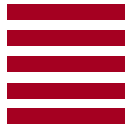


Getting the datapath to work

Clive Ayling

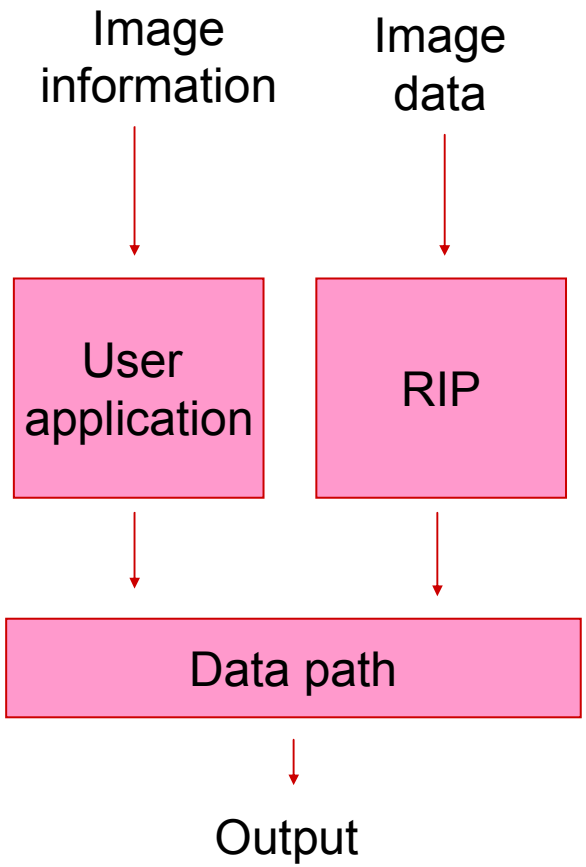
Agenda

- What is a data path?
- What may go wrong in data path design?
- What can go wrong in data path integration?
- What else can be done with a data path?
- The past, present and future of data path components

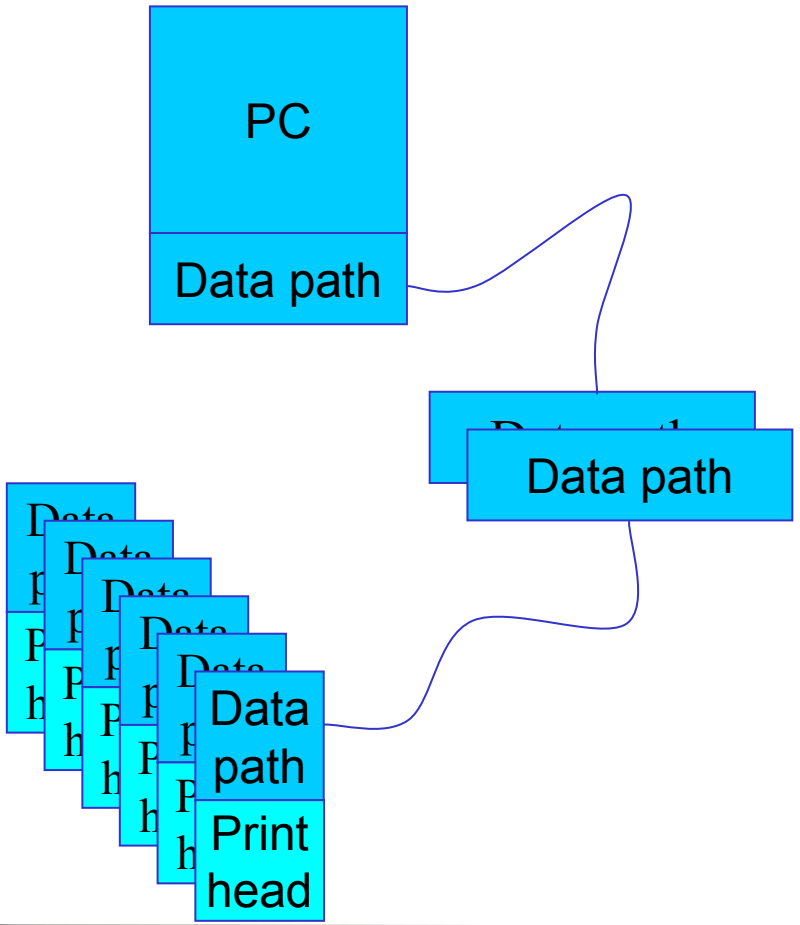
What is a data path?

Data Path

- Software



- Electronics



Data Path tasks

Asynchronous tasks

- Printhead feedback
  - Quality
  - Temperature
- Printhead assembly I/O
  - Temperature sensors
  - Ink header tank sensors
  - UV lamps status
- Splitting data into a swath for each printhead
- Configuring a programmable printhead

Buffering

Synchronous tasks

- Selection of fire data from appropriate buffers
- Pulse shaping
- Fire pulse timing
  - To each printhead
  - For each array of nozzles within a printhead

Types of Data Paths

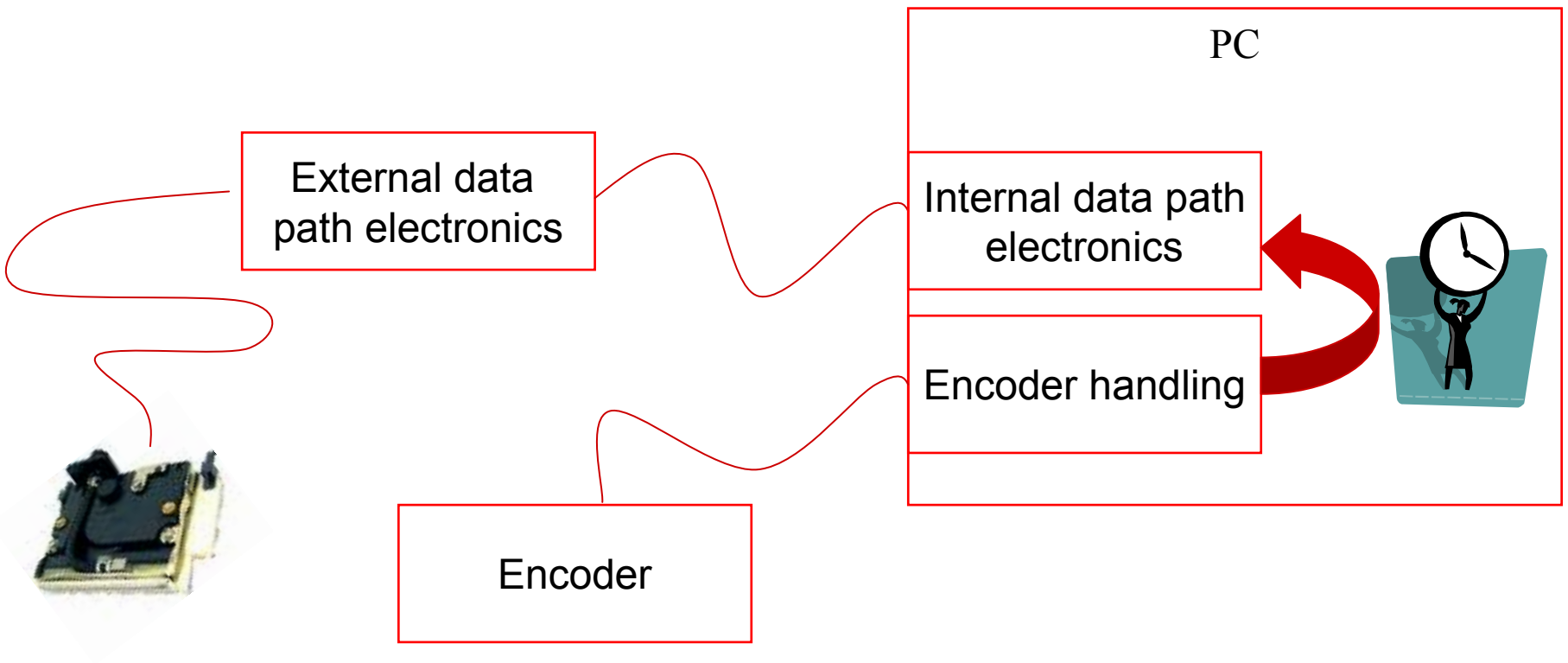
- Some data paths historically have had limitations to suit one type of application:
  - Fully variable data e.g. scanning wide format printers
  - Fixed data e.g. short run decoration of products
  - Selectable fixed data e.g. front and back alternating images
  - Fixed with variable inserts e.g. serialised labelling
- TTP's Meteor data path can do any of the above

Vocabulary

Data path Print Controller Print Electronics	All the electronics required to drive an array of printers. Does not include PC, RIP, application software, printheads, motor control electronics, ink supply system
Application software	User interface. Job queuing software. Image building software. Serialising software.
RIP	Raster Image Processor. Controls image manipulation for color and resolution.
Printhead electronics	Electronics within the printhead.
Printhead driver electronics Head Driver board	Part of the data path that directly connects to the printhead. May produce high voltage pulses to activate the piezos within the printhead.
Head dongle	Small version of a head driver board, usually encased in a plastic casing.
USB2, Firewire, Ethernet, “Cat 5”, USB1, LVDS, GBit Ethernet, RS422, RS363, Fibre optic, PCI	All standard types of cabling or interface protocols for transmitting data.

Things that can go wrong in data path design

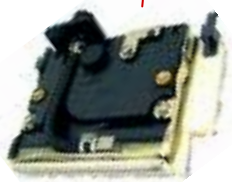
Basic things that go wrong – real time PC reliance



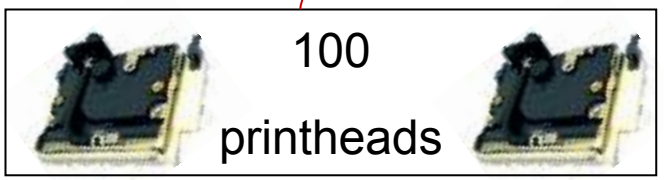
Basic things that go wrong – Expansion

- Simple first products lead on to complex second products..
  e.g.
  - First application: 4 heads, monochrome, narrow swath
  - Second application: 100 heads, color, wide swath

0.8MB/s requirement



80MB/s peak requirement
10-50MB/s average requirement

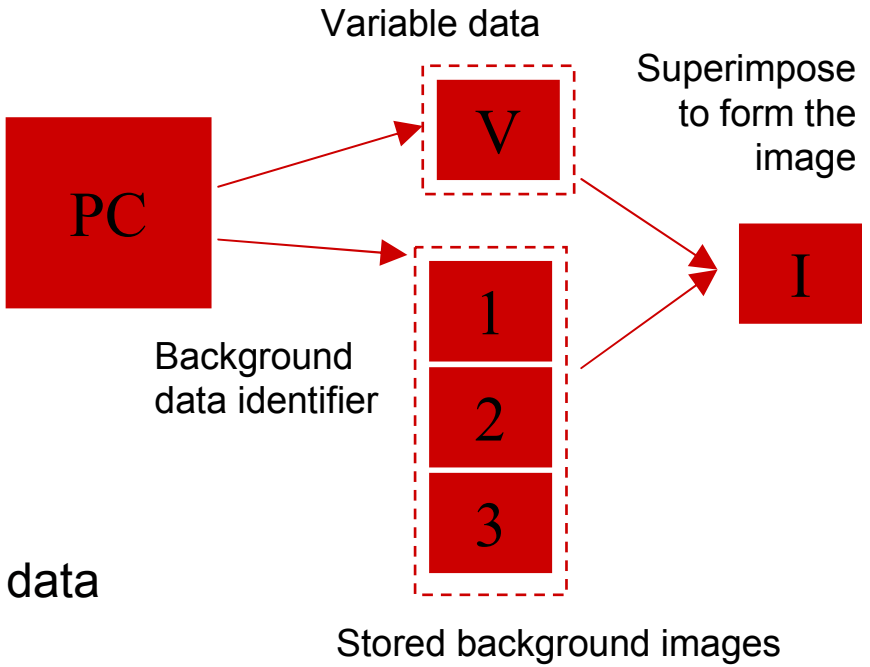


Handling large printhead arrays

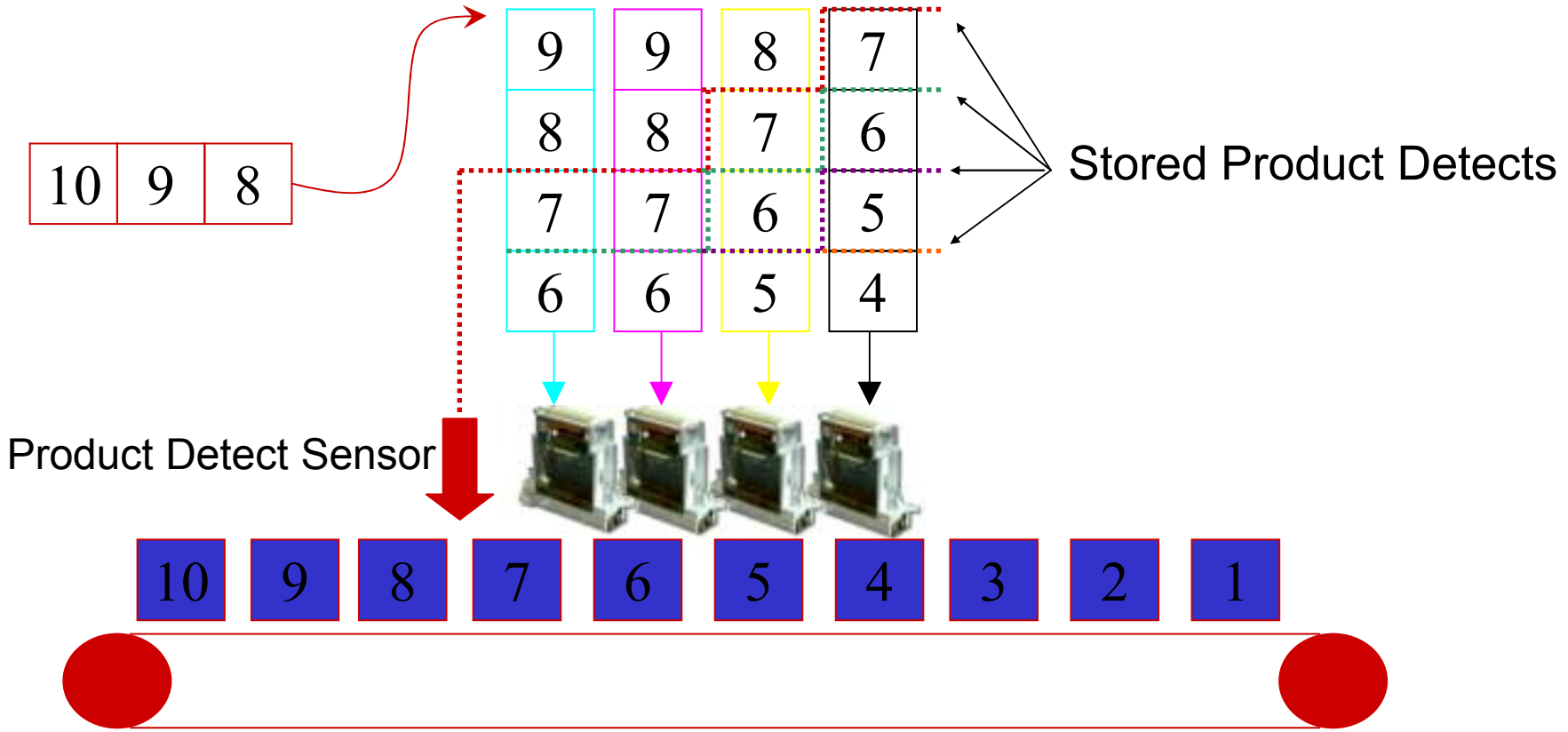
- Sub-pixel timing avoids mechanical alignment of printheads.
  - 15,16,33 multipliers are typical
- Modular electronics designed for daisy-chaining.
- Avoid wiring mess by using peripheral I/O on dongles
- Avoid short stiff cables

Handling high data rates

- Use a high data rate standard interface:
  - PCI & fibre optic
  - PCI and LVDS over Ethernet or Firewire cables
  - Gigabit Ethernet
  - USB2.0
  - Firewire
- Separate variable and fixed background data
- Use multiple interfaces to PC
  - E.g. Multiple USB controllers
- Compress the data in the PC and decompress in the data path electronics

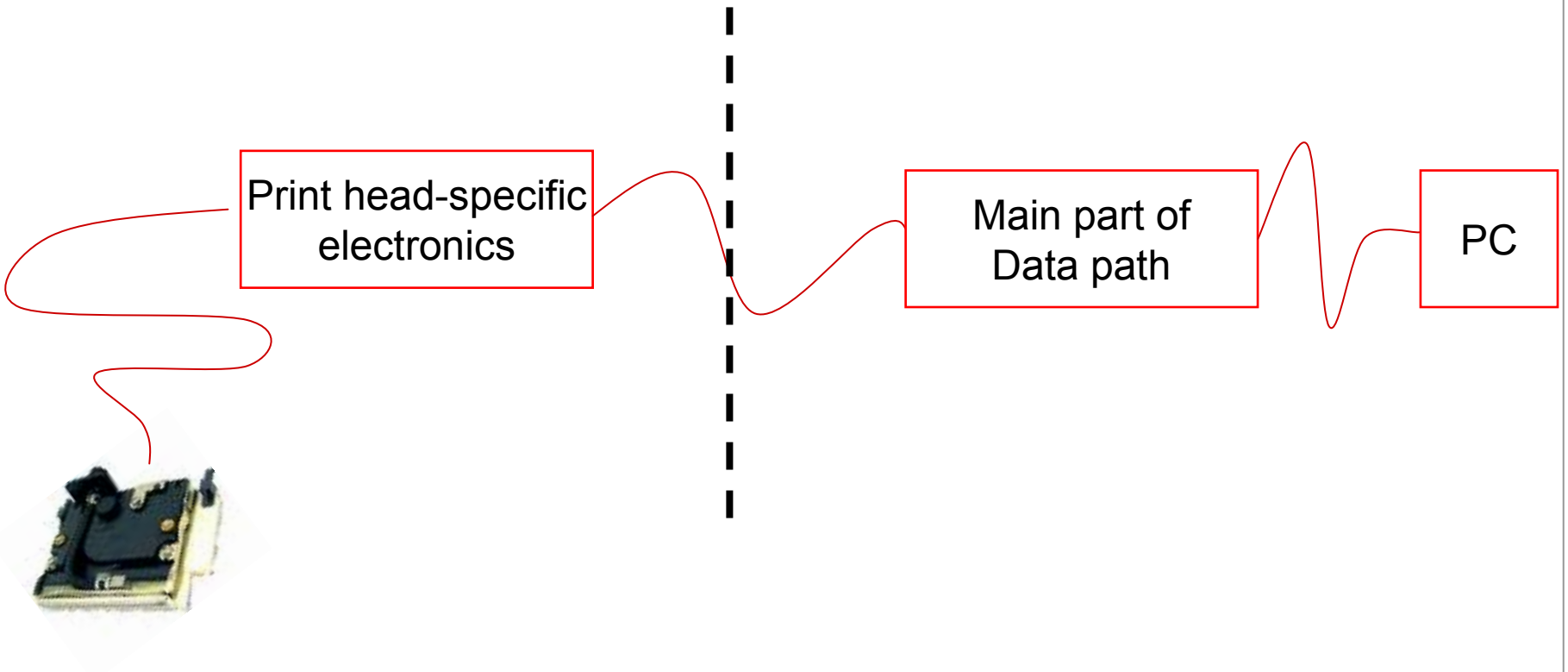


Basic things that go wrong – Product Detect Signals



Basic things that go wrong – Printhead change

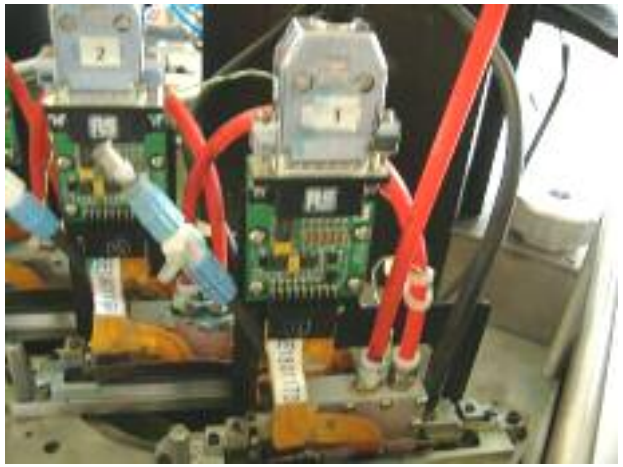
- Poor electronics architecture = large amounts re-designed

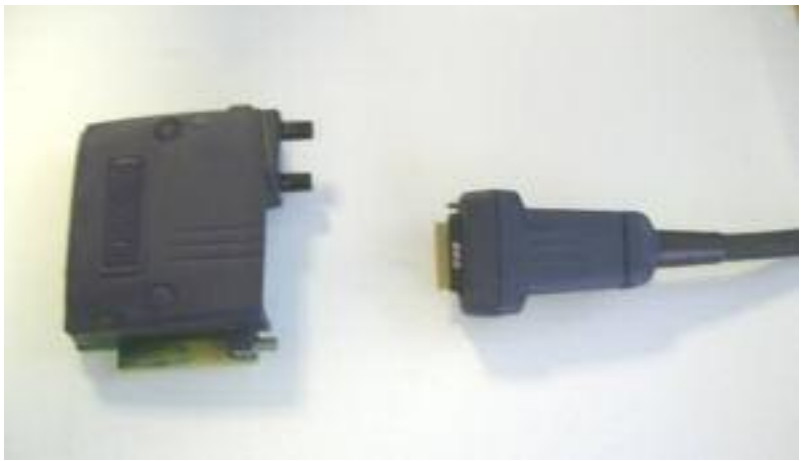


Things that can go wrong in integration

Basic things that go wrong – killing the printhead

- 30-120 Volts into 5v electronics
  - Design timing
  - Unplugging while live



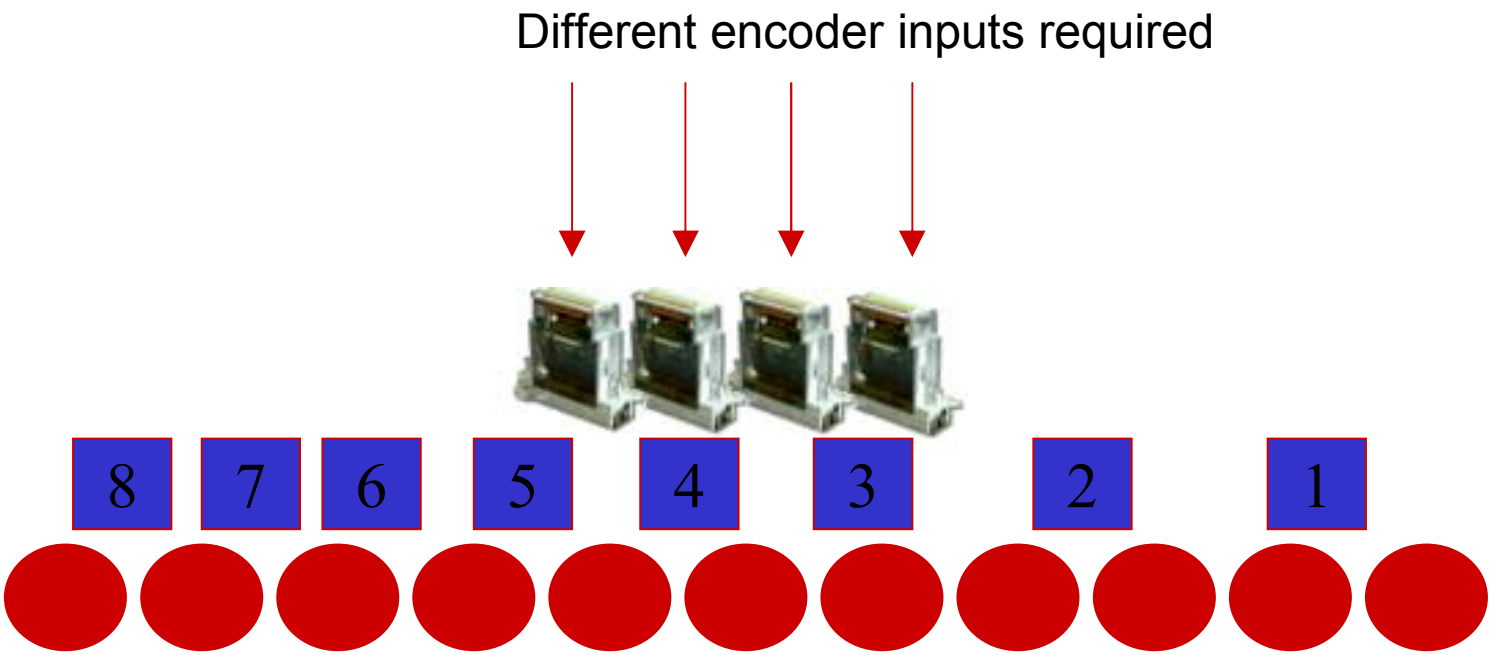


Basic things that go wrong – grounding

- High current surges in piezo printheads
- US: ground everything to earth
- EU: ground chassis to earth and 0v to itself (and maybe at power supply to earth)

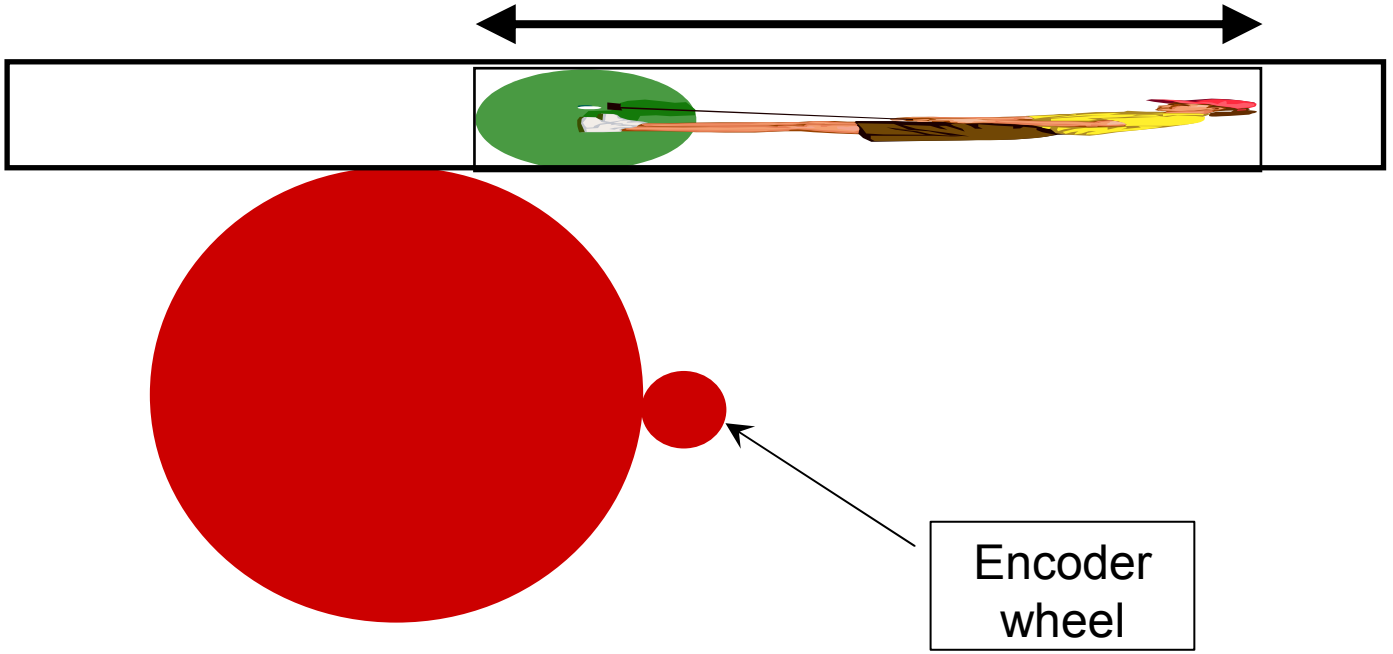
Basic things that go wrong – Encoder Signals

- Multiple products, each with different speeds, being printed by printheads within a single array



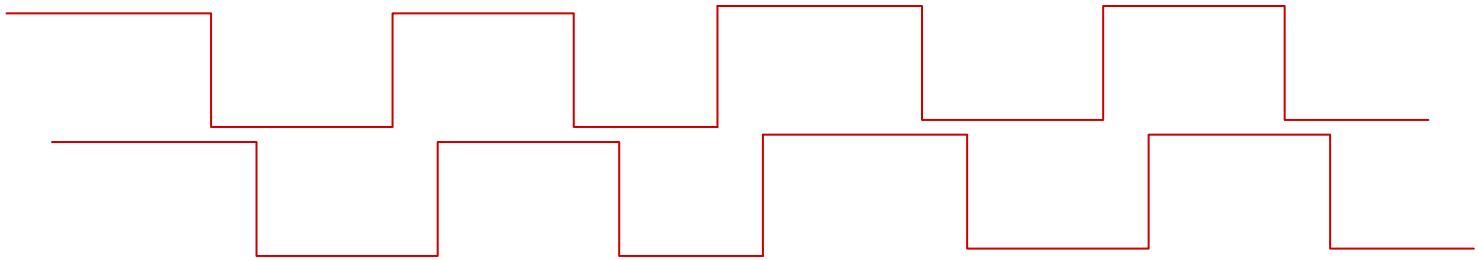
Basic things that go wrong – Encoder Signals

- Image can be the wrong length
  e.g.
  - Image specification: 500mm±0.5mm implies 0.1% accuracy
  - Tolerance loop may be long.
- Needs a high-resolution frequency multiplier to adjust the image length



Basic things that go wrong – Encoder Signals

- Speed jitter at encoder frequencies
  e.g.
  - 1m/s at 5um encoder step size = 20kHz encoder frequency
- Unexpected negative speed can be confusing for firmware



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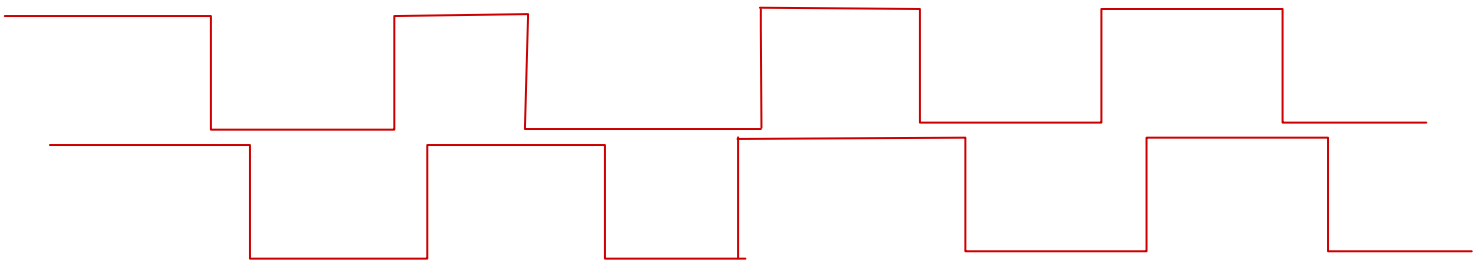

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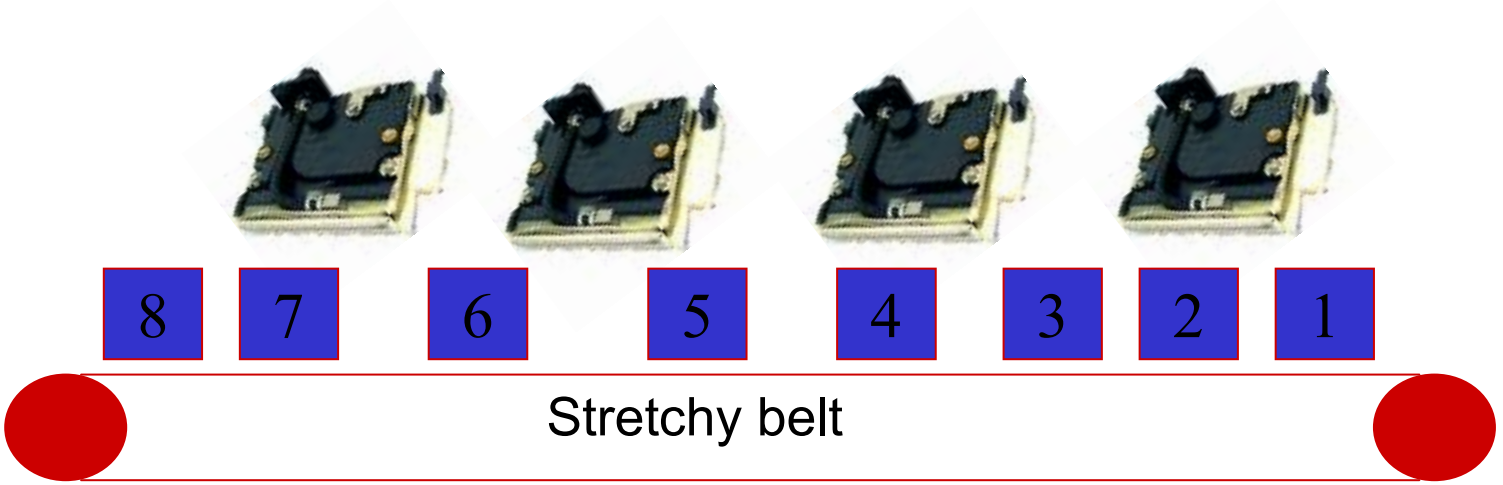
Basic things that go wrong – Encoder Signals

- Encoder gearing jitter produces jitter in image
- Encoder frequency smoothing can sometimes help



What else can be done with a data path?

- Handling distributed sensors, lamp control and valves
- Getting feedback on printhead condition
- Superimposing foreground variable and background images
- Buffering up to several meter of image
- Storing a great many product detects
- Scanning and single-pass capabilities
- Buffering meters of print data
- Feedback on the printing status of documents
- Handling 100+ printheads
- Splitting color planes into swaths for each printhead
- Stitching neighbouring printhead swaths through use of algorithms which select drops from the overlapping heads to print each pixel
- Have data rate supply capabilities that exceed the data rate consumption capability of all current printheads

Data path components of the past

- USB1.1/RS232 for single heads
- PCI systems for arrays of heads

- Evaluation kit data paths available from printhead manufacturers
  - Too high a price for adoption into production designs
  - Sometimes limited functionality
  - Only work with one supplier's products

- Low cost print electronics developed by OEM's for their own use
  - Sometimes only work in one application / printer
  - Sometimes also available to others e.g. Inca Digital

Commercial data path components of the present

- Xaar XUSB
  - USB2.0
  - 1 box (2 card) solution + dongle for Omnidot heads
  - 2 box solution + dongle for XJ printheads

- Inca Digital
  - PCI
  - 2 box + dongle for Spectra heads
  - XJ500 data path may also be available

- TTP's Meteor
  - USB2.0
  - 1 card solution + dongle/driver for any head (TTEC Q4/06, Spectra Q1/07..)

The future of data path components

- Commercial data path components will be more universally capable and less expensive.
- Printer OEMs and Integrators will spend less time developing print control electronics for each new printer.
- The cost of electronics is a reducing part of the cost of a printer.

Summary

- It is possible to use the advantages of fast PC's, Microsoft's applications and standard PC peripherals (e.g. USB2.0) without hitting the disadvantages.
- It is possible to cope with the most complex of large arrays and print data functionality with simple single-card modules.
- There are a few persistent hazards to avoid when integrating encoders, product detects, and printheads.
- Commercial universal data paths are becoming available and may one day make bespoke print electronics extinct.

Where to Get More Information

The Technology Partnership PLC “TTP” is a 300-strong independent technology and product development company with clients World-wide.

Home of the Meteor universal data path.

Thank You!

www.ttp.com

clive.ayling@ttp.com

The TTP Meteor universal data path