Integrating registry systems

Sacramento, California, 25 September 2015
A registry… for whom?

II. Registry requirements

A. National registries

17. Each Party included in Annex I shall establish and maintain a national registry to ensure the accurate accounting of the issuance, holding, transfer, acquisition, cancellation and retirement of ERUs, CERs, AAUs and RMUs and the carry-over of ERUs, CERs and AAUs.

18. Each Party shall designate an organization as its registry administrator to maintain the national registry of that Party. Any two or more Parties may voluntarily maintain their respective national registries in a consolidated system, provided that each national registry remains distinct.
Consolidation, network topology, centralized vs decentralized vs distributed

Consolidated
(100%)

Network topology

Hub and spoke
Reporting, review and the registry systems

1. Reporting

2. Review

3. Compilation & accounting database (CAD), CDM-IS, JI-IS, …

4. ITL

5. Registries

GHG Emissions

Accounting tables

Changes

Limits, parameters

Transactions

Public information
B. **Infrastructure**

18. The interface between registry systems shall operate through a central communications hub integrated with the transaction log.
How to represent units?

- Do not represent units individually: quantities only
- As destination address of transactions (→ bitcoin) ?
- As serial numbers / „unit blocks“

ISO 3166 ++
ISO 3166-2:XX
Zipcodes
IdCards, SSN
Centrally defined

Core properties (always part of a tx)

Issuer | Start | End (or Length) \}
\{ Technical validations

Determine

Additional properties (not necessarily part of a tx)

Unit type | Supp unit type | Issued CP | Applicable CP
Project | Expiry date | Color | ...

14. Each unique serial number assigned by a registry to a unit shall consist of at least the elements contained in table 2\(^2\), in accordance with formats and codes to be developed.

20. Each ERU, CER, AAU and RMU shall be held in only one account in one registry at a given time.
Transaction types, purpose, account types and accounts

Transactional needs

Registry

Generic model

Registry
The necessity for a transaction log

**Question:** How does registry B know that registry A owns the units it wishes to transfer?

**Possible answers:**

1. Because the system is 100% consolidated, and because the design of said system ensures that...
   - Flaw in design/review $\rightarrow$ Potentially catastrophic failures

2. Because registry A can provide a (mathematical) proof that it owns the units
   - Ongoing research? Very challenging to implement...

3. Because X\% of all other registries confirm that registry A owns the units
   - Subject to availability of other registries; introduces delays; can lead to „majority attacks“

4. Because the notary says so!
   - Need to trust the notary, introduces a SPOF
   - Resilience +
   - Location transparency +
   - Openness +
   - Scalability +
   - Security +
   - Need to keep in sync!
Keeping systems synchronized

1. Time

2. Records

- Which records? **Holdings**, transactions, limits/levels, account holders, ...?
- Frequency? **24 hrs**, other?
- What to do when inconsistency is detected?
  - Provide transactional information
  - Freeze units involved
  - Correct (if necessary)
  - Re-run, unfreeze units if all fine

- Time drift
- Inconsistency

Alert!
Reconciling records – unit blocks

1. Principle

<table>
<thead>
<tr>
<th>Issuer</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>BE</td>
<td>101</td>
<td>200</td>
</tr>
<tr>
<td>BE</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>FR</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>FR</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

2. Extension

a. More groups/filters

<table>
<thead>
<tr>
<th>Unit type</th>
<th>Supp unit type</th>
<th>Issued CP</th>
<th>Applicable CP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. Drill through unit blocks
c. Lock inconsistent blocks
d. Compare transactional history of inconsistent blocks

3. Hashing & Merkle tree

<table>
<thead>
<tr>
<th>Issuer</th>
<th>Start</th>
<th>End</th>
<th>CRC-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>1</td>
<td>100</td>
<td>CA89</td>
</tr>
<tr>
<td>BE</td>
<td>101</td>
<td>200</td>
<td>2F6E</td>
</tr>
<tr>
<td>FR</td>
<td>1</td>
<td>100</td>
<td>4DFC</td>
</tr>
<tr>
<td>JP</td>
<td>501</td>
<td>550</td>
<td>5D98</td>
</tr>
</tbody>
</table>
### Registry proposes 30 units

<table>
<thead>
<tr>
<th>Issuer</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>1</td>
<td>100</td>
</tr>
</tbody>
</table>

Split!

<table>
<thead>
<tr>
<th>Issuer</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>31</td>
<td>100</td>
</tr>
</tbody>
</table>

### Counter-measures

- Prefer „foreign blocks“
- Select largest blocks first (greedy, fast) or...
- Use algorithm for packing blocks into transactions (optimal, slow)
- Defragment periodically
Designing a transaction protocol

Registry  ITL

Registry  ITL

60 sec

Registry  ITL

VPN  HTTPS  SOAP

24 hrs

Legend:
- Operend/Channel
- Unauthorized
- Operational/State
- Operational/Non-State
- No Error States
- Business Error States
Some operational figures

**Completion time**

- # of transactions ever proposed: 580,788
- # units in transactions: 175,597,231,021
- # units: 70,332,502,949
- Availability: 99.9%

**Inconsistent reconciliation ratio**

**Cancellation & termination ratio**
Back to business! How to add a new „mechanism“ (1)?
Back to business! How to add a new „mechanism“ (2)?

1. Extension of concepts (by subtyping)

<table>
<thead>
<tr>
<th>Tx Type</th>
<th>Unit Type</th>
<th>Account Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supp Tx Type</td>
<td>Supp Unit Type</td>
<td>Supp Account Type</td>
</tr>
</tbody>
</table>

2. Transparent routing of generic messages

3. Extending dynamically the content of messages (incl tx)

4. Carefully phrased requirements

   „The amount to be taken into account for compliance purposes is the amount of units contained in the retirement account of the Party concerned“.

   vs

   „... of AAUs, CERs, ERUs, RMUSs ...“

   vs

   „... of Kyoto Protocol units...“
Institutional arrangements

- COP / CMP
  - Decision making bodies

- Subsidiary Bodies (SBII / SBSTA)
  - Technical and implementation advice

- RSA Forum / ITL Administrator
  - Responsible for implementing registry systems

- Working groups
  - Where the practical work gets done!

Annual report

Diagram:
- End users
- Downstream systems
- Registry
- ITL

Guidance only (or nothing)
External requirements & Guidance
Technical requirements
The functions of the ITL administrator are assumed by the UNFCCC secretariat.

Activities:

a) Support the initialization and go-live of registries
b) Develop and maintain the Data Exchange Standards (DES)
c) Organize and support the RSA Forum and working groups and facilitate the cooperation between RSAs
d) Maintain the ITL software and infrastructure, including: Ensuring the reliability, security and performance of the ITL
e) Develop maintain all common operational procedures and support their execution
f) Support the intergovernmental negotiation process
g) Manage administrative activities (extranet etc.)
h) Publish, on an annual basis, the report of the ITL administrator on organizational arrangements, activities and resource requirements
Common operational procedures

The “contracts“ between RSAs and the ITL administrator:

- Incident management
- Problem management
- Change management
- Release management
- Securing registry systems
- Secure called authentication
- SSL certificate renewal procedure
- Registry off/on line
- Reconciliation procedure
- Transaction reversal
- Independent assessment reporting
- Contact management

ITL Service Desk
Terms of Use
...
Reporting, review and the registry systems

1. Reporting

2. Art 8 Review

3. CAD

4. ITL

5. Registries

Accounting information

Changes

Independent Assessment Reporting
- Specialized in registry matters
- 24/7 service
- World wide support
Project implementation

**Budget**
- Yearly ITL budget: less than 3M EUR
- Budget does not include initial investment / re-investments
- Estimation for initial investment: 4M – 6M EUR

**Lead times**
- General design requirements: 2 years
- Initial drafting of the DES: 2 years
- Common operation procedures: 3 years
- ITL development: 2 years (started in 2005 and was put in operation in 2007)
- Release of the ITL: 3 months minimum
- Connection of a registry to ITL: 3 months minimum
Thank you!

Questions?

Next steps?