Defining Design Guidelines for XML Messages Used in Enterprise Application Integration

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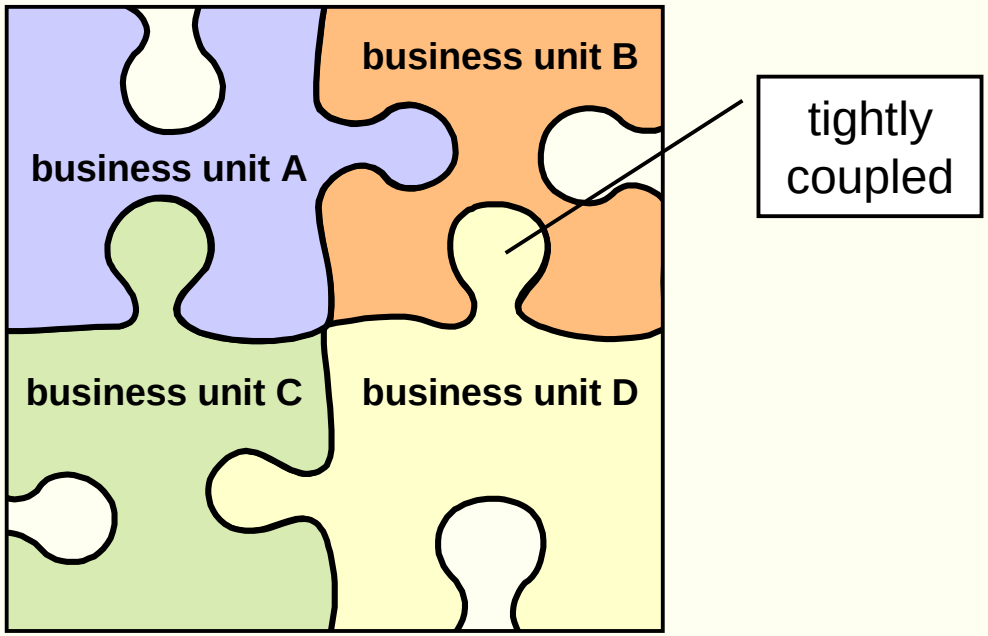
Designing XML messages for EAI

- Situating the problem
  - from inside to outside business units
  - using XML message-based EAI
- What are the challenges?
- What we first started to do
- What we eventually did
  - model at a higher level of abstraction
  - using XML Schema + XML Schema Adjuncts
- The modelling process
  - modelling steps
  - people involved
- Conclusions

Situating the problem

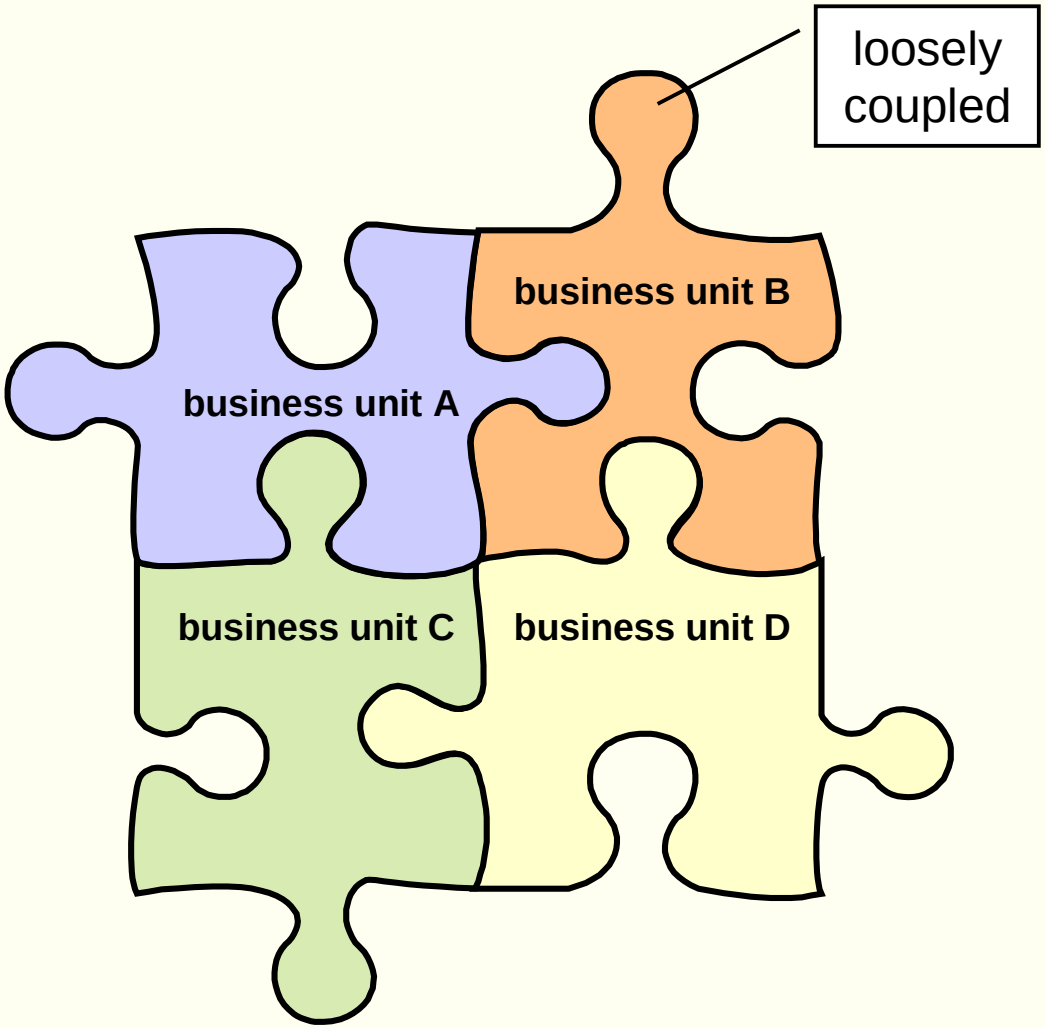
- Major Belgian bank faced with two major challenges:
  - integrating two different IT infrastructures after a recent merger
  - opening up their business units to become e-business units
- Integration challenge
  - keep using and/or joining up the best parts of both IT infrastructures
    - different programming languages, hardware & operating system platforms
    - biggest problem when exchanging data: *data heterogeneity* (the use of different data representations)
  - tendency to buy more COTS financial front-office trading systems
    è need to be integrated with middle- and back-office applications
    - bought from specialized vendors
    - are not built to be integrated
    - heterogeneous in nature
- Opening up challenge

Inside business units



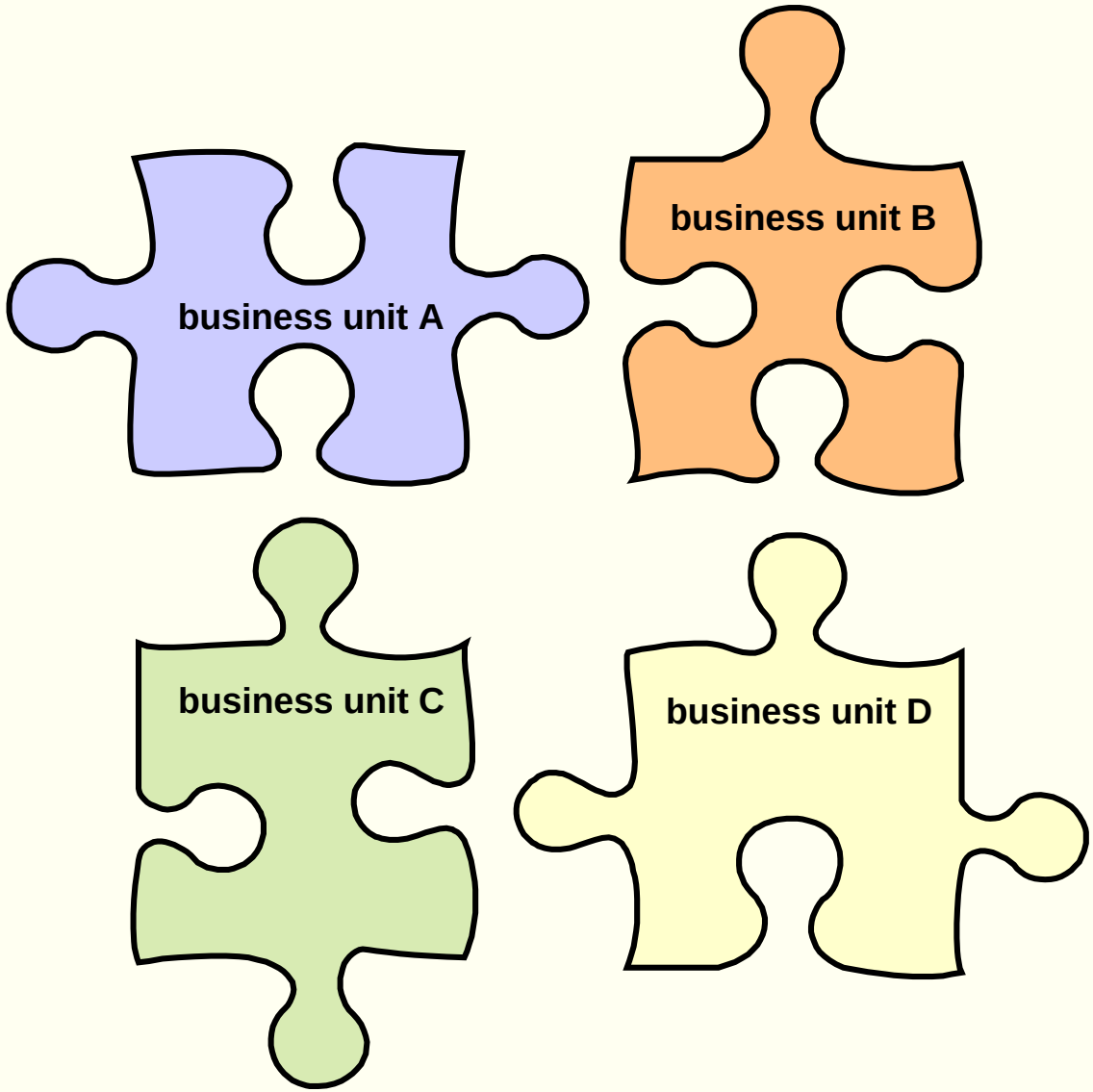
- using IT services internally, tightly coupled architecture

Opening up inside business units

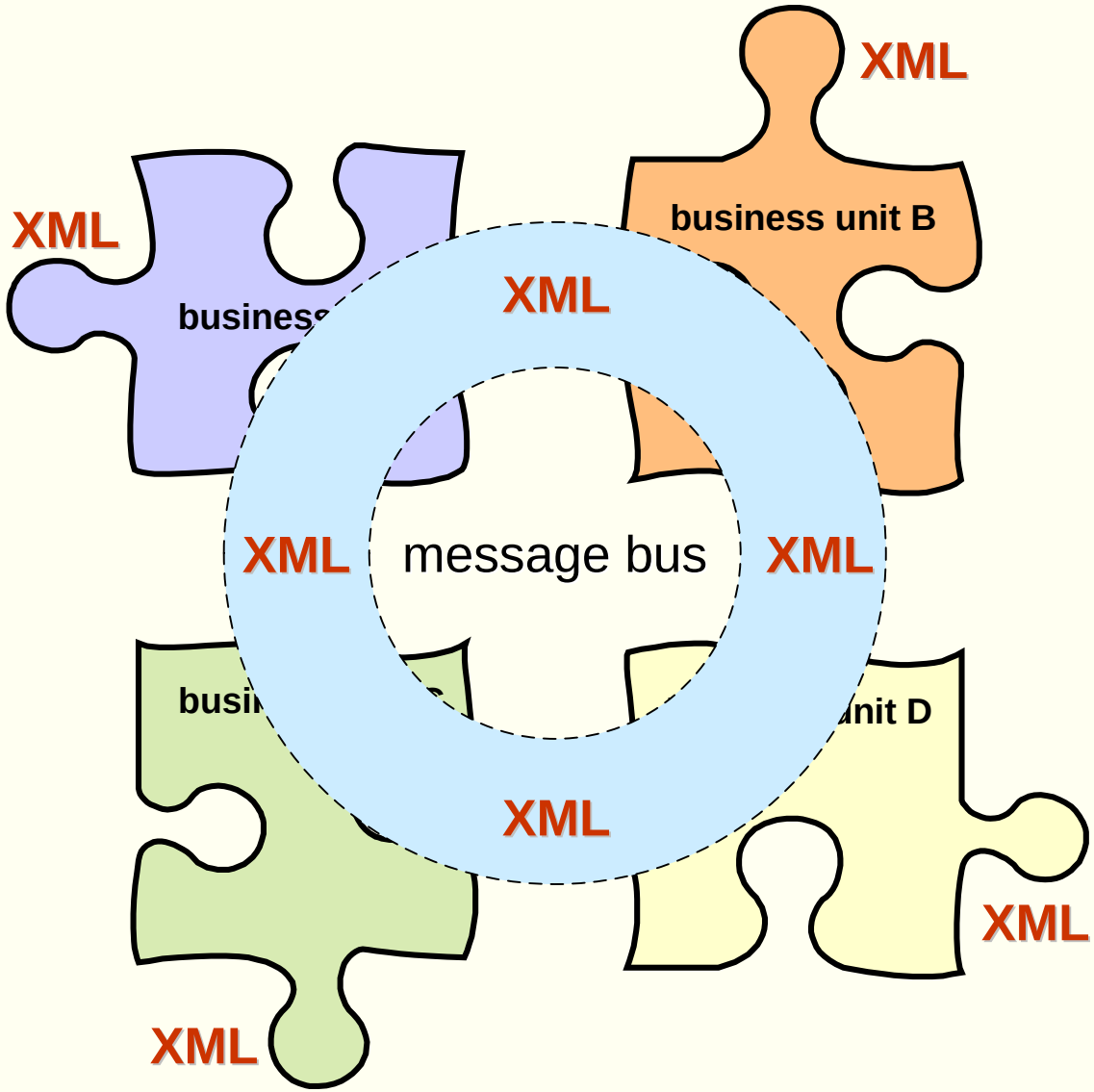


- providing IT services externally, loosely coupled architecture

Turning into outside business units



Turning into outside business units



Finding a solution

- Choosing the appropriate architecture
  - supporting message-based application integration
    - asynchronous (message-oriented middleware) and not synchronous (CORBA/DCOM)
  - allowing a “publish and subscribe” interaction model
- Using XML as the message data syntax
  - for all the usual reasons:
    - platform and protocol neutral
    - flexible & extensible but controllable
      - to adapt to ever-changing internal needs
      - to fit in with unforeseen external requirements
  - but also because the outside world increasingly uses XML
- Finding a XML message modelling methodology
  - XML was beginning to be used everywhere, so urgent need for guidelines

What are the challenges?

- Selecting the appropriate message-oriented middleware
  - capable of reliable handling massive volumes of messages
  - XML-aware or XML ready, with good local technical support

  status: selection of EAI tool is completed + pilot project has started
- Developing a methodology for modelling the XML messages
  - leveraging existing in-house standards, following emerging XML standards
  - dealing with message payload only, not with message handling
    - process/task/transaction control, message flow **è** handled by middleware

  status: business models being defined, message models under development
- Setting up a process for enforcing the use of this methodology
  - set of guidelines on how this methodology has to be applied
  - organisational framework to support the use of this methodology

  status: guidelines are being written + process is tested on pilot project

Developing a methodology

- What we first started to do:
  - look at in-house existing work
    - data modelling methodologies (ER, UML, …)
    - conventions (naming, capitalization, abbreviation rules)
  - find good design patterns for
    - XML instances
      - large set of examples at **http://www.xmlpatterns.com/**
    - XML Schemas
      - small set of best practices at **http://www.xfront.com/**
  - try to find best practices in existing (financial) XML standards:
    - FixML, FpML, GovTalk, swiftML
    - other XML standards: ebXML, SOAP, ICE, …
  - start to write a set of practical design guidelines
    - for how to write XML instances
    - not for how to design XML schemas

XML message standards considered

- FixML — http://www.fixprotocol.org/
  - real-time electronic exchange of securities transactions
  - ü rich set of business components for bonds, equities and options
  - ü clean approach to extending the core tag set of the standard
- FpML — http://www.fpml.org/
  - enable e-commerce activities in the field of financial derivatives
  - ü rich set of business components for “over-the-counter” derivatives
  - ü design patterns for the exchange of financial information
- GovTalk — http://www.govtalk.gov.uk/
  - design guidelines for the XML messages to be used as part of the UK's e-Government Interoperability Framework
  - ü guidelines for XML Schema design
  - ü advice on XML message modelling

XML message standards considered

- swiftML http://www.swift.com/index.cfm?item_id=2642
  - improve interoperability of different financial XML implementations
  - by using the SWIFTStandards methodology:
    - model financial business processes
    - store these business models in a repository
    - use these business models to derive messages
  - main design goals of using UML as modelling tool:
    - to remove any dependency on the message syntax
      - current FIN or ISO 15022 syntax, future XML syntax
    - to have the business model serve as the common denominator
  - consistent way of generating XML DTDs from UML business models
    - e.g. business information is expressed as XML elements/values, meta-data information is expressed as XML attributes
    - designed in such a way that migration to XML Schemas remains feasible

Developing a methodology

- Lessons learned:
  - existing in-house approaches:
    - oriented towards database modelling
    - modelling process itself is not a shared process
      - business analysts model + their developers build
      - standards department approves or disapproves
  - XML diversity:
    - hard to find a common set of design patterns
    - XML instances/DTDs are the result of a hidden thought process
  - XML backlash:
    - doubt about the usefulness of “XML overhead”
    - hard-to-get developer buy-in from the different divisions of the bank
- Actions taken:
  - move to a higher level of abstraction
  - focus on the development of a shared process

Developing a methodology

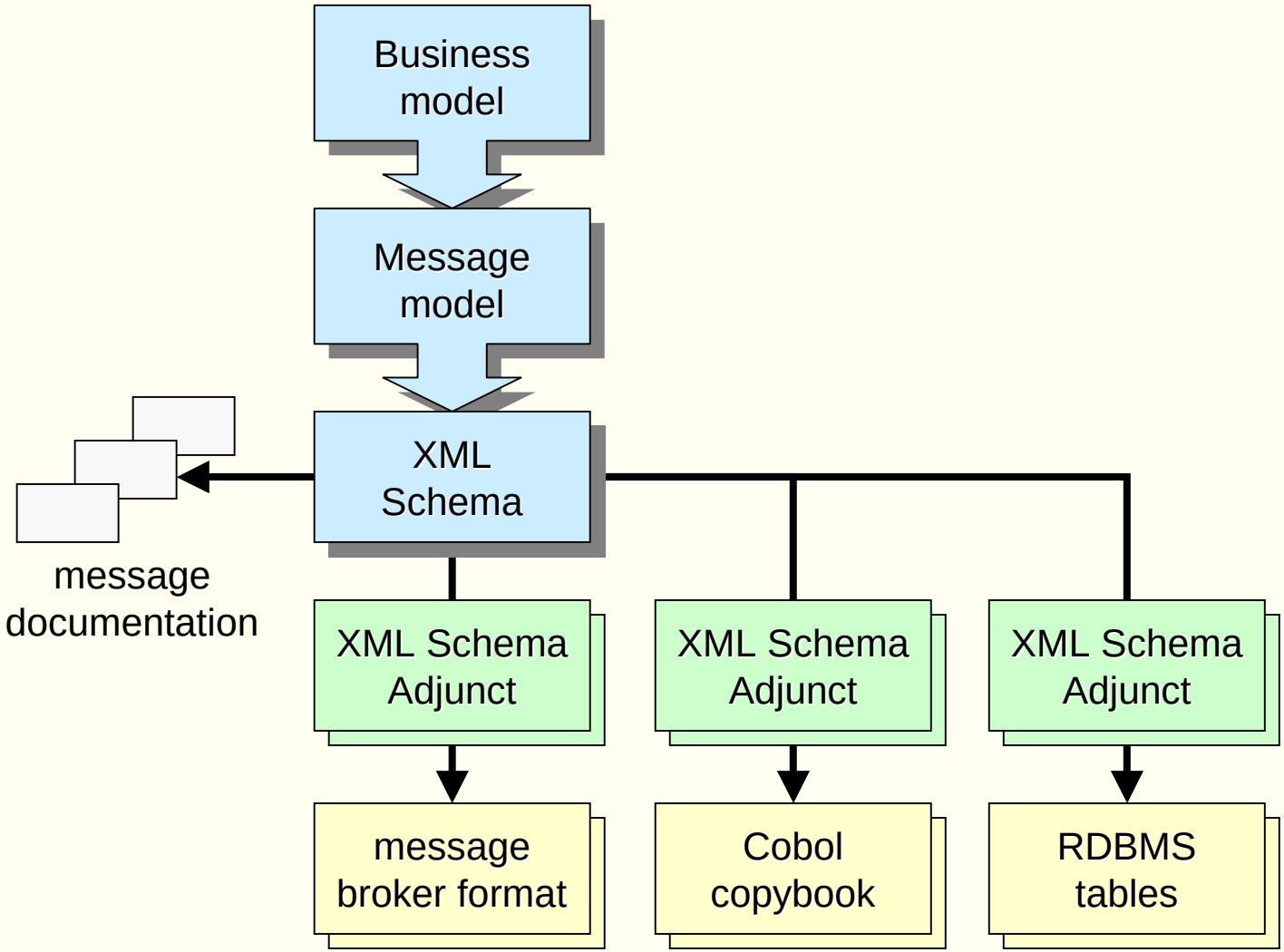
- What we then started to do:
  - introduce a distinction between

    business modelling = modelling of the business processes

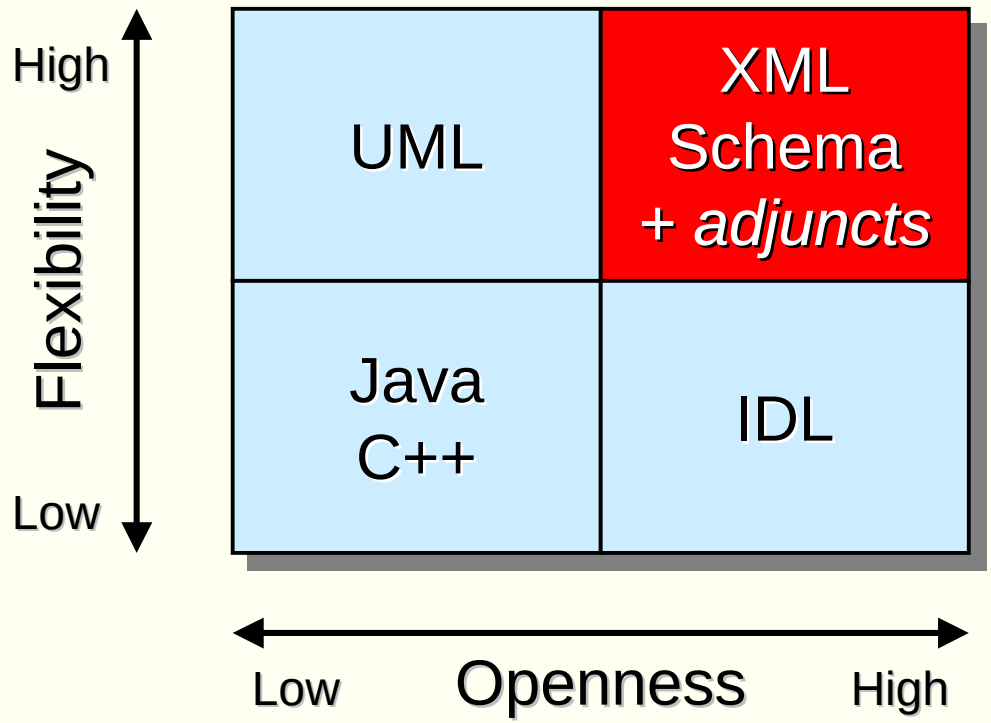
    message modelling = building a library of message components
  - business models
    - well-documented descriptions of business processes
    - no formalisation (yet, but UML is being considered)
  - message models
    - widely used base message components
    - common base datatypes
    - documentation

    to be managed in a central repository
    - under tight control of the central standards department
    - open for consultation by local standards setters & use by local developers

Different types of models



Why use XML Schemas?



- XML Schemas as a universal data modelling syntax:
  - carefully choosen set of data modelling concepts and datatypes
  - significant synergies with other XML standards
  - extensibility and programmability

Why use XML Schema Adjuncts?

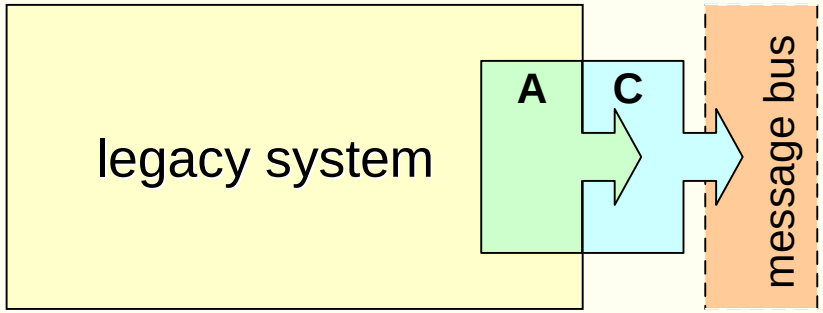
- Not a challenge: reliable messaging (is handled by broker)
  - messages should not get lost or be resent unnecessarily
  - message content should be secured against spying/tampering
- The biggest challenge of application integration: *mapping*
  - each participating (legacy) application provides/expects a different data format suited to its own needs
  - mapping between data format and message format requires knowledge about the internals of the application
- Need for mapping meta-data

  information about the mapping between two different data formats
  - not tied to a particular data model
  - explicit and exploitable

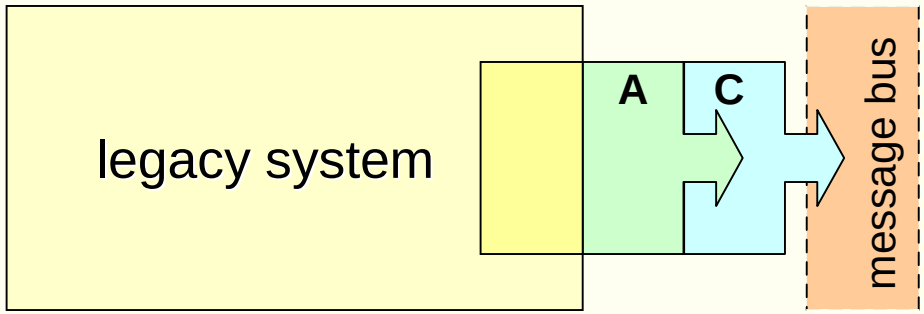
  è XML Schema Adjuncts

Who is responsible for the mapping?

- Integrating a legacy system into the messaging infrastructure
  - adapter: mapping legacy data format to message data format
  - connector: connecting the legacy system to the message bus
- Adapter responsibility of the legacy system maintainers



  - legacy system generates message data format
  - mapping in legacy system
  - existing developers struggle with writing good mapping code
- Adapter responsibility of the message bus maintainers



  - legacy system prepares (special) legacy data format
  - mapping in adapter generated from XML Schema + Adjunct
  - new developers focus on adapter

What are XML Schema Adjuncts?

- XML Schema Adjunct Framework
  http://www.extensibility.com/tibco/resources/saf_dec2000.htm
  - for adding processing-specific information to XML Schemas
    - mappings to relational databases
    - business rules for additional validation
    - indexing parameters for native XML databases
    - parameters used for presentation and input forms
  - for associating *adjunct data* with XML Schemas and their instances
- Not a W3C standard, but already widely used
  - e.g. Schemantix
    http://www.schemantix.com/
    - Schemantix Development Platform (SxDP)
      - set of open source tools for building Web interfaces
    - uses XML Schemas + XML Schema Adjuncts to generate complex multi-page HTML input forms with built-in validation

XML Schema Adjunct syntax

```
<?xml version="1.0"?>
<schema-adjunct xmlns:inst="instance NS URI"
                xmlns:proc="processor NS URI">
  <instance-namespaces default="instance NS URI"/>
  <global>
    <proc:global-meta-data/>
  </global>
  <type type="anyType" context="XPath/to/match">
    <proc:type-meta-data/>
  </type>
  <element type="anyType" context="XPath/to/match">
    <proc:element-meta-data/>
  </element>
  <attribute type="aSimpleType" context="XPath/to/match">
    <proc:attribute-meta-data/>
  </attribute>
  <!-- more type, element and attribute adjunct associations -->
</schema-adjunct>
```

XML Schema Adjunct example

```
<?xml version="1.0"?>
<schema-adjunct xmlns:acc="Account" xmlns:sql="SQLdatabase">
  <instance-namespaces default="Account"/>
  <global>
    <sql:databasename>acc_data_tbl</sql:databasename>
  </global>
  <element context="Account/AccountNumber">
    <sql:column>number</sql:column>
  </element>
  <element context="Account/AccountBalance">
    <sql:column>balance</sql:column>
  </element>
  <attribute context="Account/@ID">
    <sql:column>ID</sql:column>
  </attribute>
</schema-adjunct>
```

Message modelling principles

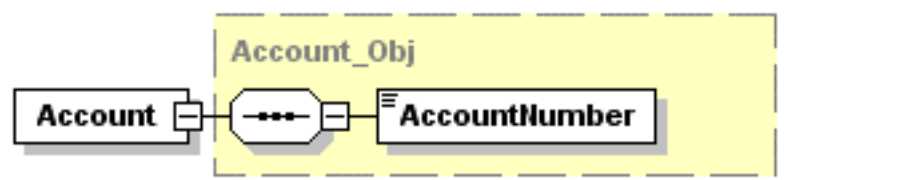
- Message modelling constructs
  - objects with properties participating in relations
  - “box-in-a-box” modelling approach:
    - attributes are sub-elements of the object element
    - objects participating in a relation are sub-elements of the relation element

  è focus on *efficiently shipping data* around, not *capturing complex structure*
- Technical design principles
  - XML attributes only used for technical meta-data
  - mixed content model is never used in elements
  - use globally defined complex types for elements
- No type hierarchy, but definition re-use
  - set of base components which have to be reused
    e.g. **`MyPostalAddress`** includes **`PostalAddress`**

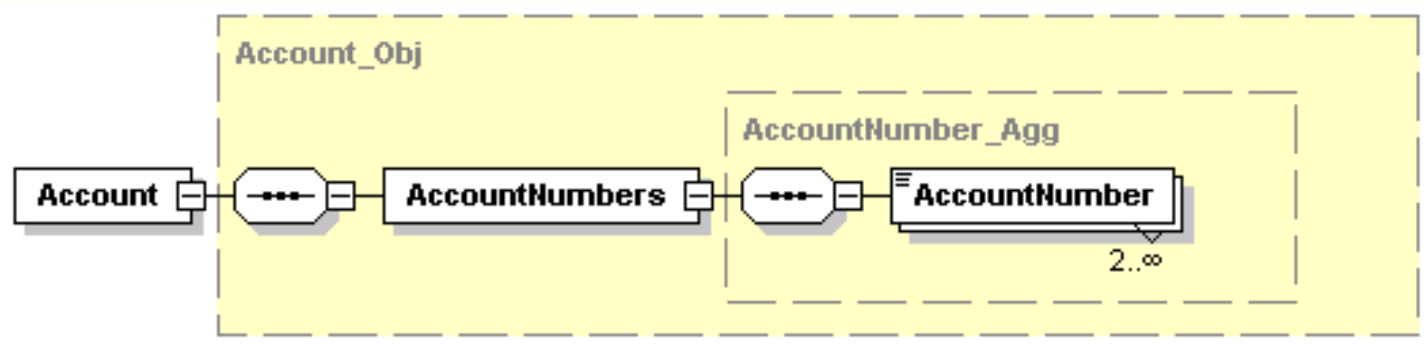
  è focus on modelling reusable message components

Modelling objects

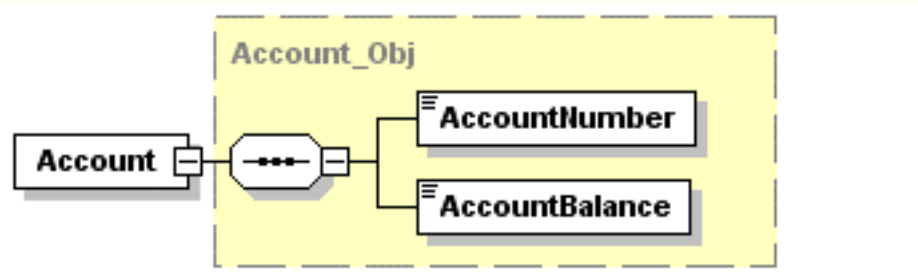
- With a single property



- With multiple similar properties



- With different properties

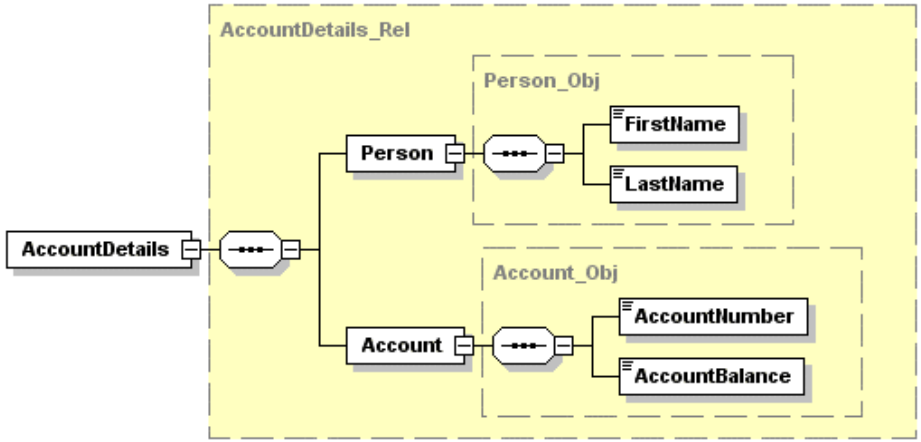


Example

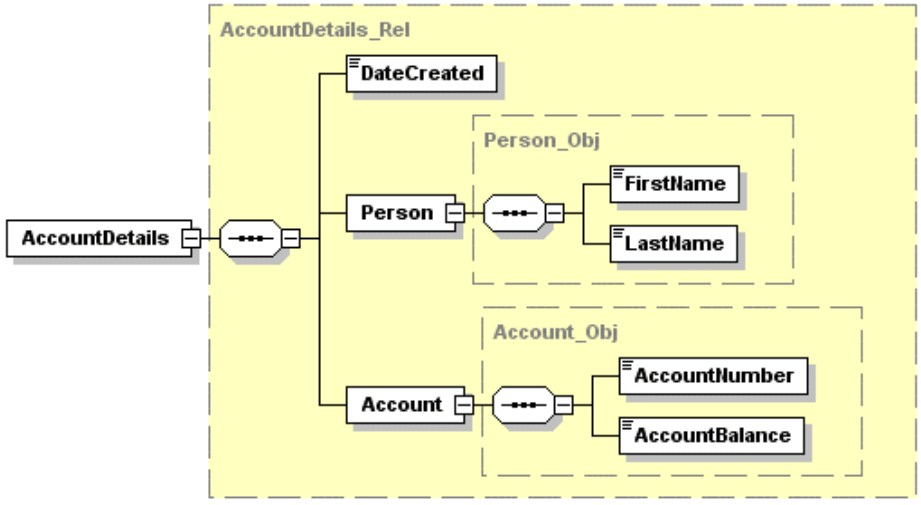
```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2000/10/XMLSchema" elementFormDefault="qualified">
  <!--Property definitions-->
  <!--Account number property definition-->
  <xsd:complexType name="AccountNumber_Prop">
    <xsd:simpleContent>
      <xsd:restriction base="xsd:string">
        <xsd:pattern value="\d\d\d-\d\d\d\d\d\d\d\d-\d\d"/>
      </xsd:restriction>
    </xsd:simpleContent>
  </xsd:complexType>
  <!--Account balance property definition-->
  <xsd:complexType name="AccountBalance_Prop">
    <xsd:simpleContent>
      <xsd:restriction base="xsd:integer"/>
    </xsd:simpleContent>
  </xsd:complexType>
  <!--Object definitions-->
  <!--Account object definition-->
  <xsd:complexType name="Account_Obj">
    <xsd:sequence>
      <xsd:element name="AccountNumber" type="AccountNumber_Prop"/>
      <xsd:element name="AccountBalance" type="AccountBalance_Prop"/>
    </xsd:sequence>
  </xsd:complexType>
  <!--Account -->
  <xsd:element name="Account" type="Account_Obj"/>
</xsd:schema>
```

Modelling relations

- Without own properties:

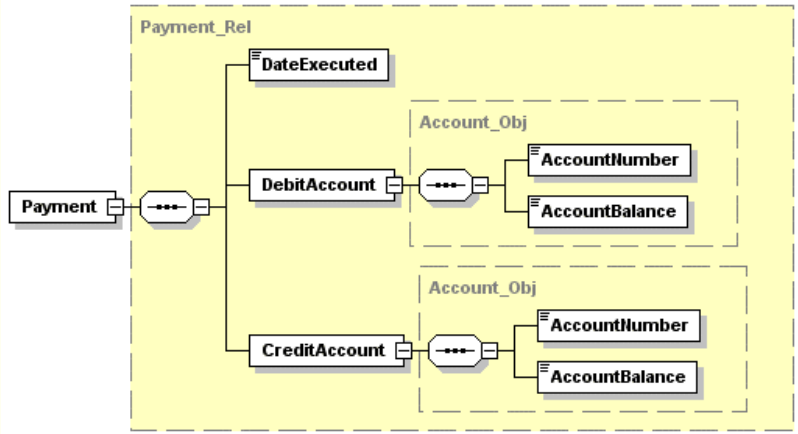


- With own properties:

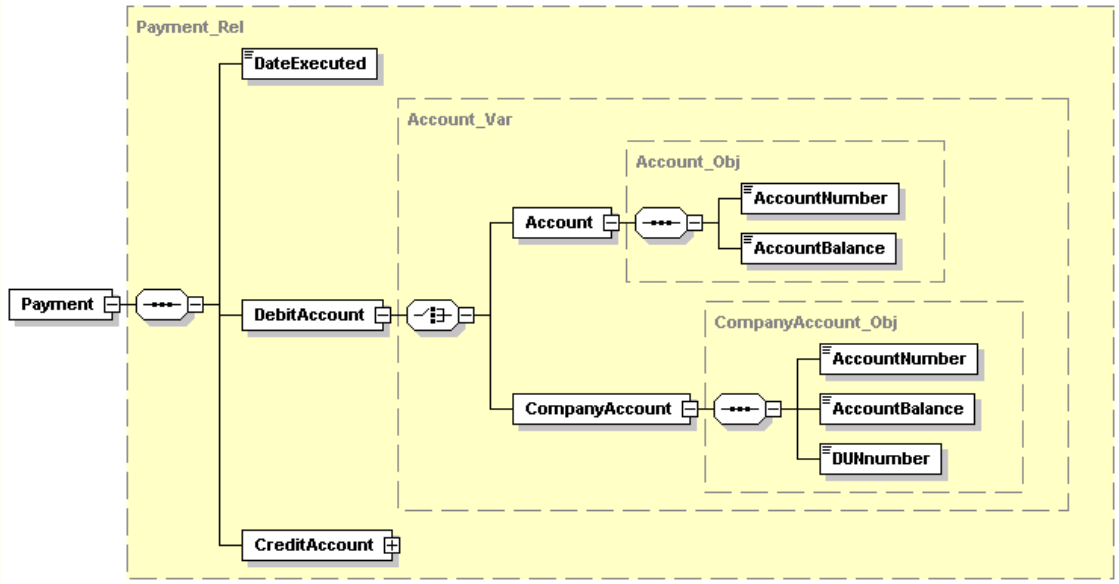


Modelling roles and variants

- A relation with two different roles:



- A relation with two variants for the same object:

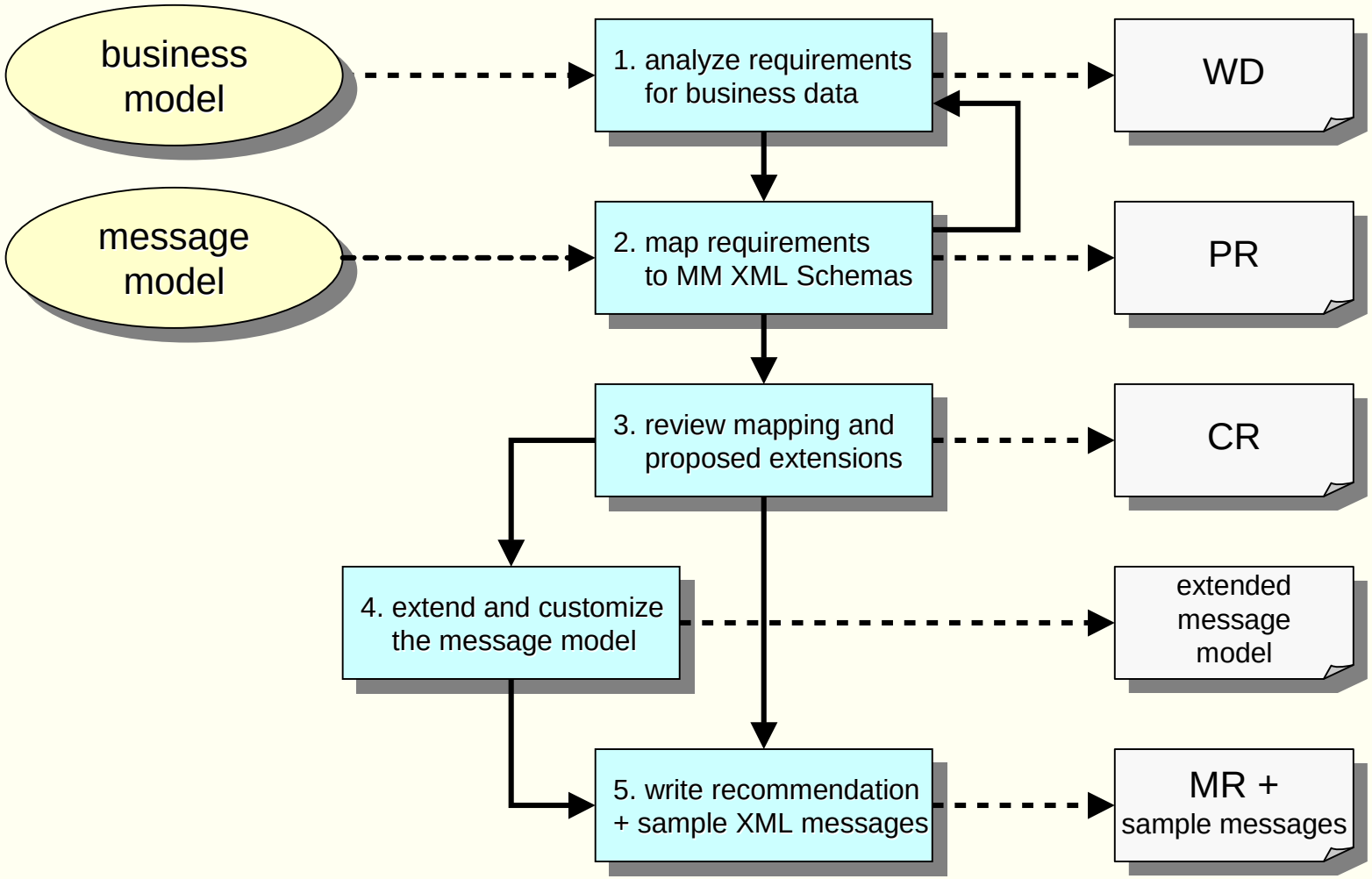


Setting up the modelling process

- Finding the right balance between local and central
  - local activities:
    - business modelling
      - by business analysts
    - local message modelling
      - either by local standards setter
        (if needed supported by central standards setter)
      - or by a central standards setter delegated to the project
  - central activities:
    - building the library of message components
    - monitoring and managing the model evolution
- Coping with the planned evolution of the modelling process
  - now: in-house standards setting department
  - in the future: joint standards setting body ("out-house")

  è the W3C model is designed for efficient joint standards development

The modelling process



The modelling process

- Modeling is about defining *shared* standards **è** modelling process is inspired by the W3C standardization process
  - Working Draft (WD)
    - written by business analysts using business model concepts
  - Proposed Recommendation (PR)
    - written by local standards setters, helped by the central standards setters
  - Candidate Recommendation (CR)
    - after review of the PR by the central standards setters
    - if necessary, central standards setters modify/complete the message model
  - Message Recommendation (MR)
    - used by the local developers and the central developers
- Responsibility shared by the local business analysts, the local standards setters and the central standards setters
  - lots of meetings & lots of discussions, but central dept. has the last word

Conclusions

- Complete design process for XML messages for EAI
  - business model **è** message model **è** message implementation
  - using a W3C-inspired joint modelling process
- Use of XML Schemas to model messages at a high level
  - platform and technology-neutral data modelling standard
  - “runable data models” that can be used for code-generation
- Use of XML Schema Adjuncts for application-specific details
  - business analysts should focus on message content modelling
  - application developers can focus on message mapping/processing
- Open questions:
  - how to handle large numbers of XML Schemas/Adjuncts?
  - how to version an XML Schema and its Adjuncts?

  è started to evaluate XML Schema repositories