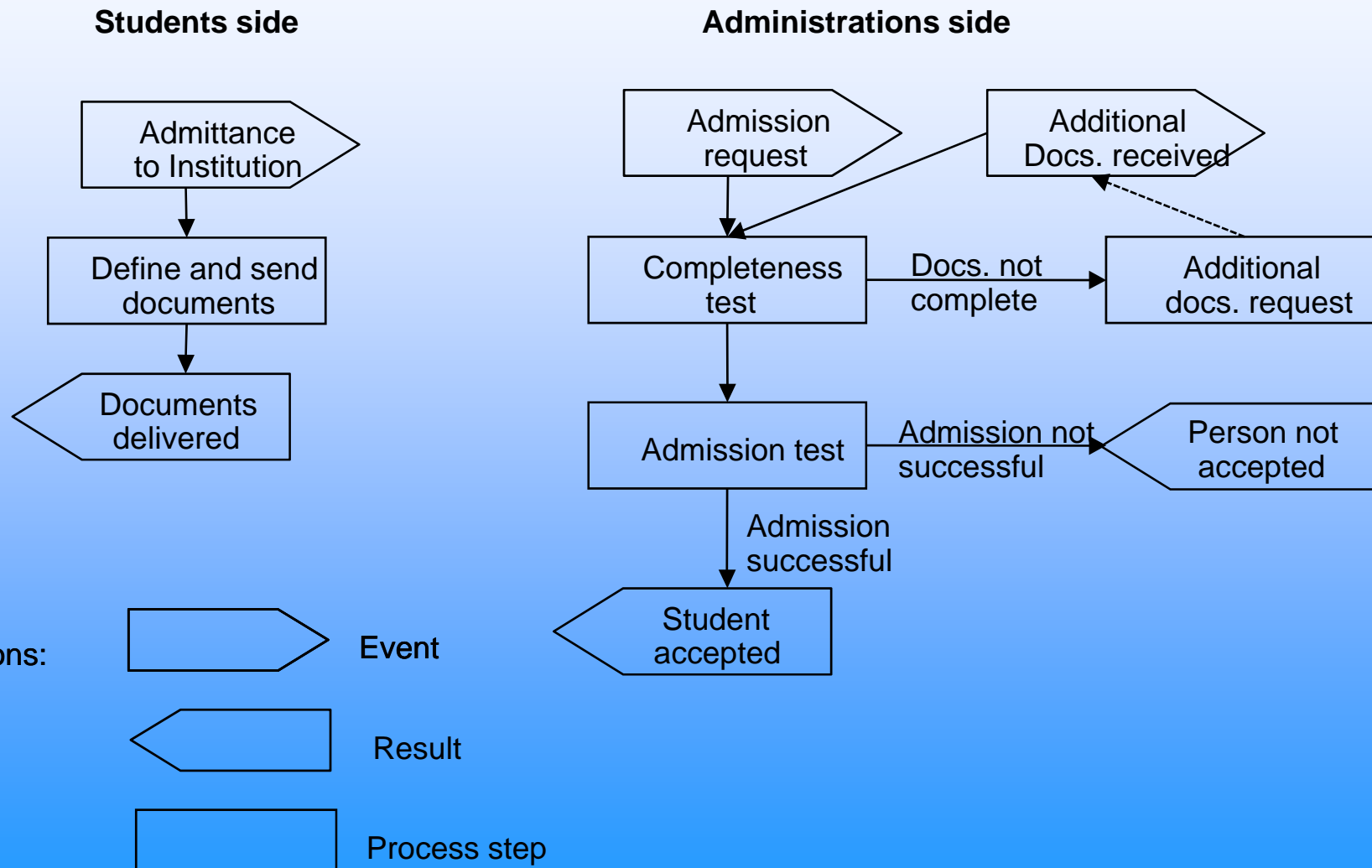# Long Term Management
of
Private Digital Assets

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Observations

- ## Growing amount of individual digital assets:
  - Personal digital photos: these should be accessible to great-grandchildren
  - Contract documents that hold claims against third parties for decades
  - Personal communication like e.g. love-letters (e-mail, SMS)
  - Certificates, degrees etc. from professional organisations or universities

- ## Individual assets are or will be used via networks:
  - On-line admission to universities and other organizations
  - On-line / off-line digital documents like driving licence, passport etc.
  - Internet based personal services like banking, shopping etc.

- ## Result: Digital artefacts of individuals are of growing importance

Example: paperless student administration

Students side

Administrations side

```
┌─────────────────┐
│   Admittance    │
│  to Institution │
└────────┬────────┘
         ↓
┌─────────────────┐
│ Define and send │
│    documents    │
└────────┬────────┘
         ↓
┌─────────────────┐
│    Documents    │
│    delivered    │
└─────────────────┘
```

```
┌──────────────┐          ┌────────────────┐
│  Admission   │          │   Additional   │
│   request    │          │ Docs. received │
└──────┬───────┘          └────────────────┘
       ↓                           ⋮
┌──────────────┐  Docs. not  ┌────────────────┐
│ Completeness │  complete   │   Additional   │
│     test     │────────────→│  docs. request │
└──────┬───────┘             └────────────────┘
       ↓
┌──────────────┐ Admission not  ┌────────────────┐
│Admission test│  successful    │   Person not   │
│              │───────────────→│    accepted    │
└──────┬───────┘                └────────────────┘
       │ Admission
       │ successful
       ↓
┌──────────────┐
│   Student    │
│   accepted   │
└──────────────┘
```

Icons:

- Event
- Result
- Process step

Requirements / Goals

- Requirements for Private Digital Asset Management:
  - Provide long term **preservation** of digital assets (LPDA: long living private digital asset)
  - Digital assets must be **accessible** to humans today and in the future (accessible via eyes, ears, …)
  - Digital assets are used (on-line) in **transactions controlled by owner**

- Resulting efforts
  - Digital assets should not depend on hardware/software/networking technologies
  - Digital assets must autonomously migrate into future environments
  - Secure interaction / exchange of assets assured in the long run

- Individual needn't (shouldn't!) care!

Known solutions / approaches

- Long term management of digital information:
  - Archaeological approach (secure old systems completely)
  - Emulation of old in existing (new) infrastructure (HW / SW)
  - Manual migration on a regular basis (e.g. every 2nd decade)
  - Special architectures for migration (e.g. UVC)
  - Technical support for migration (e.g. PLM)
  - HD-Rosetta (microscopic text on hardened nickel surfaces)
  - …

- Secure on-line asset exchange:
  - Public key infrastructure for trustful interactions
  - Re-signature of assets necessary in the long run

Our approach

Provide Private Digital Asset Management in Time via:

- Virtual machine for
  - Persistent and secure storage (extension of the J2EE DAO pattern)
  - Information exchange (extension of J2EE TO pattern)
  - Metadata explicitly provided for each LPDA
  - Ontology for mapping each LPDA into private context

- Proactive Agents
  - Monitoring changes in the virtual machine instance: activating migration process if necessary
  - Monitoring the environment of the virtual machine: activating re-signature of assets if necessary

Digital Asset Management in Time

Cyberworld

Insert asset

Migrate assets

Retrieve asset

Sign asset

IDI (U1,T1)

LPDAs

IDI (U1,T3)

LPDAs

Re-signature (third party assets)

Re-signature (own assets)

IDI (U2,T2)

LPDAs

t
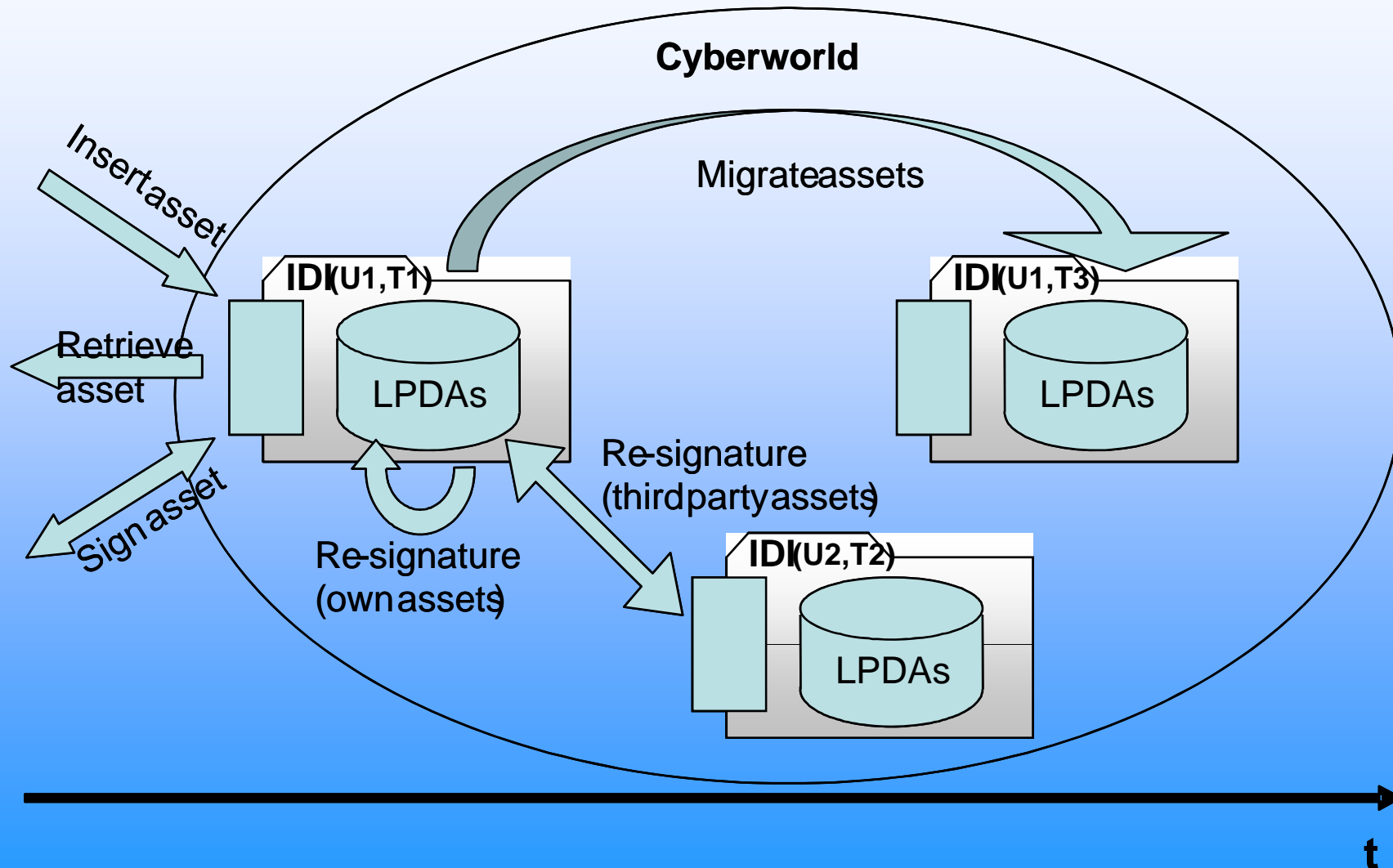
Supporting Technology:
Metadata and Ontology

- **Meta data**
  - Self-contained data (and meta data)
  - Extends standard RDF-types by
    - Formatting information (in abstract syntax)
    - Presentation algorithm (in abstract syntax)

- **Ontology**
  - Self-aware data and it-infrastructure
  - "Knows" IT infrastructure
    - Old and new,
    - Abstractions of storage principles, database formats, communication channels, security features, …
    - Hints for migration process

Architecture of Prototype
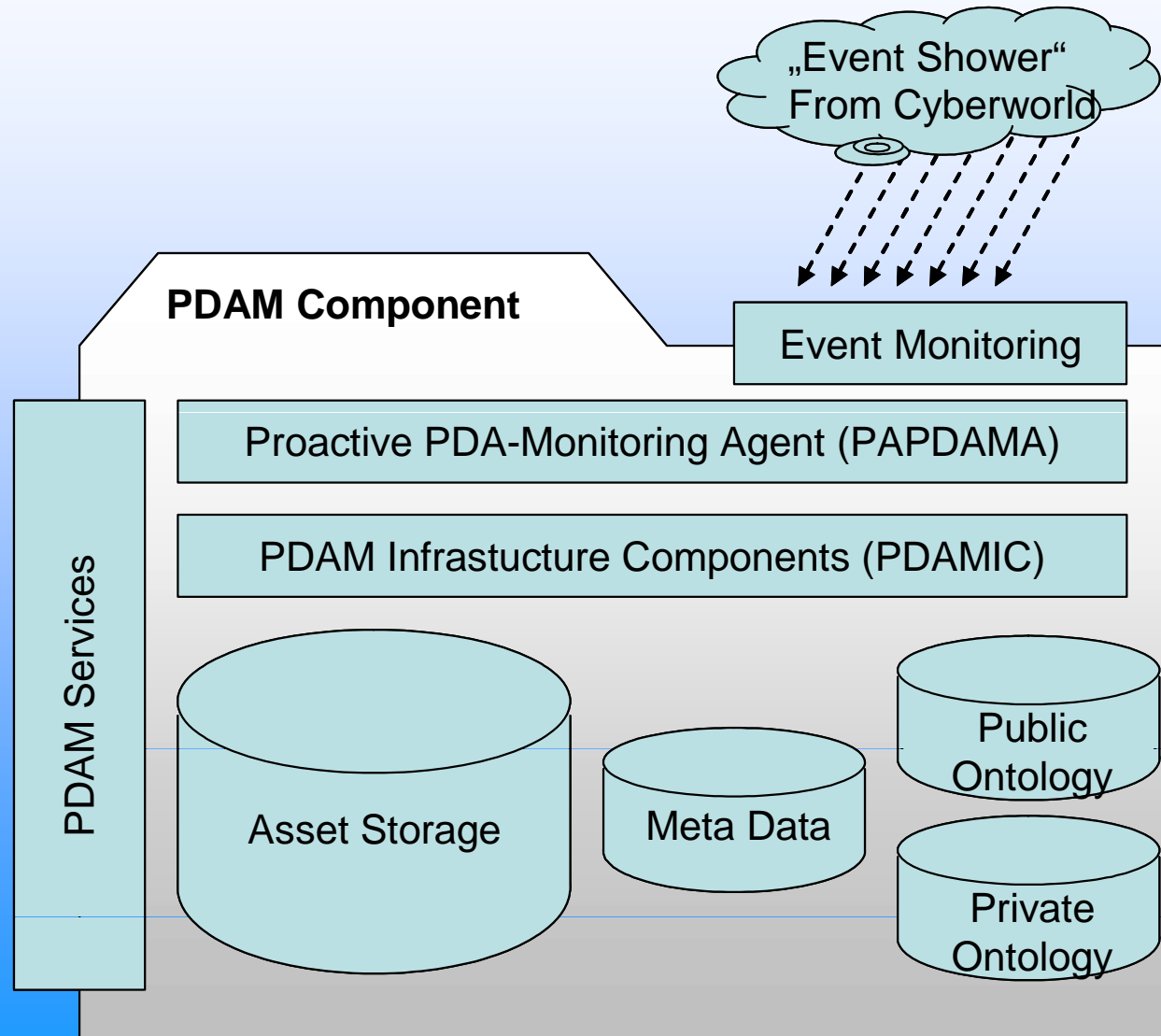
Re-Signature of a digital asset
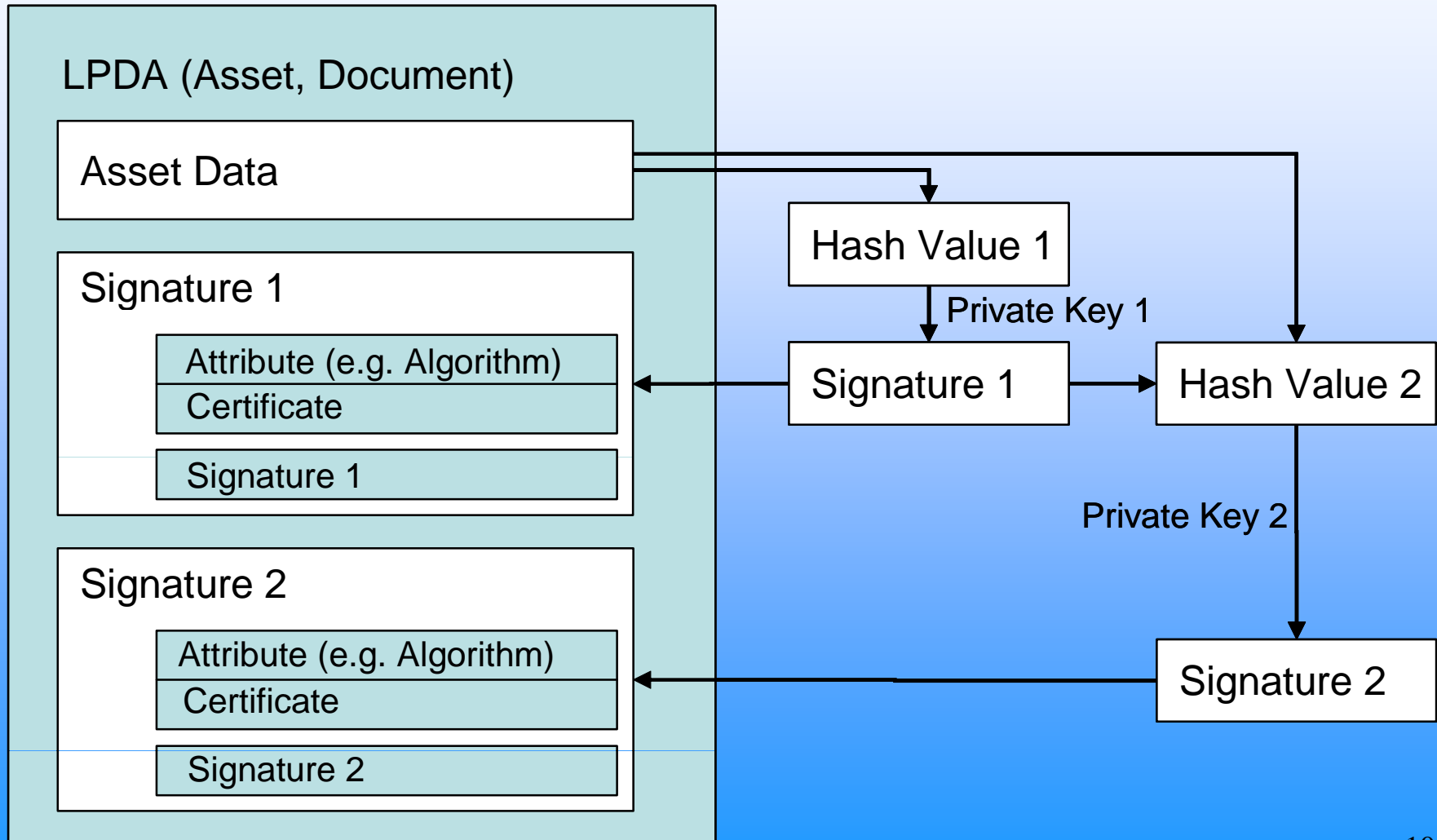
The Migration / Preservation Process

- As much automated as possible

- Set-up for process (by IT-System supplier)
  - Define meta data for long term preservation
  - Define data conversion frames where necessary
  - Define migration ontology for migration of existing IT

- Process: each time a new IT-infrastructure is to be installed
  - Get Migration Ontology of new IT
  - Generate or construct migration routines (fill out frames)
  - Migrate data onto new platform
  - Migrate meta data onto new platform
  - Update archiving ontology of new IT
  - Get rid of old infrastructure

Status / Open Issues

- **Feasibility study ongoing**
  - PDAM based on virtual machine approach
  - Content of ASCII / UNICODE documents well suited
  - Open document infrastructures dito (e.g. TeX)
  - Standard Ontology technology incorporated
- **Open Issues**
  - Layout information critical
  - Graphics and pictures even more critical
  - Concentrate on well defined open formats for non-character-information (which one?)
  - Ontology must evolve over a very long time period (centuries)
  - Private Ontology not well understood
- **Other topics**
  - Ontology: "intelligent manual", if necessary for future users
  - Proactive objects with own volition to survive migration of infrastructure might be the future

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Thank you!