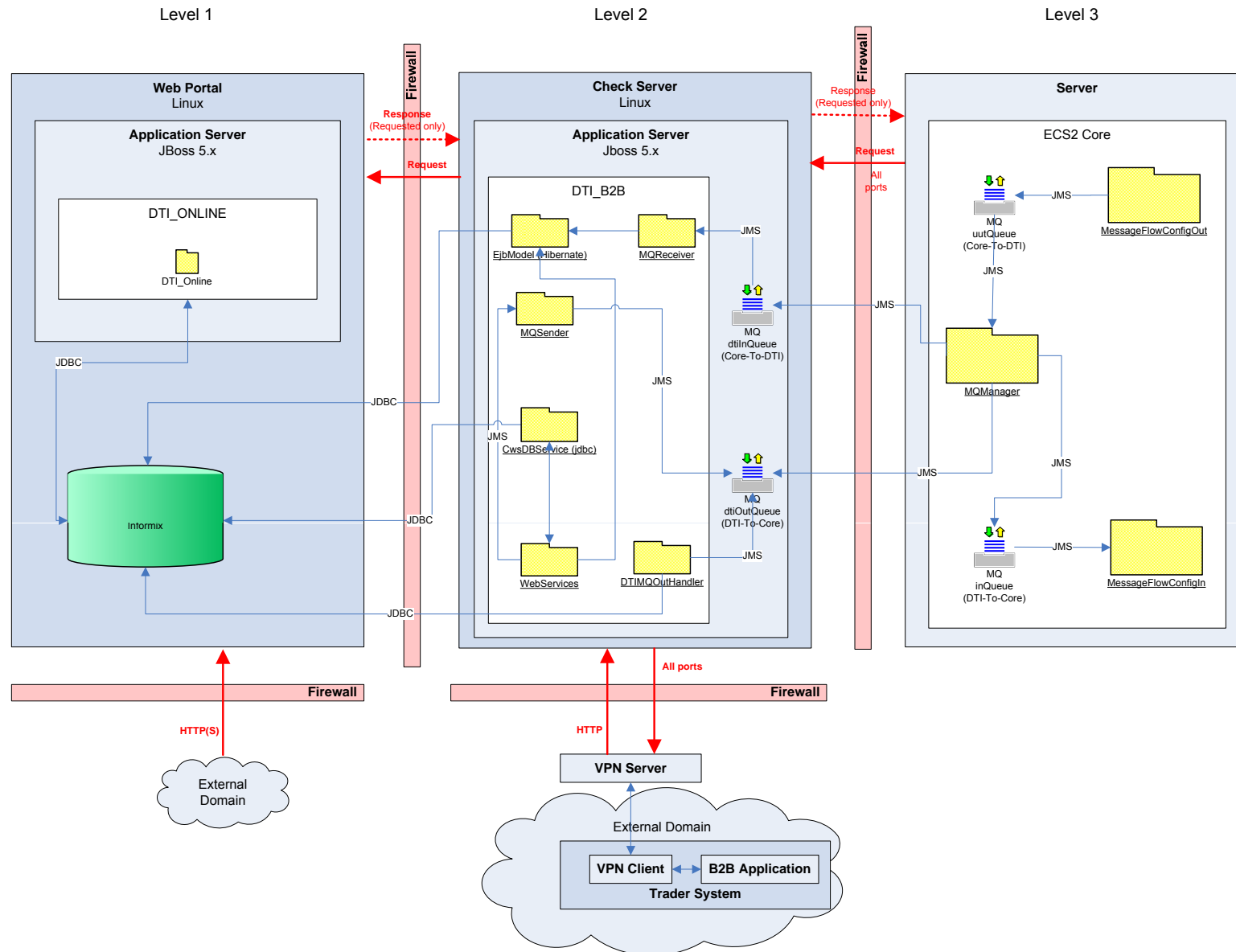
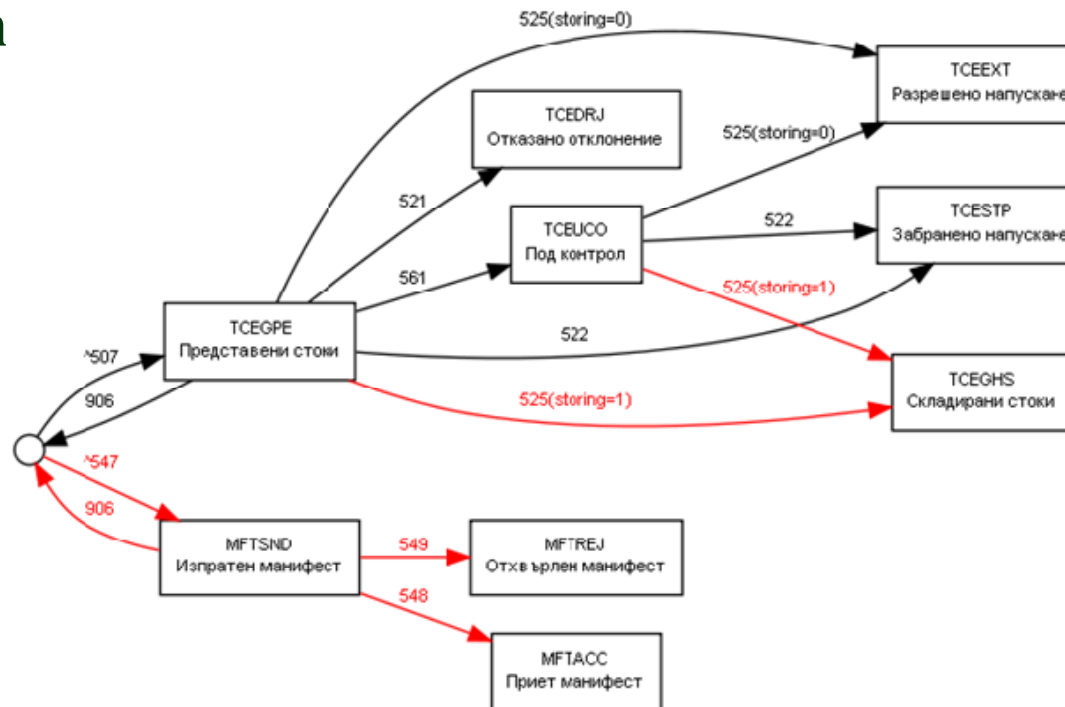# DTI Scope: Actors, Messages
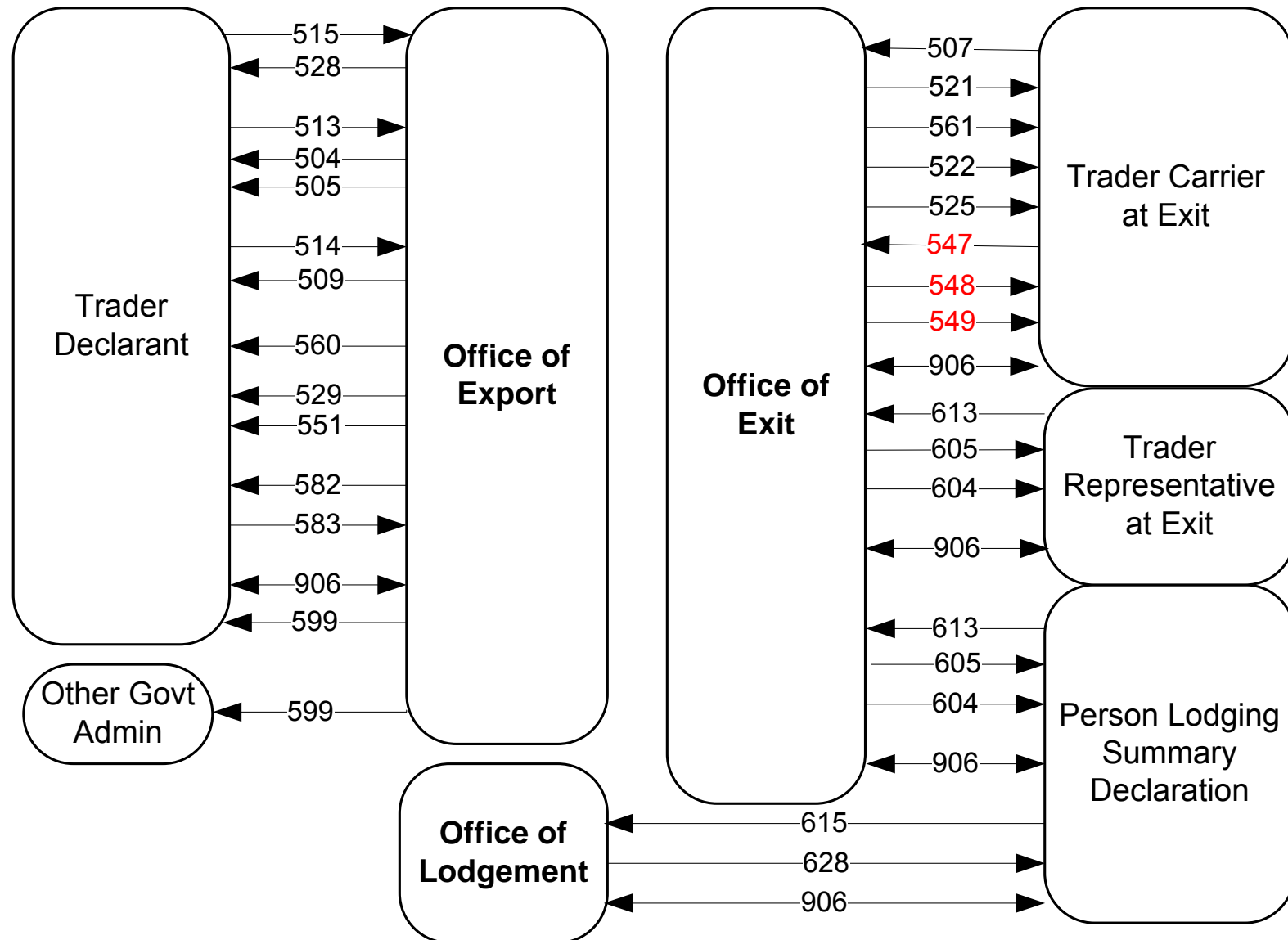
DTI Scope: Trader Processes

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

DTI Scope: Trader Processes

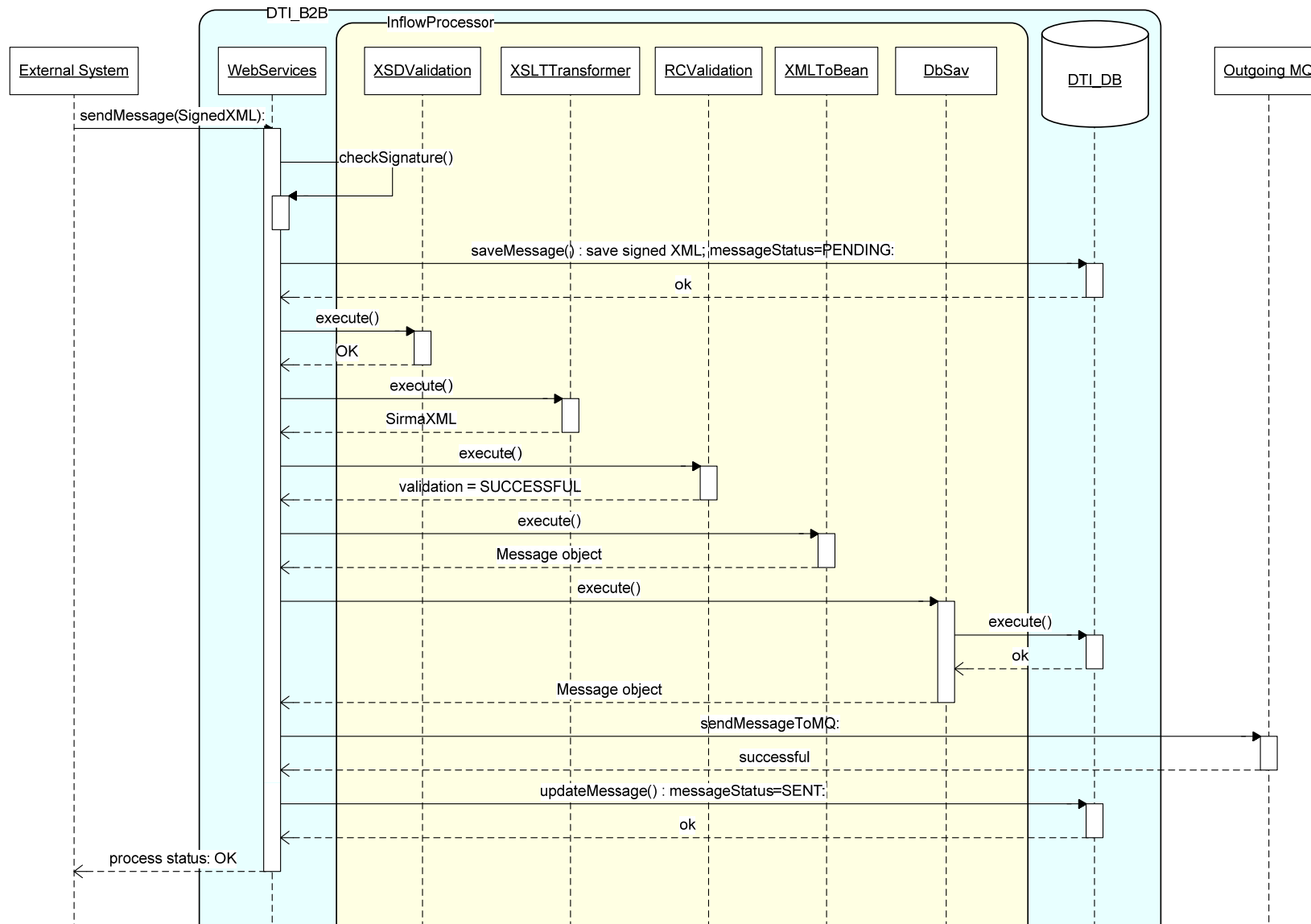- ## Person Lodging Summary Declaration and Trader Representative at Exit

- ## Trader Carrier at Exit

  - ### Export Operation

  - ### Exit Manifest

DTI Processing

Successful processing of sendMessage WS call

DTI GUI: Forms as in ECS2 GUI

Потребител: Иван Добромиров Петров (**ЕГН:** 8001021234, **TIN:** 08BG20080812175958), Изход

Търсене: LRN 08BG20080812175958 MRN 09IT04211632307816 **Дата:** от 13.05.2009 до 13.05.2009 **Дата на приемане:** от 13.05.2009 до 13.05.2009 Търси, Изчисти

Изпращане: BG507B: Представени стоки в изходно МУ, BG513B: Заявка за корекция (ЕАД), BG514B: Заявка за анулиране, BG515B: Износна декларация (ЕАД), BG583B: Отговор на заявка за данни при проследяване, BG613B: Заявка за корекция (ОДН), BG615B: Обобщена декларация за напускане (ОДН)

BG515B: Износна декларация (ЕАД)

Обща, Стоки :

1 ДЕКЛАРАЦИЯ			А МИТНИЧЕСКО УЧРЕЖДЕНИЕ НА ИЗНОС		

3 Комплекти	4 Товарни списъци	LRN		
		MRN		

5 Стоки-брой	6 Колети-брой	7 Справочен номер	S32 Индикатор специални обстоятелства
	0		

35 Общо брутно тегло	9 Финансово отговорно лице	No	Общо вземания	S29 Начин на плащане за транспорт

10 Държава на последно изпращане	11 Държава на сделка	13 О.А.П.

2 Изпращач / Износител		Населено място
Улица, Номер		ПК Държ.
ТД на НАП	Данъчна служба	

8 Получател		Населено място
Улица, Номер		ПК Държ.

14 Декларатор		Населено място
Улица, Номер		ПК Държ.
Статус на представител	Номер на представител	Номер на митнически агент

15 Държава на износ	15а Код държава изпращане/износ	17а Код държава на получаване
16 Държава на произход	17 Държава на получаване	

18 Идентификация и националност на транспортното средство при тръгване	19 Контейнер?
	0

20 Условия на доставка	

21 Идентификация на транспортното средство при напускане на ЕС	

22 Валута и обща фактурна стойност	23 Валутен курс	24 Вид на сделката

25 Вид транспорт на граница	26 Вид транспорт във вътрешността	27 Място на товарене/разтоварване	28 Финансови и банкови данни

29 Изходно МУ	30 Местонахождение на стоките	Подмясто в митница	30.5 Място за складиране

48 Отсрочено плащане Разрешение		Основание	Отсрочка	[+]

49 Идентификация на склад			
Тип	Номер на склада от разрешителното		Държава

S13 Маршрут	[+]

В СЧЕТОВОДНИ ДАННИ			
50 Отговорно лице	No	Представено от	Подпис:	Място и дата:

35 Общо брутно тегло	9 Финансово отговорно лице
334.000	
W	

10 Държава на	стойността трябва да бъде число със знак, състоящо се от нула или повече цифри, следвано по избор от десетична запетая и дробна част, напр. 198.23
2 Изпращач / И KOPPEL Улица, Номер FUNKE-STR. 8 Получател	Общо бруто тегло (totalGrossMass, TotGroMasHEA307, 35). Общо бруто тегло на всички декларирани стоки. Формат: число със знак, състоящо се от общо 11 цифри, 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 (Charismatics, Siemens, SafeNet, Datakey, ActivCard Gold, Setec SetWeb, Gemplus, Utimaco SafeGuard, ActiveKey, Aladdin, …)
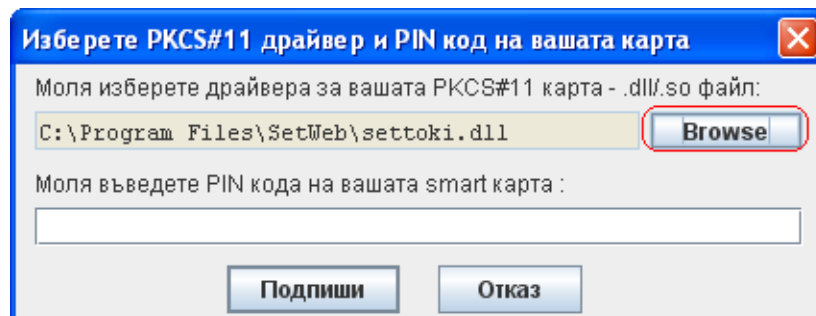
- Ensures that traders can:
  - Only read messages that "belong" to them
  - Only send messages in their own name
  - Both Web (browser) and B2G (WS-Signature)

ФОРМУЛЯР ЗА РЕГИСТРАЦИЯ
за подаване на митнически документи по електронен път

☐ Регистрацията се извършва чрез упълномощено лице cnt_is_offline

I. Данни за икономическия оператор clients

◉ Юридическо лице   ◯ Едноличен търговец   ◯ Физическо лице cnt_type

Наименование на икономическия оператор	БУЛСТАТ cnt_bulstat_number

Седалище /Град/	Адрес на управление	Териториална дирекция НАП

Пощенски код		Подразделение НАП

Управител, собственик   ЕГН

Име	Презиме	Фамилия	cnt_egn

Валиден адрес за електронна поща	cnt_email

II. Икономическият оператор ще подава митнически документи и в качеството си на:

☐ Представител   ☐ Митнически агент

III. Служители на икономическия оператор, имащи право да подават митнически документи от негово им да администрират работното му пространство:

[Нов ред] clients_empl

	Име	Презиме	Фамилия	ЕГН	Админ	Данни за цифровия сертиф
						Издател
X	cnte_first_name	cnte_mid_name	cnte_last_name	cnte_egn	cer_role_id ☐	– – – ca_sid

IV. Списък от представители и митнически агенти, които икономическият оператор е упълномощил да по митнически документи от негово име:

[Нов ред] clients_repr

	БУЛСТАТ	или	ЕГН	
X	cntr_bulstat	или	cntr_egn	☐ Митнически агент cntr_agent_num

---

Изберете PKCS#11 драйвер и PIN код на вашата карта

Моля изберете драйвера за вашата PKCS#11 карта - .dll/.so файл:

`C:\Program Files\SetWeb\settoki.dll`   [Browse]

Моля въведете PIN кода на вашата smart карта :

[Подпиши]   [Отказ]

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?
- Contacts: vladimir@sirma.bg, +359 (888) 568 132, callto://valexiev1