Large-Scale Single Pass Inkjet Printing: A Focus on Variable Data Software & High-Speed Datapath Electronics

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Global Inkjet Systems Ltd

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• Single pass inkjet system evolution
• Single pass drivers
• Variable data
  – Partial or fully variable applications
  – Challenges for RIP & workflow manufacturers
  – Content creation
• Typical system architectures
  – Getting data to the printheads – “feeding the beast”
• Advanced printing techniques & configurations
  – Options possible with GIS technology
• Impact of variable data on production pipeline
  – Upstream and downstream from print station
Global Inkjet Systems

- Founded in 2006 – privately held
- Based in Cambridge, UK
- Leading developer of software and electronics for industrial inkjet printheads
- Wide industrial printhead capability
  - Dimatix, Konica Minolta, Kyocera, Xaar etc.
- Portfolio of products
  - Uniti
  - Puriti
- Global coverage
  - GIS products are running on single pass and scanning systems in Asia, Europe, Africa & the Americas
- Proven in production over several years
  - Systems in field driving over 100 printheads
GIS Product Portfolio

OEM
System Integrator
Ink Developer
Industrial User

Uniti
Complete operating system
Variable data RIP
Colour management/layout
tools
Printhead electronics
Driver software

High Volume Wide Format OEM

Puriti
Printhead electronics
Driver software
GIS Uniti

Data Source → Design File → GIS Variable Data RIP → Colour Separation → Linearization → Colour Management

- Layout
- GIS Variable Data RIP
- Colour Separation
- Linearization

- Design File
- Xaar 1001
- Head Personality Board
- Print Manager Board
- Stitching
- Screening

e.g. Xaar 1001
GIS Puriti

OEM’s datapath
3rd party RIP, content creation, colour management, multipass strategies

API

Windows DLL

Print Manager Board

Head Personality Board

Printhead
e.g. Xaar 1001
Scanning vs. Single Pass

- **Scanning**
  - Safe and reliable
  - Errors recoverable
  - Lower productivity

- **Single pass**
  - No room for error
  - Defects highly visible
  - High productivity

Source: GIS
Single Pass System Evolution

Ferro Kerajet
35cm wide
180dpi

Mono
Low res
Variable data

Inca FastJet demo
52cm wide
200x300dpi
1.6m/sec

Dotrix Dot Factory
High res/greyscale
Up to 63cm wide (now)

Miyakoshi MJP600
50cm wide
120 heads

Kodak Prosper
2 up wide 200m/min
175lpi

Kerajet K700/720
1m -1.26m wide

Miyakoshi MJP600
50cm wide
120 heads

Nilpeter/FFEI Caslon
310-420mm wide
greyscale

Fujifilm Jetpress 720
28” x 20” wide
180 sheets/min

Jetrion, CSAT, Durst, Atlantic Zeiser, IIJ, PPSI, Domino......
Single Pass – Commercial Drivers

• Opens up new applications not possible or viable with scanning systems
• Higher volume throughput - matched to production requirements
• Capable of running in-line with analogue presses
  – Modular approach
  – Incorporate advantages of analogue technologies with digital – e.g. flexo pre-coat/varnish stations; post-print finishing/processing

Edale/Agfa - Dotrix
Nilpeter/FFEI - Caslon
Omet/Beijing Founder - X-Jet
PPSI - DICE
Atlantic Zeiser - Gamma/Omega series
Industrial Inkjet – Colourprint series
Single Pass – Commercial Drivers

• Single system vs. multiple smaller systems
  – Potentially fewer operators
• Inkjet perceived as more reliable now
  – Moved from prototypes to full commercialization
  – Market has benefited from the single pass pioneers
• Printheads – larger; higher speed; built-in alignment features; recirculating ink; long life & reliability
Single Pass - Applications

Examples of output systems

- Screen Truepress
- Impika I-Print
- HP T300

Examples of printed output

- Short run cut sheet
- Transpromo
- Books

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Single Pass - Applications

Sun FastJet
Corrugated - sheets
ITW Trans Tech InDecs
Product decoration

Kerajet K700
Tiles
Domino N600
Labels

Barberan BIJ 400
Boards
Agfa Dotrix
Flexible packaging

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## Printheads and Nozzles

<table>
<thead>
<tr>
<th>System</th>
<th># Heads</th>
<th>Total Nozzles*</th>
<th>Print Width</th>
<th>Printheads</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUJIFILM Jetpress 720</td>
<td>52 (CMYK) + BA</td>
<td>106,496</td>
<td>520mm (20.4”)</td>
<td>Samba 14 modules per print bar</td>
</tr>
<tr>
<td>Océ JetStream (per engine)</td>
<td>40 (CMYK)</td>
<td>106,240</td>
<td>515mm (20.3”)</td>
<td>Kyocera KJ4</td>
</tr>
<tr>
<td>System Ceramics Rotodigit-NG</td>
<td>44 to 66 (4 - 6 colour)</td>
<td>22,528 (4 colour)</td>
<td>712mm</td>
<td>Dimatix Sapphire</td>
</tr>
<tr>
<td>Cretaprint Cretaprinter</td>
<td>48 to 128 (3 - 8 colour)</td>
<td>64,064 (4 colour)</td>
<td>1.12m</td>
<td>Xaar 1001</td>
</tr>
</tbody>
</table>

* Does not take into account nozzle redundancy

> 1m wide systems
> > 100 heads
Industrial Inkjet Printhead Data Rates

- Printhead data rates have increased over 100 times over the last 15 years
- Colour/Resolution/Speed/Variable Data/ # of Heads

### Data Rate Per Head (Mb/s)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Nozzles</td>
<td>128</td>
<td>128</td>
<td>500</td>
<td>128</td>
<td>256</td>
<td>512</td>
<td>1024</td>
<td>256</td>
<td>1024</td>
<td>1000</td>
<td>2656</td>
<td>2656</td>
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<tr>
<td>Grey Levels (non-zero)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Bits per nozzle</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sub-drop freq (kHz)</td>
<td>5</td>
<td>30</td>
<td>8</td>
<td>40</td>
<td>20</td>
<td>20</td>
<td>7.6</td>
<td>5.9</td>
<td>26</td>
<td>50</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Native Resolution (dpi)</td>
<td>185</td>
<td>50</td>
<td>180</td>
<td>50</td>
<td>100</td>
<td>360</td>
<td>360</td>
<td>100</td>
<td>360</td>
<td>360</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Head Height (mm)</td>
<td>17.4</td>
<td>64.5</td>
<td>70.4</td>
<td>64.5</td>
<td>64.8</td>
<td>36.1</td>
<td>72.2</td>
<td>64.8</td>
<td>72.2</td>
<td>70.5</td>
<td>108.2</td>
<td>108.2</td>
</tr>
<tr>
<td>Data Rate Per Nozzle (kb/s)</td>
<td>5.0</td>
<td>30.0</td>
<td>8.2</td>
<td>40.0</td>
<td>20.0</td>
<td>13.3</td>
<td>7.6</td>
<td>33.3</td>
<td>11.1</td>
<td>29.3</td>
<td>60.0</td>
<td>90.0</td>
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<tr>
<td>Data Rate Per Head (Mb/s)</td>
<td>0.8</td>
<td>3.8</td>
<td>4.1</td>
<td>5.1</td>
<td>5.1</td>
<td>6.8</td>
<td>7.8</td>
<td>8.5</td>
<td>11.4</td>
<td>29.3</td>
<td>159.4</td>
<td>239.0</td>
</tr>
</tbody>
</table>
Increasing Demands on Print Data

- The demands for print data have increased steadily over last 15 years
- Application Drivers / Quality Improvements
  - **Monochrome vs. Colour**: Process colour requires at least 4 times the amount of data of monochrome
  - **Resolution and Greyscale**: Increasing resolution and moving to greyscale all require more data per square mm
  - **Static vs. Variable Data**
    - **Static**: All print data can be downloaded to print electronics before printing
    - **Partially Variable**: Similar to static data but a small section is downloaded on each print
    - **Fully Variable**: New print data needs to be downloaded every time at the speed it is consumed by the printheads
## Variable Data Applications

<table>
<thead>
<tr>
<th>Application Example</th>
<th>Requirements</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tracking</strong></td>
<td>Data Path&lt;br&gt; RIP&lt;br&gt; Text/Barcode Images&lt;br&gt; Images</td>
<td><img src="image1.png" alt="Tracking Example" /></td>
</tr>
<tr>
<td></td>
<td>Partially variable&lt;br&gt; Real-time&lt;br&gt; Fully variable&lt;br&gt; Pre-cached</td>
<td></td>
</tr>
<tr>
<td><strong>Late Stage Product Customisation</strong></td>
<td>Data Path&lt;br&gt; RIP&lt;br&gt; Text/Barcode Images&lt;br&gt; Images</td>
<td><img src="image2.png" alt="Late Stage Example" /></td>
</tr>
<tr>
<td></td>
<td>Partially variable&lt;br&gt; Offline&lt;br&gt; Static/fully variable&lt;br&gt; Pre-cached/fully variable</td>
<td></td>
</tr>
<tr>
<td><strong>Number Plate Printing</strong></td>
<td>Data Path&lt;br&gt; RIP&lt;br&gt; Text/Barcode Images&lt;br&gt; Images</td>
<td><img src="image3.png" alt="Number Plate Example" /></td>
</tr>
<tr>
<td></td>
<td>Fully variable&lt;br&gt; Real-time&lt;br&gt; Fully variable&lt;br&gt; Pre-cached</td>
<td></td>
</tr>
<tr>
<td><strong>ID Card/Passport Printing</strong></td>
<td>Data Path&lt;br&gt; RIP&lt;br&gt; Text/Barcode Images&lt;br&gt; Images</td>
<td><img src="image4.png" alt="ID Card Example" /></td>
</tr>
<tr>
<td></td>
<td>Fully variable&lt;br&gt; Real-time&lt;br&gt; Fully variable&lt;br&gt; Fully variable</td>
<td></td>
</tr>
<tr>
<td><strong>Natural Material Printing</strong></td>
<td>Data Path&lt;br&gt; RIP&lt;br&gt; Text/Barcode Images&lt;br&gt; Images</td>
<td><img src="image5.png" alt="Natural Material Example" /></td>
</tr>
<tr>
<td></td>
<td>Fully variable&lt;br&gt; Offline&lt;br&gt; N/A&lt;br&gt; Pre-cached</td>
<td></td>
</tr>
</tbody>
</table>
Content Creation and Management

- **Existing technologies**
  - Adobe PDF, JDF and VDP
  - Workflow management
  - Custom Application Tools
    - Label Design Software
    - CD Design Software
    - GIS Layout tool etc
- **Is “Adobe Inside” right for all?**
  - Appears to be the trend
  - All but niche players could adopt PDF/JDF and move away from TIF/BMP etc.
Challenges for RIP and Workflow Manufacturers

Graphics Designers | Jobs | Partially Variable Print Engine | Partially Variable Output

Single pass inkjet press

Jobs 11712, 11713, 11714, 11715
Challenges for RIP and Workflow Manufacturers

- Fully variable print applications require vast amounts of data and artwork
- Single pass inkjet press

Jobs:
- Job 11712
- Job 11713
- Job 11714
- Job 11715

Graphics Designers
Jobs
Fully Variable Print Engine
Fully Variable Output
Getting Data to the Printheads

Speed isn’t everything.....

Print Server  Data Path Electronics  Printheads

RIP Servers

A  B  C

Speed and reliability of network, latency.

Speed and reliability of hardware; maximum cable lengths; cost; connectors.

Speed, reliability, waveform generation and quality, error correction etc.

...reliability, cost etc. also factors
Large Single Pass System
Single PC Architecture Example

Simple Single PC Solution
• Limited Processing Speed
• Limited Memory Bandwidth
• Limited Peripheral I/O
• Slow Start Up
• Limited Variable Capability

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Large Single Pass System
Multi-PC Architecture Example

PC running GIS master controller software

TCP/IP (Network)

Slave 1
Slave 2
Slave 3

PCs running GIS software

User Interface

Full Variable Data Capability

1250mm
2000mm
Advanced System Configurations

• Further complexity

• Mixed technology printheads
  – One technology of printhead for precoat or post-varnish
    • Large drop volume
  – Second technology of printhead for image
    • Small/greyscale drops

• Mixed printhead resolutions
  – Single printhead technology – running bars or colours/fluids of printheads at different resolutions
  – E.g. Precoat or varnish in binary mode; image in greyscale
Impact of Variable Data on Production Pipeline

• **Upstream from print station - “feeding the beast”**
  – Variable data management
  – Job change management
  – More complex workflow
  – More content designers
  – Must be in production 24/7
  – Cost model and benefits
    • Is the demand really there?
  – Customer education
    • Capabilities of variable data printing – training etc

• **Downstream from print station - “processing the output”**
  – Flexible interleaved production runs
    • Short and long runs
  – Post-print processing
  – Customer education on capabilities
  – Consumer education
Summary

• Single pass systems growing in width/numbers of printheads/speed
  – 100’s printheads; > 1m wide
• More applications demanding fully variable data
  – Where will variable really make money?
• Will the future become dominated by “Adobe Inside”?
• Much should become clearer by Drupa 2012
Thank You – Any Questions?

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PS. Look out for our new web site – coming soon!