Single Pass Printing for Labelling & Packaging - A Software & Electronics Perspective

Presented by

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AWA Labelling & Packaging Print Seminar

8-9 November 2011

AWA
Conferences & Events

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Agenda

- **Single pass systems**
  - Labelling, packaging
  - Product decoration
    - The move to no labels
- **Stitching & colour registration**
- **Data processing**
- **Production issues & challenges**
  - Zero gap & overlap printing
  - Pause, rewind, resume
- **Curved surface printing**
  - Direct product printing – no label

Single Pass Evolution – Labelling & Packaging

IIJ
Up to 35 cm wide

Inca FastJet
104 cm wide

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

PPSI - DICE
Up to 56cm wide

Agfa Dotrix
63cm wide

CSAT

Mono
Low res
Variable data

Dotrix Dot Factory
High res/greyscale
2 heads wide

Nilpeter Caslon
310-420mm wide
greyscale

Linoprint

Jetrion 4900

Domino N600

Long established
single pass systems

DRUPA 2000 **DRUPA 2004** **DRUPA 2008/ IPEX 2010/ Label Expo 2011**

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Single Pass Evolution – Industrial Manufacturing

MS Italy La Rio
Up to 75m min
1.6m wide

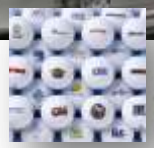
Textiles

Ceramic Tiles

Kerajet K700/720
1m -1.26m wide

XY Scanning machines

SMT Digital



ITW TransTech
InDecs

Industrial Product Decoration

Ferro Kerajet
35cm wide
180dpi

Laminates

Food

2000

2008

2010/2011

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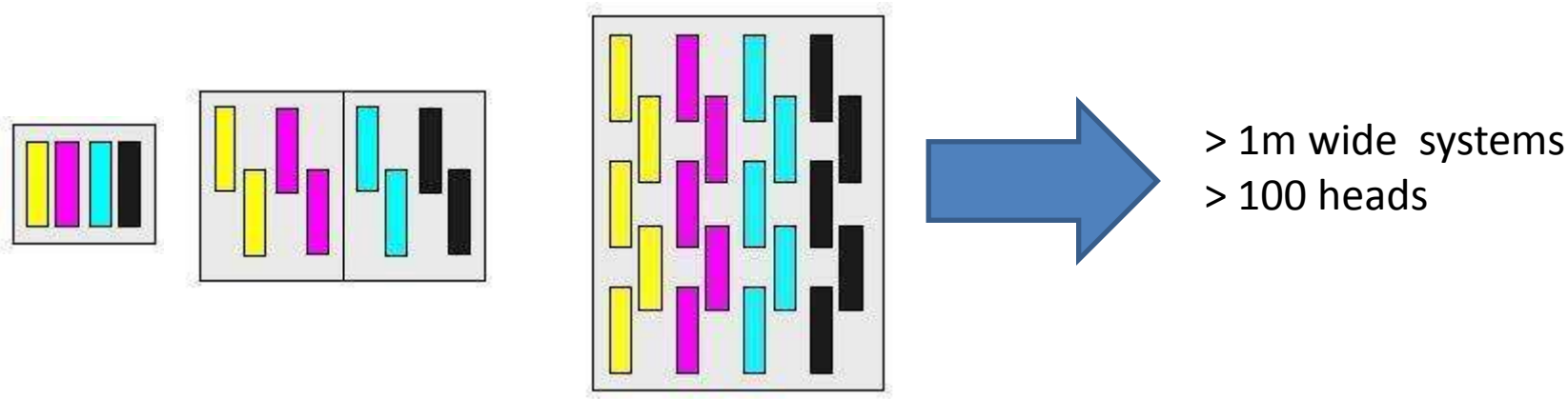
Single Pass Evolution – Number of Printheads



Product	Printhead Type	# Printheads	Colours
Nilpeter: Caslon	Xaar 1001	Up to 24	CMYK
Agfa: Dotrix Modular	TTEC	Up to 72	CMYK + OV
Cretaprint: Cretaprinter	Xaar 1001	Up to 96	Up to 8
MS Italy: La Rio	Kyocera KJ4	Up to 120	Up to 8

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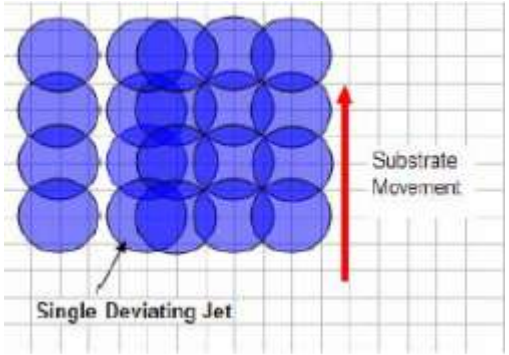
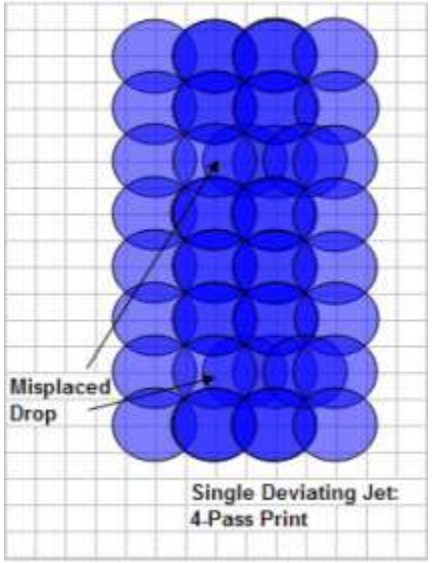
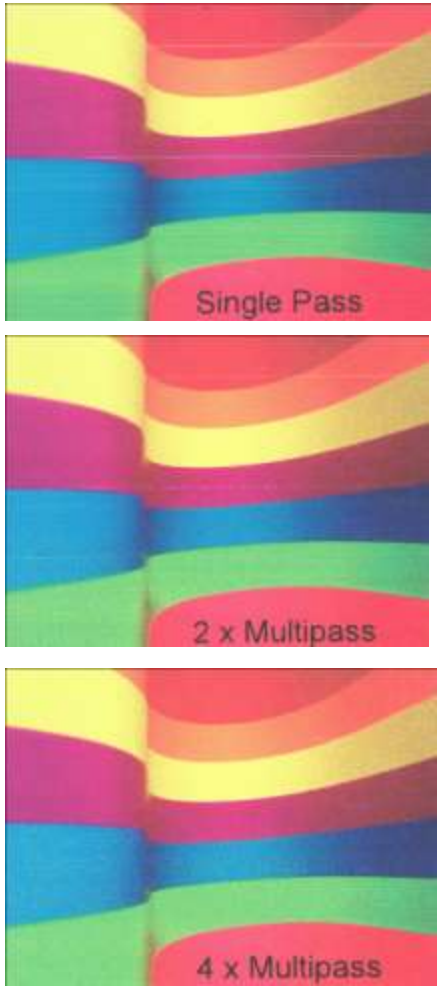
Scanning vs. Single Pass

- **Scanning**
  - Safe and reliable
  - Errors recoverable
  - Lower productivity
- **Single pass**
  - No room for error
  - Defects highly visible
    - Missing nozzles
    - Jet straightness
    - Consistent jet velocity
  - High productivity
  - Reliability critical







Source: Industrial inkjet

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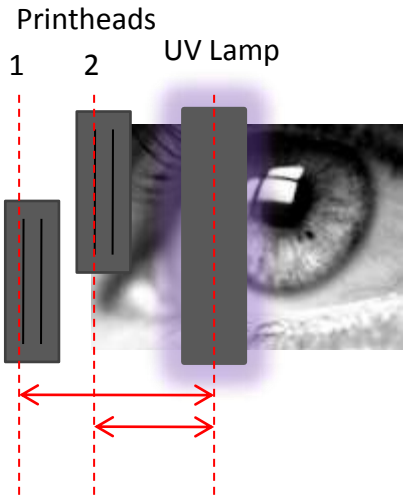
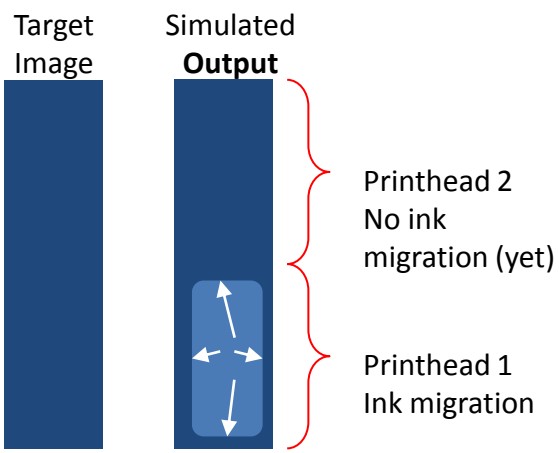
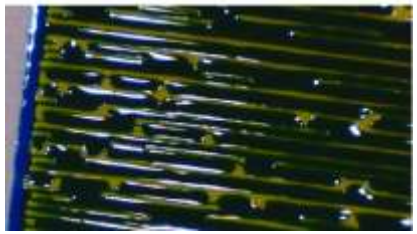
Printhead Stitching

- **Why is a good stitch important?**
  - The human eye is very good at spotting discontinuities especially in areas of flat colour
- **What needs to be controlled?**
  - **Printhead alignment** : typically positioned to within <20% of the diameter of a drop
  - **Printhead calibration** : printheads ideally need to be tuned for jet straightness and drop size conformity
  - **Ink substrate interaction** : Ink moves over time creating visible artefacts – ink migration control
- **Stitched printheads do not all jet in the same place at the same time**
- **Some will be printing *wet on dry* while others will print *wet on / near wet***







Reticulation
Source: Industrial Inkjet

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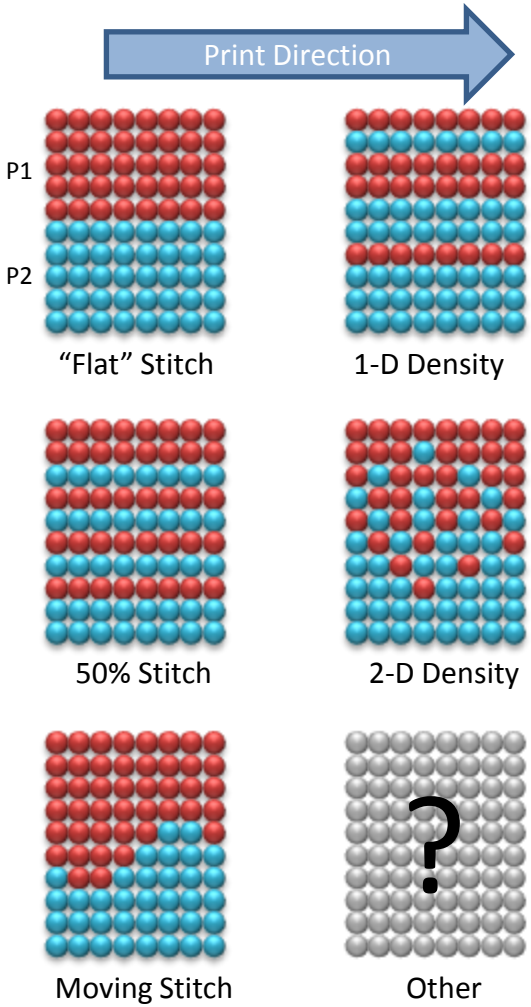
Stitching Strategies

- **Digital stitching strategies**
  - Can massively improve output quality
  - Different applications benefit from different strategies
- **50% stitch**
  - Printing with alternating lines from each printhead in the region of overlap. Simple to implement
- **1-D density**
  - Density gradient blend from 1 printhead into the next in the cross print direction
  - Good where media can stretch. Better than 50% stitch
- **2-D density**
  - Same as 1-D but with dithering in the print direction
  - Better than 1-D but requires excellent media control to avoid white gaps
- **Moving stitch**
  - Typically a sinusoidal or saw tooth stitch that disrupts the visible stitch line
  - Can be improved by using different frequencies for each ink

Digital Stitching Strategies



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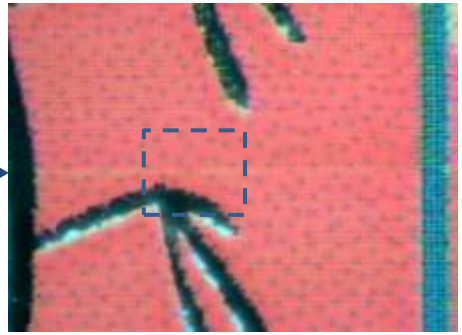
Stitching Examples

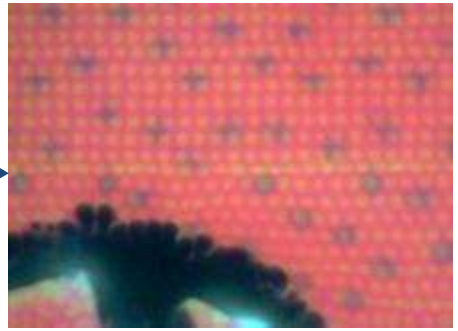
"Flat" or "No" Stitch across flat colour

Stitch Line



Higher Density Bands

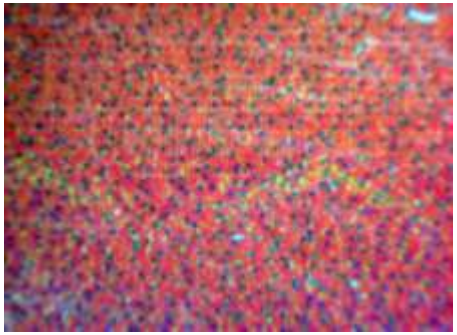
Stitch Line



'Moving Stitch' across flat colour

Stitch Line

Stitch Line



- **Software solutions**
  - GIS tools give customers the power to develop their own stitching strategies
  - Choice all depends on the application and substrate

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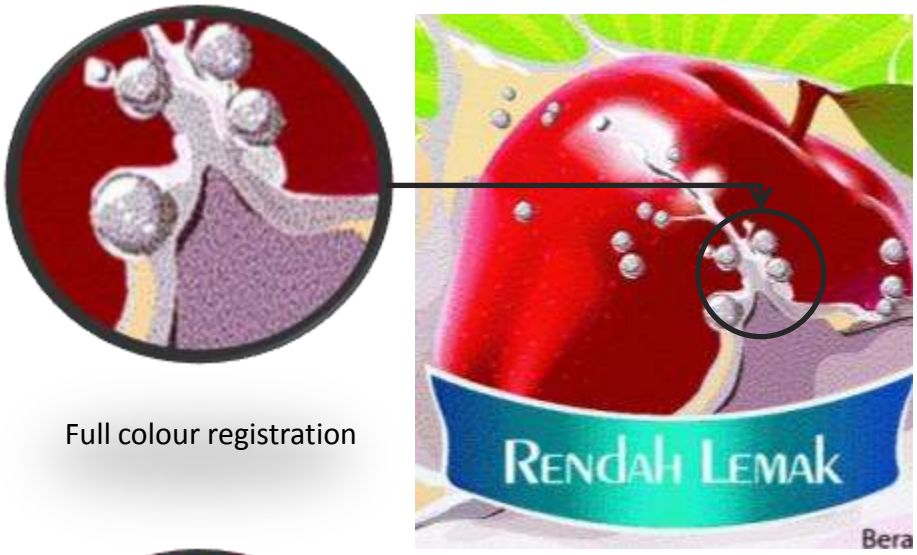
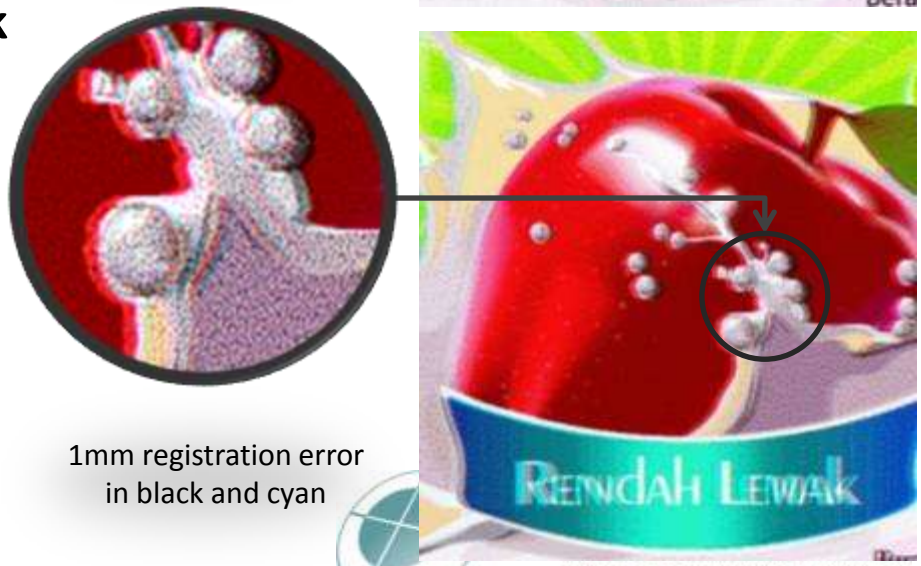
Poor Colour Registration Image Effects

- **Images are less clear**
- **Text less readable**
- **Fine detail is lost**
- **Colours are not accurate**
  - Gamut reduced
- **Some images look worse than others**
- **Mono text & graphics tend to look ok**



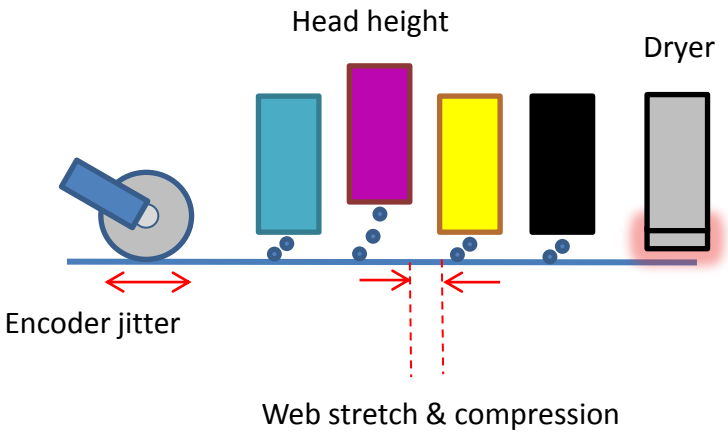
Full colour registration



1mm registration error
in black and cyan

Causes of Poor Colour Registration

- **Mechanically misaligned printhead/s**
- **Time of flight variation**
  - Printhead waveform settings
  - Height off the substrate
- **Encoder noise/jitter**
- **Substrate/web errors**
  - Web weave
  - Web stretch and compression
- **Media wetting/drying**



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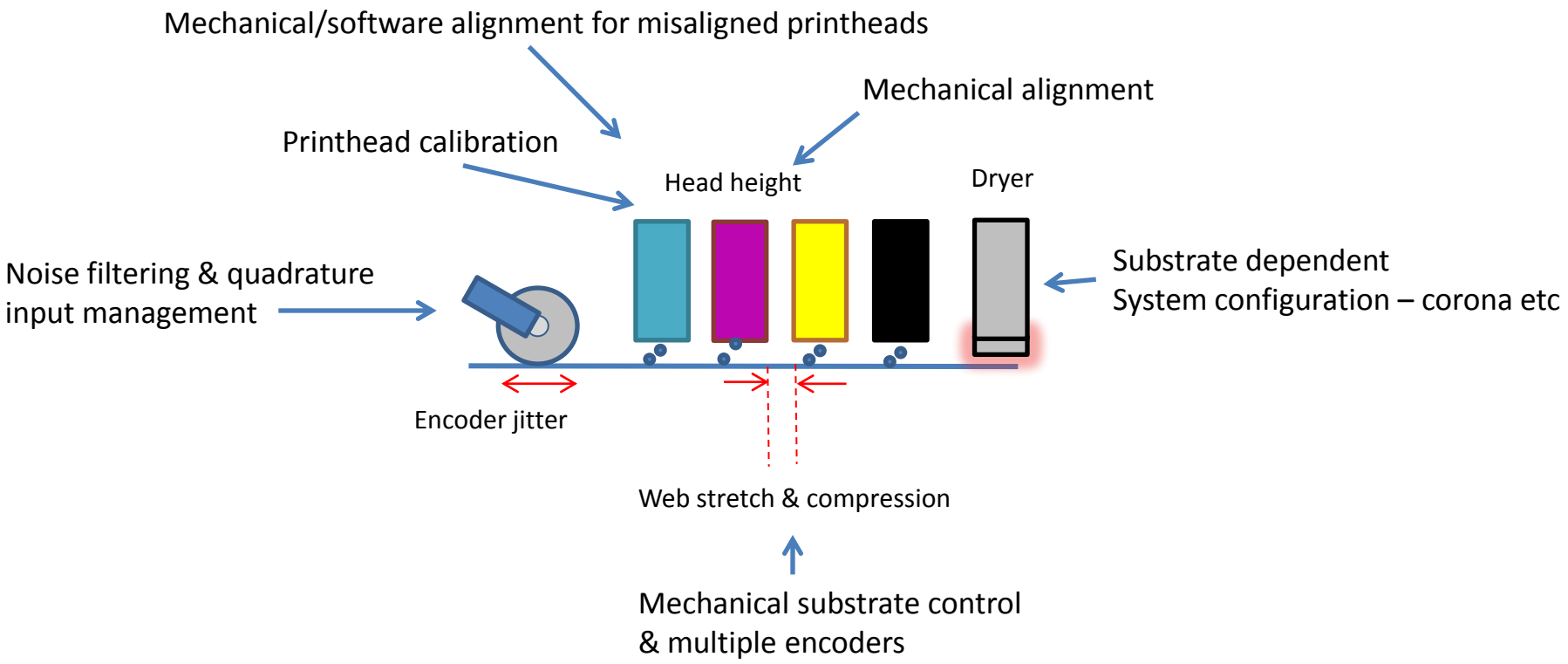
Improving Colour Registration



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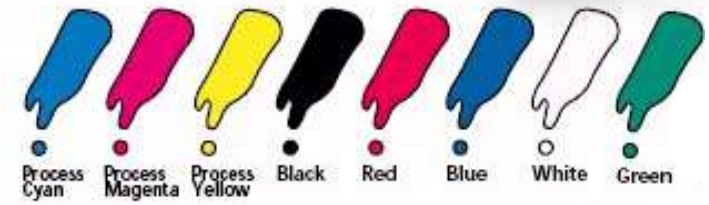
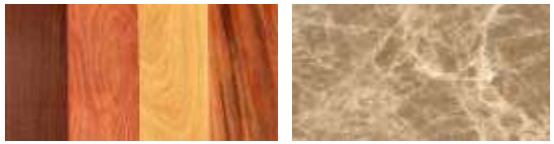
Critical Datapath Challenges of Single Pass Systems

- **Number of printheads**
  - Greyscale printheads
- **N-colours**
  - 8+ colours
- **Pre-coat & varnish**
- **Print speed**
  - >1m/sec
- **Variable data usage**
  - Partially variable
  - Every image different
    - Natural material simulation
- **Wide widths**
  - >1m becoming well established





- **Increasing demands on print data**

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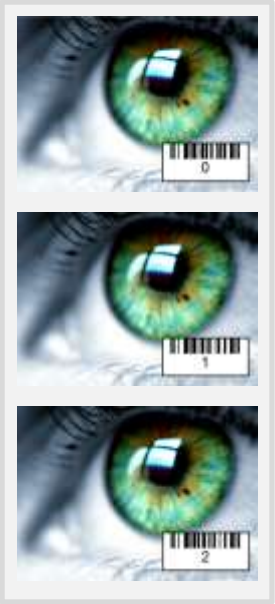
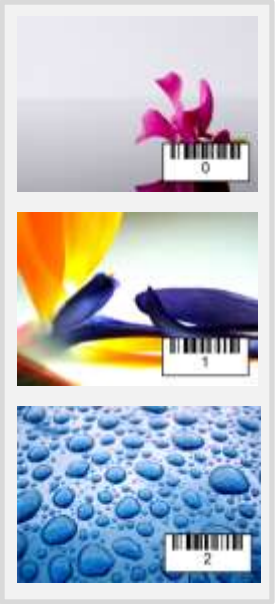
Increasing Demands on Print Data

- **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

Partially Variable



Fully Variable



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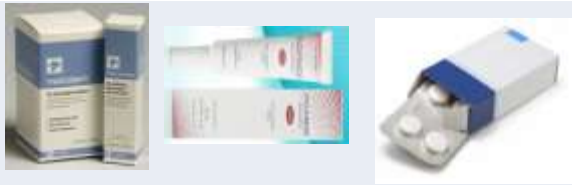
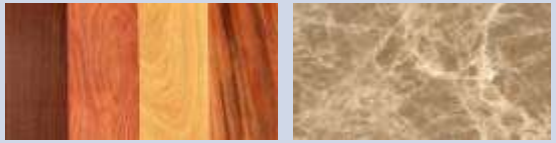
Variable Data Applications

Application Example	Requirements		Example
Tracking	**Data Path** **RIP** **Text/Barcode** **Images**	Partially variable Real-time Fully variable Pre-cached	
Late Stage Product Customisation	**Data Path** **RIP** **Text/Barcode** **Images**	Partially variable Offline Static/fully variable Pre-cached/fully variable	
Number Plate Printing	**Data Path** **RIP** **Text/Barcode** **Images**	Fully variable Real-time Fully variable Pre-cached	
ID Card/Passport Printing	**Data Path** **RIP** **Text/Barcode** **Images**	Fully variable Real-time Fully variable Fully variable	
Natural Material Printing	**Data Path** **RIP** **Text/Barcode** **Images**	Fully variable Offline N/A Pre-cached	

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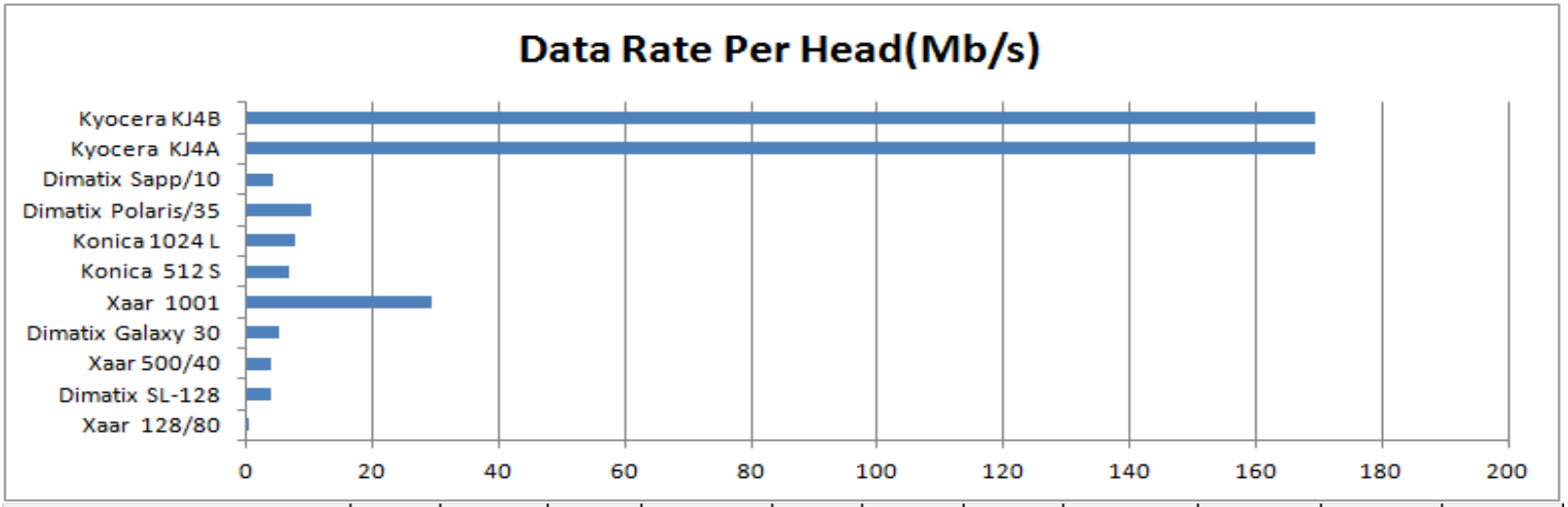
Industrial Inkjet Printhead Data Rates

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



	Xaar 128/80	Dimatix SL-128	Xaar 500/40	Dimatix Galaxy 30	Xaar 1001	Konica 512 S	Konica 1024 L	Dimatix Polaris/35	Dimatix Sapp/10	Kyocera KJ4A	Kyocera KJ4B
Nozzles	128	128	500	256	1001	512	1024	512	256	2656	2656
Grey Levels (non-zero)	1	1	1	1	7	3	1	1	3	4	4
Bits per nozzle	1	1	1	1	4	2	1	1	2	3	2
Sub-drop Freq (kHz)	5	30	8	20	50	20	7.6	30	50	20	30
Native Resolution (dpi)	185	50	180	100	360	360	360	200	100	600	600
Head Height (mm)	17.4	64.5	70.4	64.8	70.5	36.1	72.2	64.8	64.8	108.2	108.2
Date Rate Per Nozzle (kb/s)	5	30	8.2	20	29.3	13.3	7.6	20.4	16.96	63.8	63.8
Data Rate Per Head(Mb/s)	0.6	3.8	4.1	5.1	29.3	6.8	7.8	10.4	4.3	169.4	169.4

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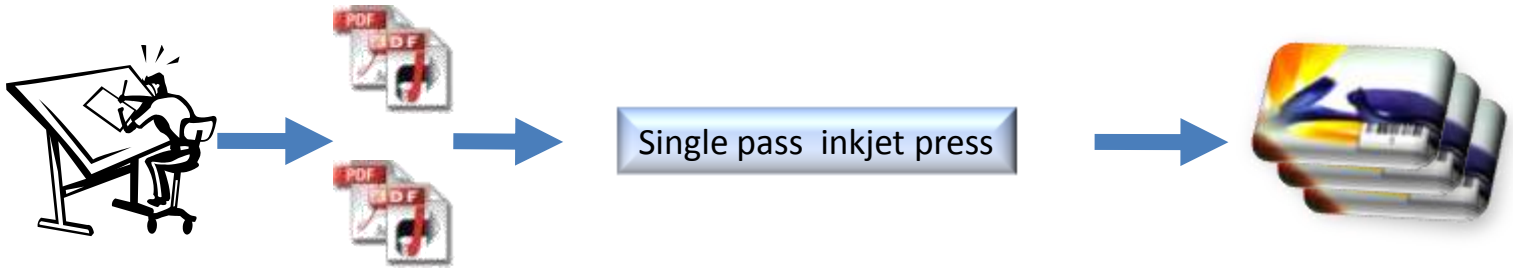
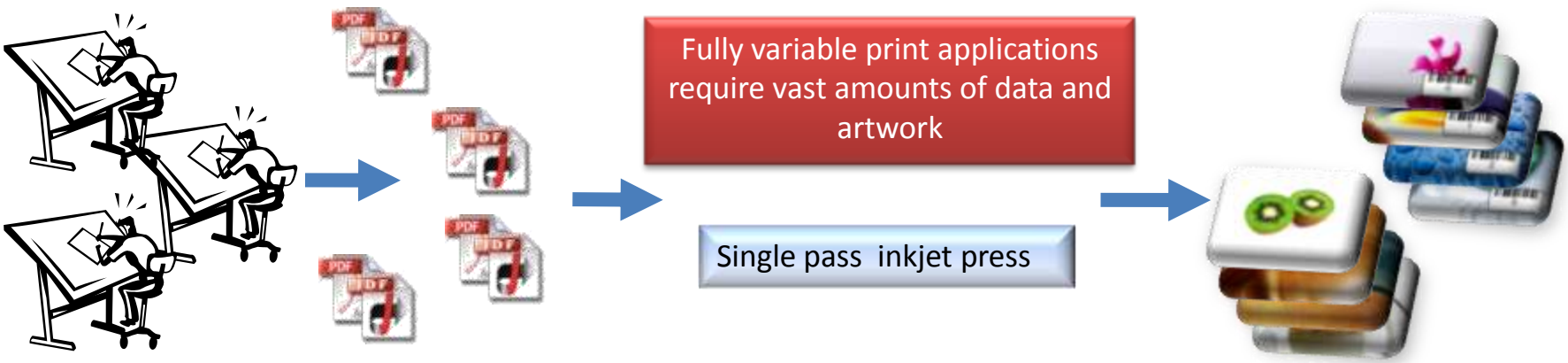
Challenges for RIP and Workflow Manufacturers



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



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

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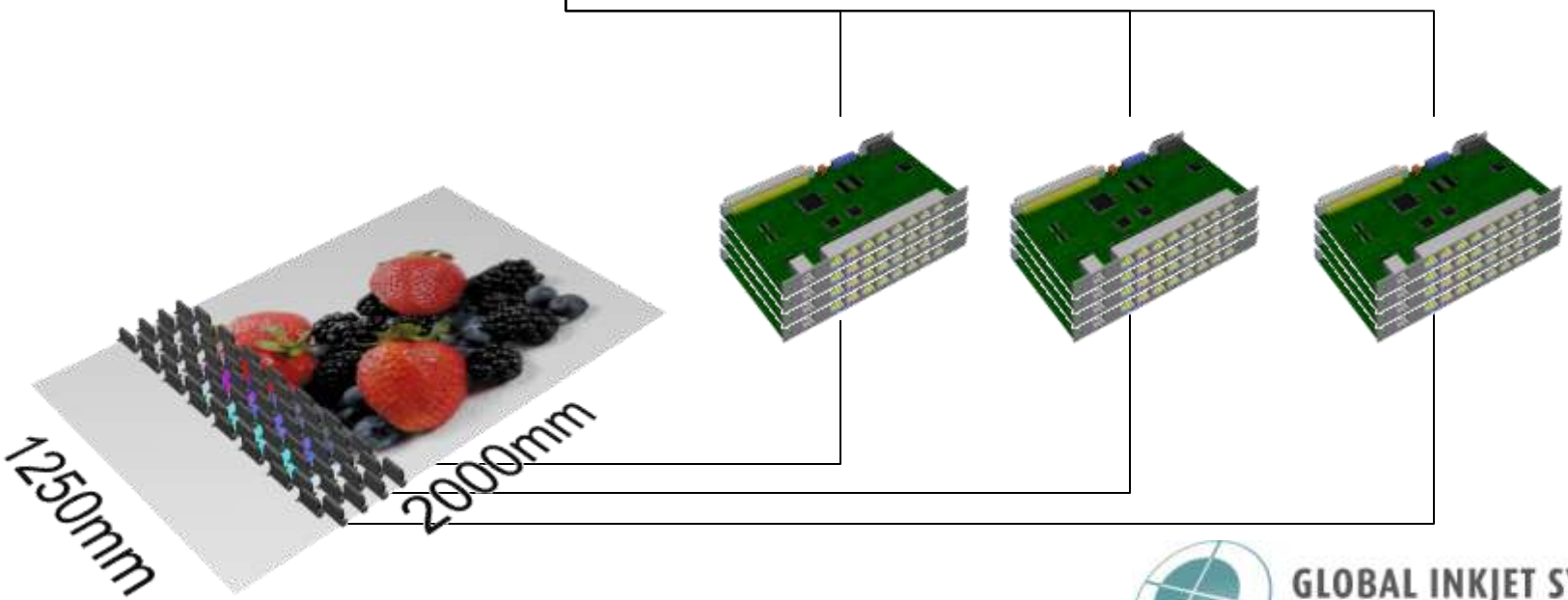
Large Single Pass System
Single PC Architecture Example

User Interface

Print PC

Single PC Solution

- Limited Processing Speed
- Limited Memory Bandwidth
- Limited Peripheral I/O
- Slow Start Up
- Limited Variable Capability



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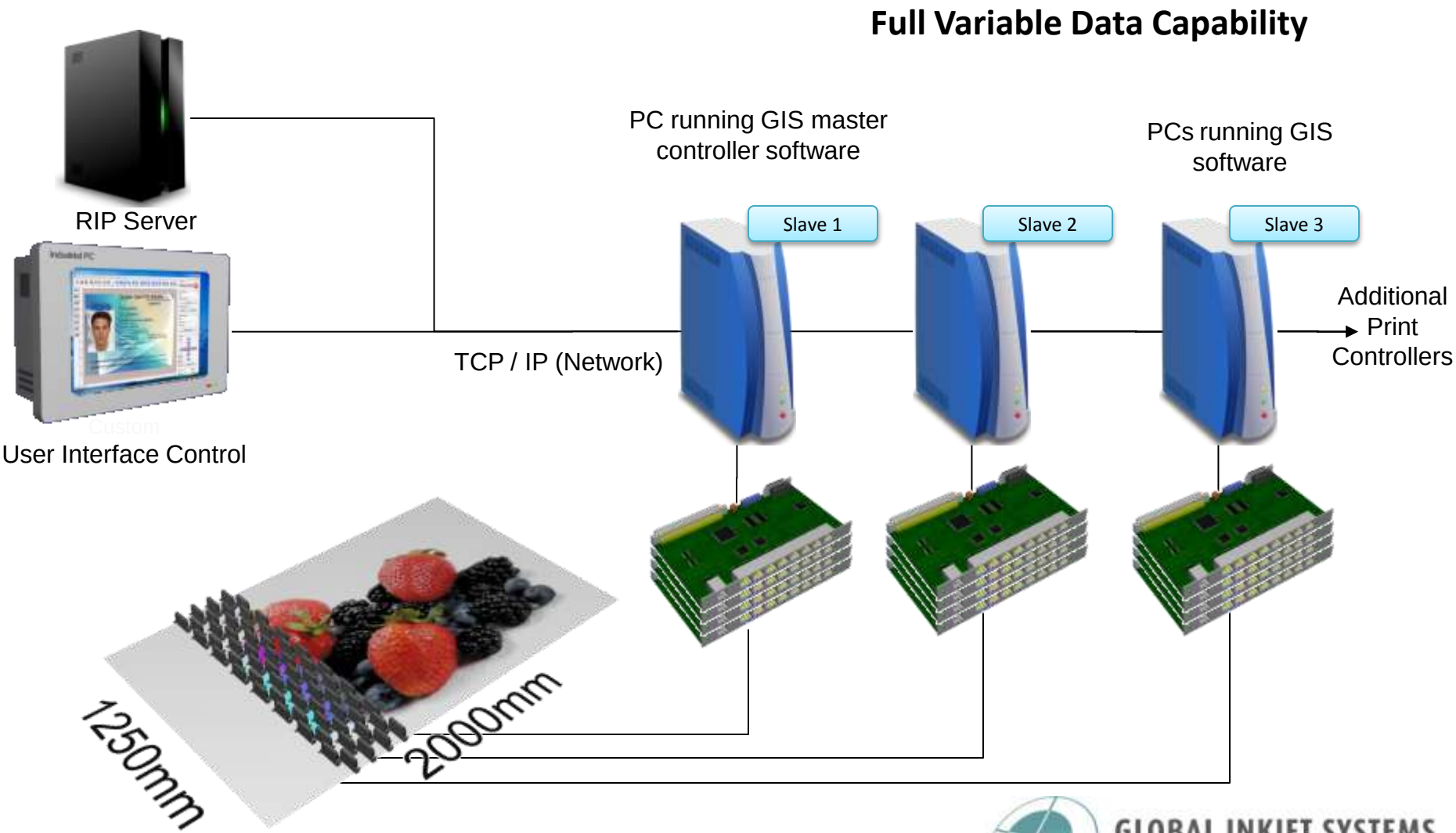
Large Single Pass System
Multiple PC Architecture Example



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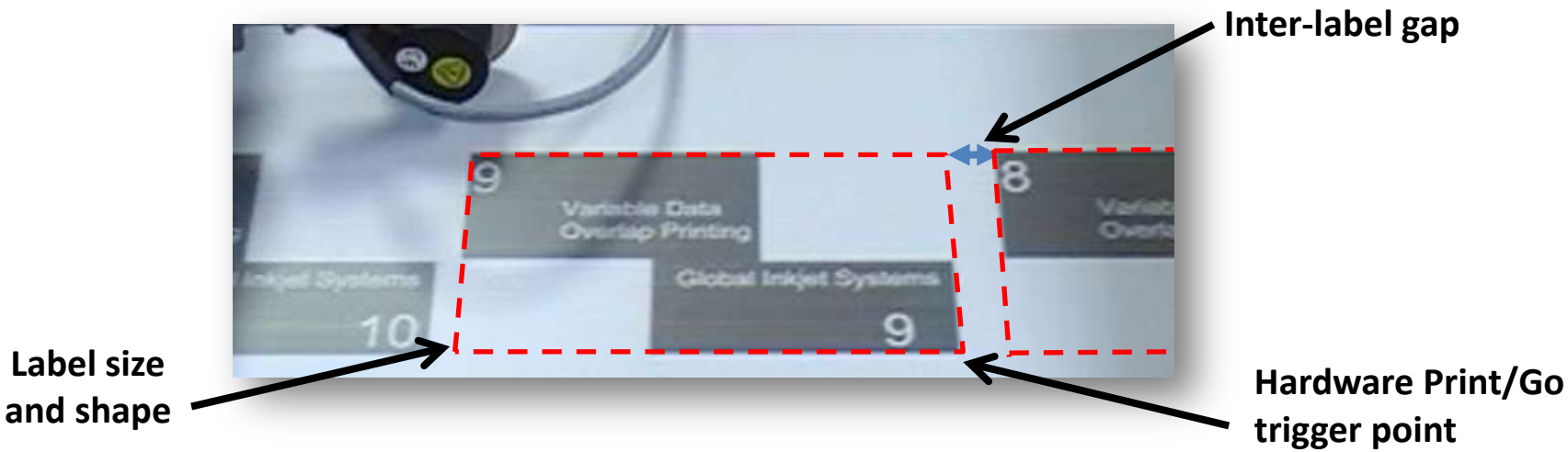
Zero Gap & Overlap Printing

- **Ideally suited for combining inkjet with traditional printing**
- **Traditional printing techniques can have zero gap between plates**
  - Adding inkjet requires a hardware Print/Go with zero gap or close to zero gap
- **Overlap printing solves this issue allowing:-**
  - Small inter-label gaps; zero gaps; and even negative inter-label gaps or ‘overlap’



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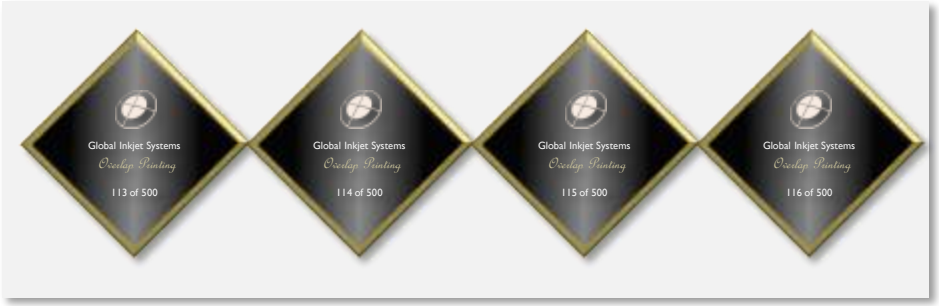
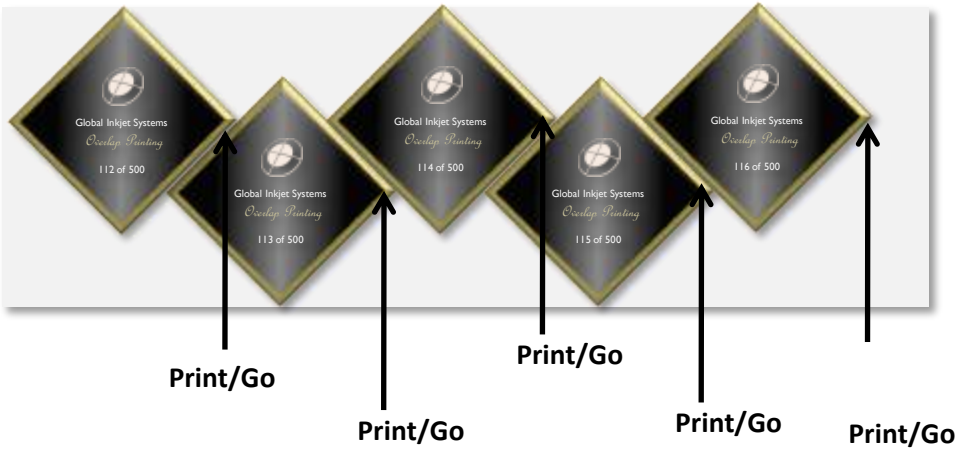
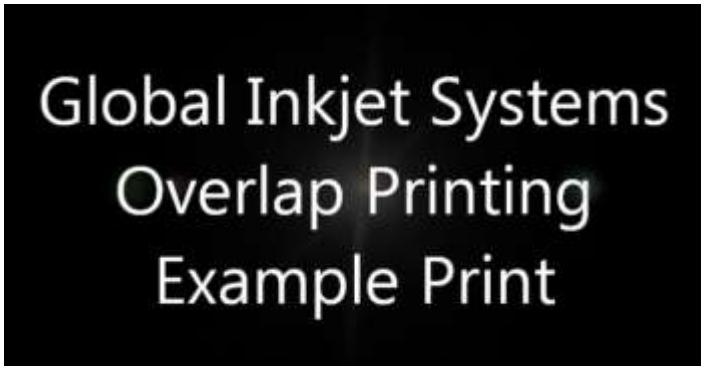
Zero Gap & Overlap Printing







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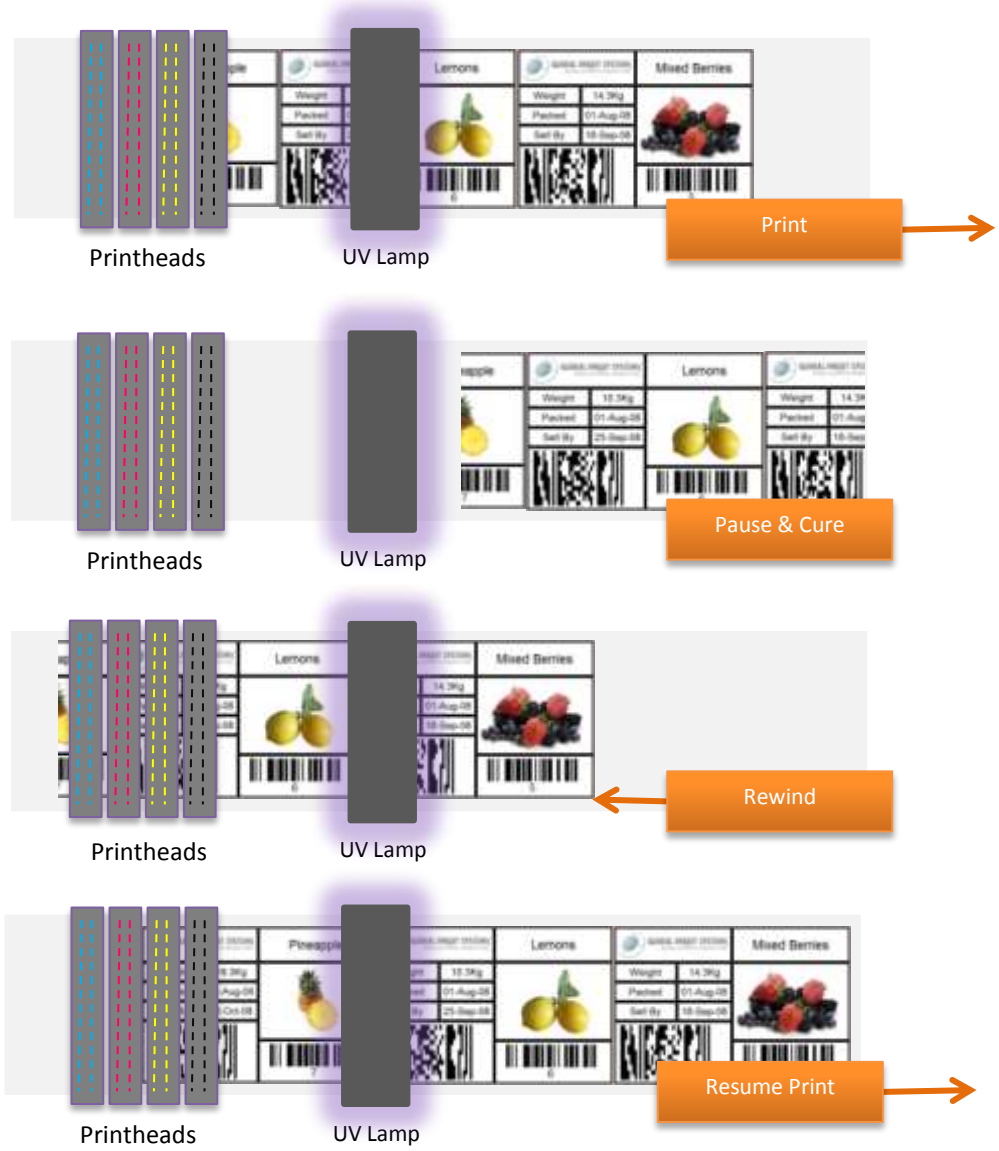
Print, Pause, Rewind, Resume



- **Problems unconnected with the printing station may require the line to be stopped; backed up; and then restarted**
- **If a production line is stopped, a short distance of additional travel is beneficial to cure the ink**
- **Print, Pause, Rewind, Resume allows production lines to be stopped, reversed and the print resumed precisely from the point it was stopped**

Curved Surface Printing

- **Direct product printing**
  - More flexible than label printing
  - Cuts out at least one step in the production process
  - No need to manage label stock
  - Less waste
- **Some of the key issues include:-**
  - Throw distance
  - Jet straightness
  - Drop density

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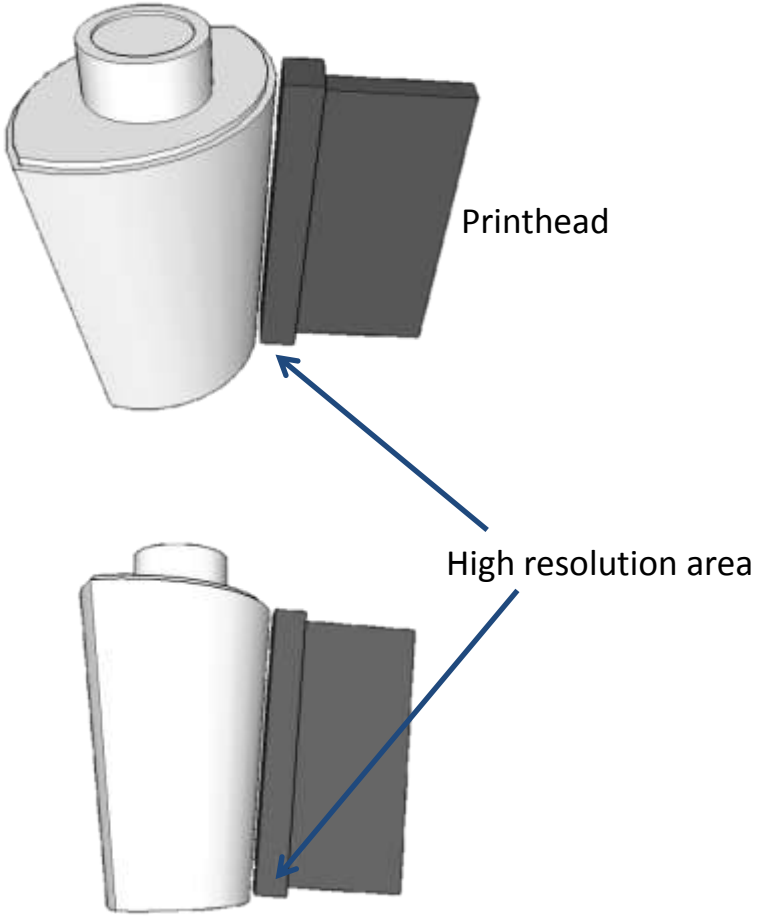
Curved Surface Printing

Resolution changes when printing onto curved surfaces



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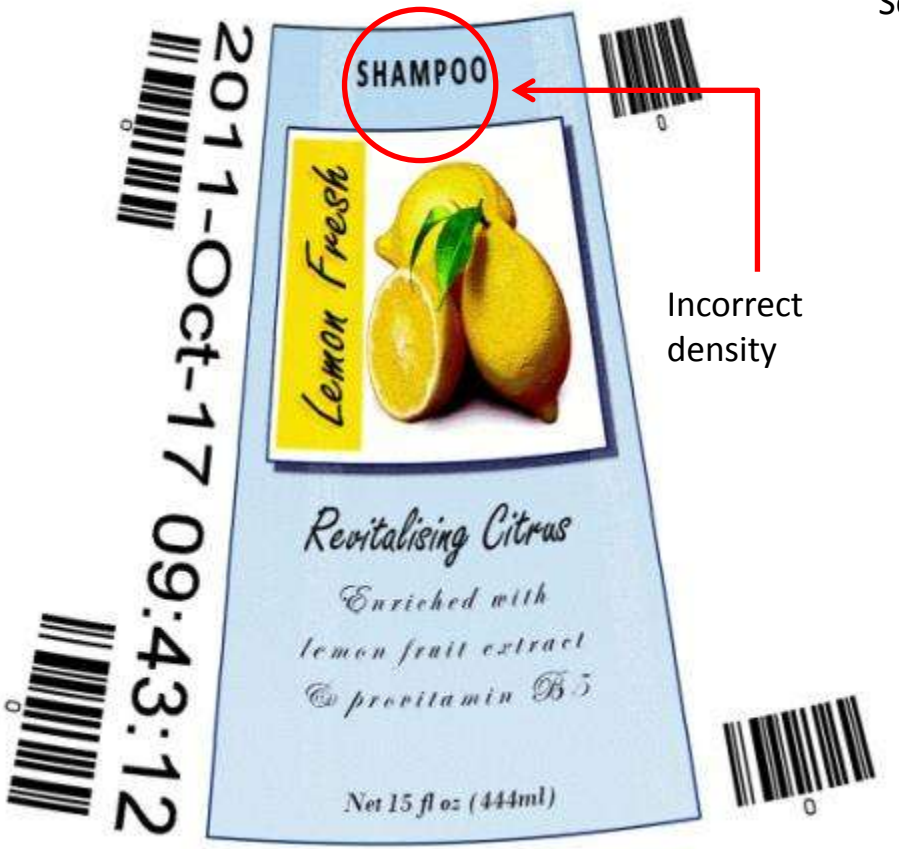
Printing Without Correction

Printing with Partial Correction

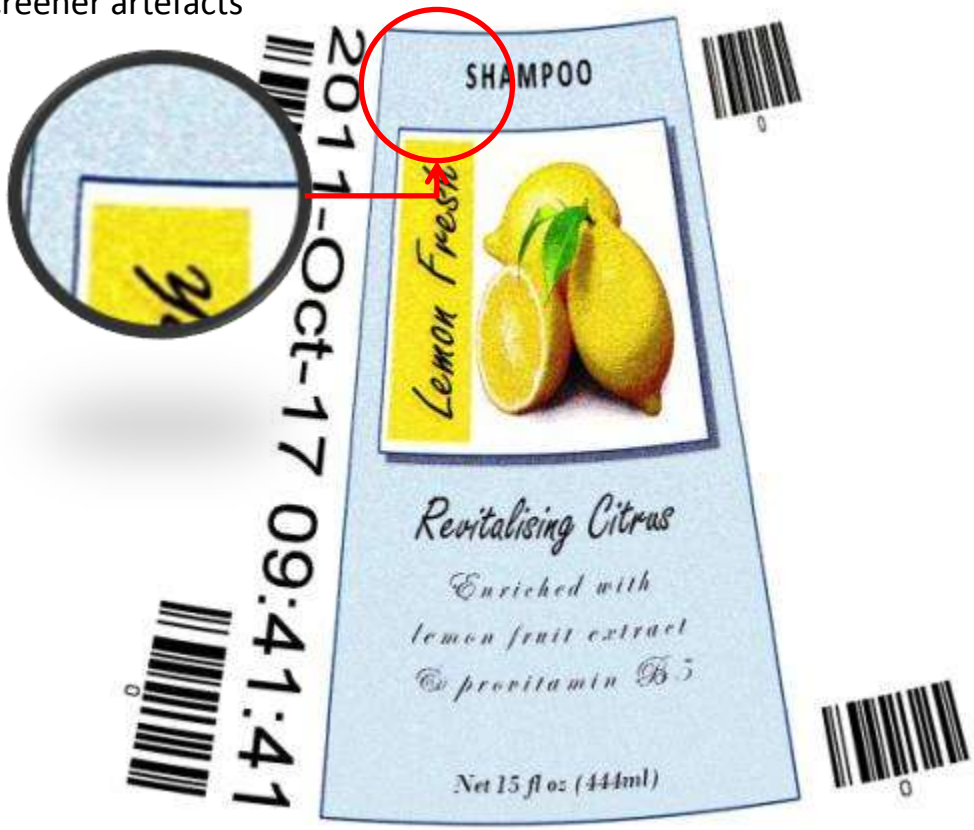
No density correction

No screener correction

Screener artefacts



Incorrect density



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Printing with Correction

Curved surface compensation

- **Correct nozzle alignment**
- **Density correction**
- **No dot gain issues**
- **No screening artefacts**

Image distortion can also be managed in original artwork

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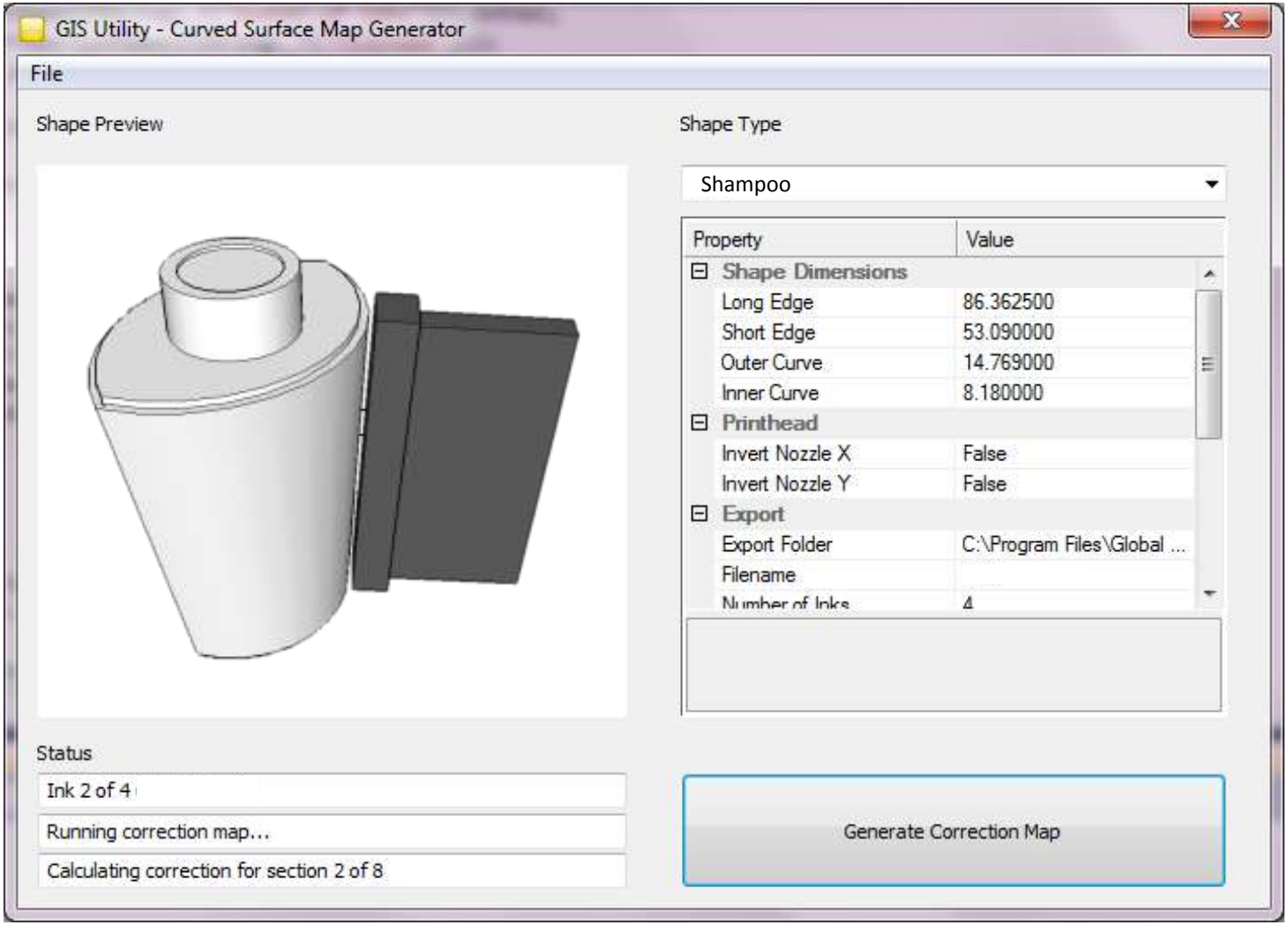
GIS Curved Surface Map Generator



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Summary

- **Inkjet technology acceptability**
  - Printhead reliability
  - System reliability
    - System electronics architecture
    - Software capabilities
    - Datapath capacity
- **New application developments driven largely by:-**
  - Advanced product handling/system design
  - Sophisticated software features

print media messe
drupa

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