CIP4 Technologies II
JMF and XJMF

JDF Communication Model
AuditPool
Digital Planning Board
(X)JMF Message Family
Examples: Job Submission, Abort Job, Device Capabilities
ICS

Thomas Hoffmann-Walbeck
Summary about (X)JMF Communication

- CIP4 does not specify how (X)JDF data is communicated.
- The JDF element *Auditpool* contains a production protocol after the process is done with the execution.
- JMF and XJMF is a messaging formats which (often) goes together with JDF and XJDF.
- Among other things, these messaging formats transport operational data.
  
  » The “SMS” in the graphical arts industry to inform about the current status of a device, for example

- Interoperability requirements (ICS) of (X)JDF devices and controllers.
Original JDF Communication Model

Initiates JDF

Distributes & collects JDF

Interprets JDF, controls a machine

Executes a process
Assets are referenced

- Assets are not part of the (X)JDF files.
  - They are stored in a file system or in a database.
  - Assets are not forwarded via JDF/JMF but rather referenced

Customer database
- Production sequences
- Machine specifications

Paper database
- Content data
- ICC profiles
- Machine settings

JDF Agent
JDF Controller
JDF Device
Production Protocol: Audits

- Summary report of a process at the end of execution.
- Data for later use, e.g., for production cost analysis.
  - Who created, modified or deleted a JDF-node at what time,
  - Process times (Start, End,...),
  - Status of process end (Completed, Aborted, Stopped,...),
  - Used, generated or missing resources (paper etc.).
- After a process is terminated the Audits should not be changed any more.
- Audits are pooled in AuditPools.
Example of a Basic JDF Node

JDF-Node

- ResourcePool
- ResourceLinkPool
- AuditPool
Audit Element PhaseTime

- A *Phase* is a subsection of a process.
  - Examples: setting up a device, maintenance, washing, downtimes as a result of failure, breaks,…
  - Attributes: *Start*, *End*, *Status*,…
  - Sub-elements of *PhaseTime*: *Device*, *Employee*, *ResourceLink*,…

- In a *ResourceLink* inside the *PhaseTime* element the used or produced resources in a phase are recorded.
  - E.g., *ComponentLink* for a *Component* Resource.
  - E.g., Number of good print sheets that have been produced, number of waste sheets.
Original JDF/JMF Communication Model

Initiates JDF

Distributes & collects JDF

Interprets JDF, controls a machine

Executes a process

MIS

Prepress

Press

Postpress

Agent

Controller

Device

Machine

RIP

Preflight

Console

Console

Console

CtP

Press

Folder

Guillotine

MIS initiates JDF

Prepress distributes & collects JDF

Press interprets JDF, controls a machine

Postpress executes a process
Job Messaging Format (JMF & XJMF)

- Messaging protocol between the parties supporting **dynamic interaction**
  - MIS, production, administration, external companies

- Main tasks:
  - Job submission, job tracking, material consumption, system control, system set-up, queue control, pipe control
  - Real-time messages

- (X)JMF is optional
  - Only ICS at higher levels require some (X)JMF messages

- (X)JMF messages are (small) XML data sets
  - "JMF"/"XJMF" are the root-element; based on http
Digital Planning Board: JDF and JMF
Digital Planning and Metadata (JDF/JMF)

- Integration of MIS and production.
  - MIS provides product and production description via (X)JDF, deadlines for planning software.
  - Production devices provide actual status, material consumption etc. via (X)JMF.
  - XJDF/JDF (parts) are sent to devices with NodeInfo resource in production order.
  - Process dependencies must be observed.
  - The goal is short make-ready times for devices.
  - Manual / automatic planning.
  - Dynamic adjustments to new situations.

- Scheduling is the champions league of integration.
Scheduling

- Scheduling is a crucial task in a **smart factory**.
- The job production order is determined by a scheduler observing different constraints.
  - E.g., availability of resources.
  - The job order needs to be planned from back to front
    - E.g., Deadlines ⇒ Postpress processes ⇒ printing ⇒ platesetting ⇒ RIPing ⇒ imposing ⇒ approval,
    - E.g., shortly before printing a job in offset, plates should be imaged in the right order
  - On the other hand: scheduling for best utilization of devices
    - E.g., Printing order according to material, color, ink coverage, ...
Main Communication (X)JDF and (X)JMF

(X)JDF
1. (Parts of a) Job Ticket
2. Updates, Audits

(XJMF)
3. Commands, Queries
4. Response, Signals
I Am a Folder - You Are My Controller!

What do you tell me? What do you expect from me?

<table>
<thead>
<tr>
<th>JDF</th>
<th>Category</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller2Device</td>
<td>machine set up info</td>
<td>Sheet size = 25x19, fold catalog = F16-6</td>
</tr>
<tr>
<td></td>
<td>job information</td>
<td>JobID, deadlines, number of copies</td>
</tr>
<tr>
<td></td>
<td>Customer Info</td>
<td>Name = &quot;Bob&quot;, Phone: 123456789</td>
</tr>
<tr>
<td>Device2Controller</td>
<td>Report of Process outcome (AuditPool)</td>
<td>Material used, time needed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>JMF</th>
<th>Category</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller2Device</td>
<td>Queries</td>
<td>What is your status? Do you handle job 007?</td>
</tr>
<tr>
<td></td>
<td>Commands</td>
<td>Delete job 007 in queue,</td>
</tr>
<tr>
<td></td>
<td>Registration / subscription</td>
<td>Inform me regularly about your status</td>
</tr>
<tr>
<td>Device2Controller</td>
<td>Response</td>
<td>My current Status is idle</td>
</tr>
<tr>
<td></td>
<td>Acknowledgement</td>
<td>Command completed</td>
</tr>
<tr>
<td></td>
<td>Signals</td>
<td>12% of folding is done</td>
</tr>
</tbody>
</table>
JMF Message Families

- **JMF Query**: Query (Q),
- **JMF Command**: Command (C),
- **JMF Signal**: Periodic status description (S),
- **JMF Response**: Synchronous response to Q or C,
- **JMF Acknowledge**: Asynchronous response to Q or C
- **JMF Registration/Subscription**: Request to send messages/signals to some controller regularly
(X)JMF Examples

- Command: Jobs can be sent by means of the `SubmitQueueEntry` command in two ways.
  - Queue controller gets the job through the file system.
  - Queue controller gets the job over http "get".

- Command: `AbortQueueEntry`.

- Unidirectional messages (often: "fire and forget").
  - E.g., status changes.
  - Receiver can subscribe to signals from the transmitter.
  - The receiver can use it to update a progress bar, for example.
DeviceCapabilities

- I) A controller stores features of devices (hard-wired).
  - E.g., Screening options, number of possible folds, colour zones.

- II) Controller queries features interactively.
  - In JDF called DeviceCapability; Query and Response via JMF.
  - Device must return appropriate information, e.g., possible values for attributes.
  - Complex relationship: number of folds depend on type of paper, folding options depend on the configuration of the machine.
  - Performance values: average set-up time and production speed, resource consumption, ...
  - Implementations? Or rather pre-defined feature set?
Interoperability Conformance Specification

- The (X)JDF specification is enormous and no (X)JDF-compatible software can cover everything
  - (X)JDF-software implements only a subset of the functionality
    This increases the risks of incompatibilities between JDF modules
    A folding machine will not understand press features and, may be, not even all (optional) entries in FoldingParams

- Therefore, well-defined subsets are specified
  - Print production interfaces are specified in several ICS-papers
  - Agreements on (X)JDF entries that should be written or read by entities such as the MIS, prepress, press, finishing...
  - ICS are papers, not machine-readable interfaces

ICS Documents, Integration matrix
ICS Interfaces

- ICS Interfaces are “coarse-grained”.
  - Few “internal“ interfaces are specified, like Layout-Imposition.

- Certifications according ICS requirements.
ICS - Levels

- The ICS Papers specify different levels.
  - E.g., three different conformance levels for ICS-MIS-1.5.
  - Levels are based on each other: level n+1 based on level n.

- Manager-Worker
  - The Manager sends JDF Instances, JMF Messages and other data to a Worker (a Device or Controller) and may receive information back from a worker.
  - The Worker receives JDF Instances, JMF Messages and other data from a Manager (a Controller or MIS) and may send information back to a Manager.

- Each JDF node should state the conformance Level
  - E.g., `ICSVersions="Base_L2-1.5 MIS_L2-1.5"`
Examples for Manager and Worker

- A *Gray Box* is written by a Manager and read by a Worker.
- A process node is supplied by a Manager and read by a Worker.
- The resource *BinderySignature* is written by a Manager and read by a Worker.
- A *Command* is send by the Manager and read by the Worker.
- The *Signals* are written by a Worker and read by a Manager.
Further Information

- JDF and XJDF specifications
- Messaging ICS