TTP

The Technology Partnership

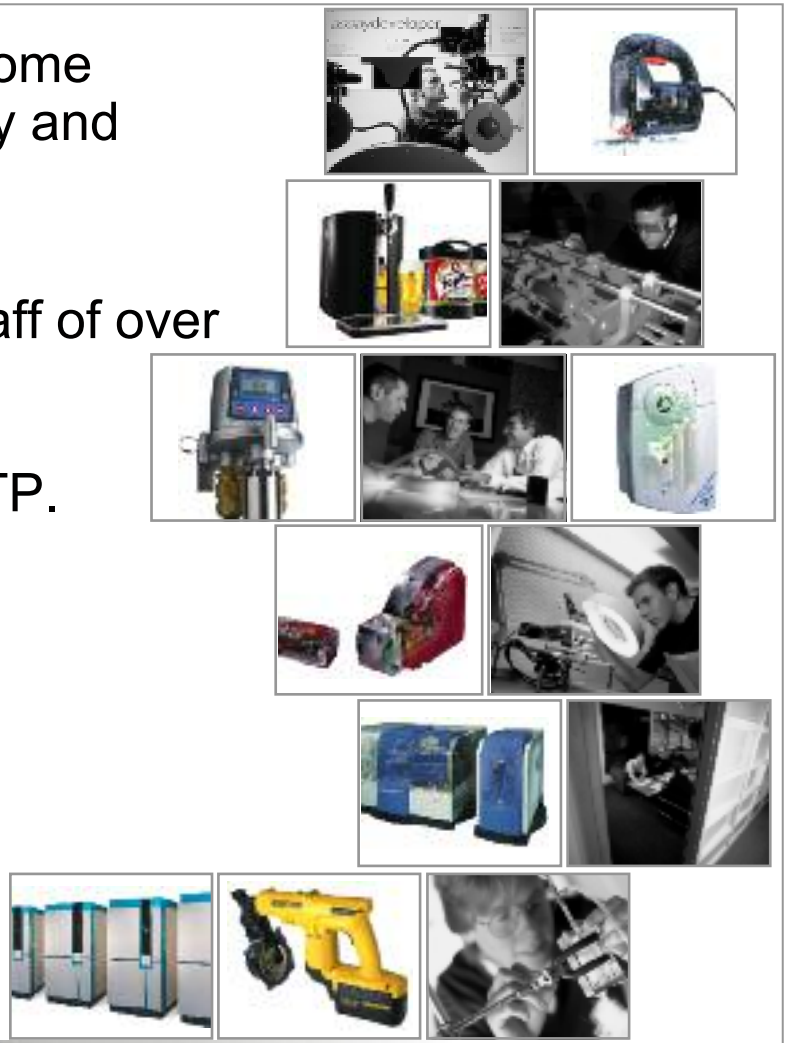
A science and engineering services provider

and the home of Meteor
- a universal printhead control system

Meteor

TTP Background

- Founded in 1987, TTP has grown to become Europe's leading independent technology and product development company.
- Near Cambridge (UK) TTP employs a staff of over 200 engineers and scientists.
  Many hundreds more work in technology businesses incubated and spun off by TTP.
- TTP services the following industries:
  - Printing (30%)
  - Communications (20%)
  - Consumer products (20%)
  - Medical and healthcare (20%)
  - Industrial and automotive (10%)



TTP Skill Set - overview

All the skills required to help you develop your new technology or product and get it into manufacture

Project
- Concept generation
- Design evaluation
- Supplier selection
- Prototype manufacture and build
- Testing
- Production transfer
- Industrial design

General
- Technology development
- Sensor development
- Turnkey product development
- Cost reductions
- Low-High volume manufacture
- Manufacturing partner selection

Management
- IP portfolio management
- Technology sourcing
- Business case development
- Project management
- Off-shoring manufacture strategy
- Venture Capitol

Physics
- Inkjet
- Laser/Optics
- Micro fluidics
- Microstructures
- Mathematical modelling
- Non-linear stress analysis
- CFD

Mechanical Engineering
- 3D CAD
- Stress/fatigue analysis
- Fluid handling (dispense, cooling, pumping)
- Media handling (web, sheet, other shapes)
- Product design
- Manufacturing processes
- Materials expertise

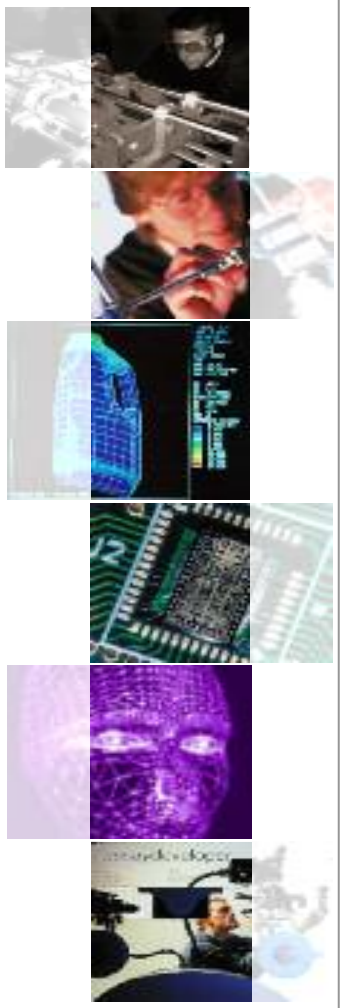
Electrical/Electronic Engineering
- RF design
- Power electronics and control
- Wired/wireless Communication
- Signal processing
- Vision systems
- ASIC/FPGA/IPM

Chemistry
- Ink
- Liquid toners

Biology
- Systems and consumables

Software Engineering
- Large system development
- Micro,DSP
- ASM, C, C++
- Embedded software
- Real time operating systems

Techniques
- FMEA
- Risk Analysis
- DfMA
- Project reviews



TTP and Inkjet

Printer Development Speeding up time-to-market Increasing innovation Introducing inkjet to a product portfolio	**Printer re-design for cost reduction and/or transfer to manufacture in a lower cost country** Improving the performance of existing product lines	**Inkjet component design** Meteor Providing components and designs to facilitate inkjet printer developments
Novel print technology development tonejet Vista Doing what inkjet can't do Improving on what inkjet can do	**Custom printing system development** Providing bespoke inkjet systems for unique applications	**Consulting** Technology studies Manufacturing Strategy studies Advising on business and Intellectual Property strategy Managing VC investments and public grants

TTP Case study: Inkjet Printer for Postage Franking

- Neopost IJ25

- TTP activity:
  - Printhead and manufacturer selection
  - System design and project planning
  - Detail design for mechanics, electronics, and print engine firmware
  - Prototype assembly and testing
  - Production transfer
  - Production support

TTP Case Study : Cost reduction of an inkjet printer

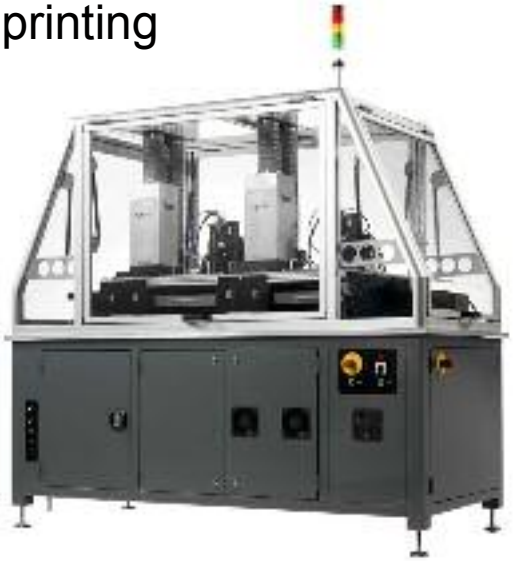
- Stork AX4 / Du Pont Cromalin

- TTP Activity
  - Initial analysis of cost reduction opportunity
  - Detailed study into cost reduction options from new architecture, detail design changes, and suppliers
  - Assistance in implementation of design changes
  - Redesign of sub-systems

TTP case studies: Inkjet System Integration

- Printed Electronics Development
  - Used for testing a wide range of functional inks, resolutions and curing methods
  - Suitable for full-size (18”x24”) PCB format

- Inkjet Ink Development
  - Used for testing UV-cured inks
  - 2 colours; 2 variable-power UV lamps; Spectra and Xaar printhead modules
  - Wet-on-wet or wet-on dry printing



TTP Case Studies: Design of Inkjet Components

TTP has developed inkjet subsystems for integration into digital printers and inkjet systems

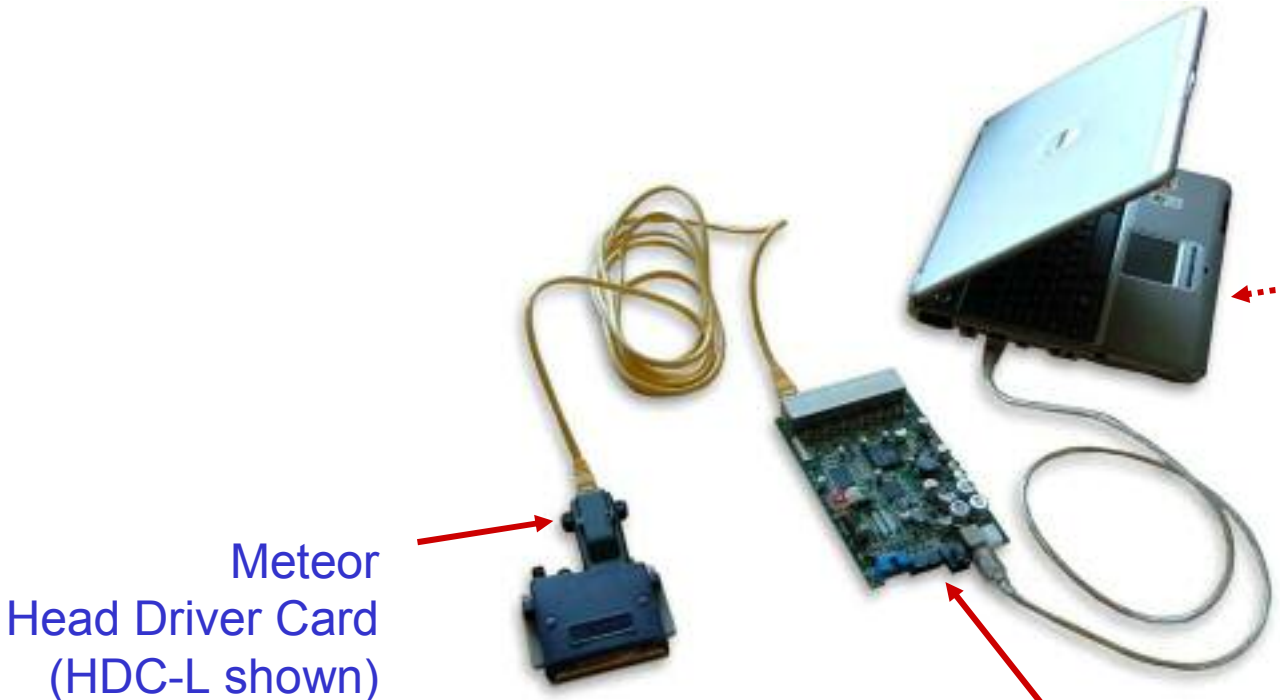
- Header tanks, ink supply controllers (e.g. Xaar's ink supply peripherals)
- Proprietary data path systems (e.g. Xaar's "XPCI")
- "Meteor" - a universal software and electronics platform for all printhead types

Meteor

Meteor Universal Print Controller

- Suitable for any printhead type and for any industrial inkjet printer
- First public announcement at IMI Inkjet Developers Conference 2006 Chicago, it is now in use in multiple applications:
  - Single pass and scanning systems
  - Few printheads and many printheads per system
  - Binary printheads and greyscale printheads

Meteor Components



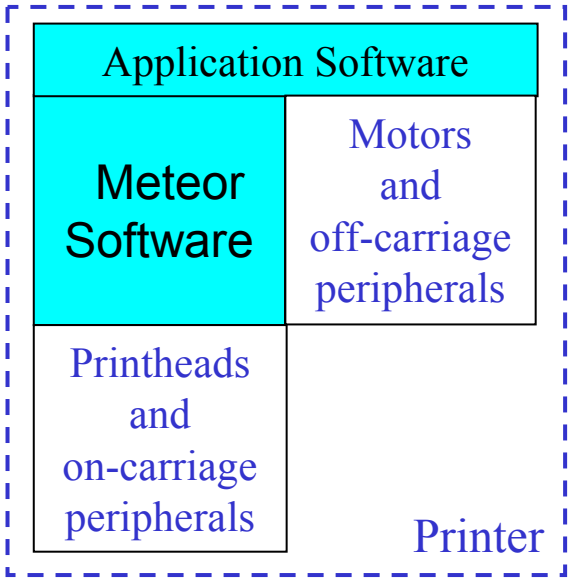
Meteor
Software

Meteor
Head Driver Card
(HDC-L shown)

Meteor
Print Controller Card

Meteor Software

- Microsoft Windows® DLL
- Controls the configuration of printheads and peripheral I/O
- Splits print data into streams of data for each printhead
- Buffers print data
- Synchronises large arrays of printheads
- Handles encoder signals and home/product detect signals
- Handles repeated fixed images and variable images and overlays of variable data onto fixed background images
- Tested to extremely high data rates (for very large printers and print systems)



Meteor Print Controller Card

- The Print Controller Card (PCC) is a USB2.0 data path module designed to be used either alone or in racks for large printhead arrays
- Each PCC has 6 outputs, each used for driving a printhead or a group of small printheads

- Eurocard in size (160mm x 100mm) it is easily stacked and can be placed up to 25m from a PC and up to 10m from printheads

- Each PCC has 8MBytes of memory to store fixed data and/or buffer variable print data for each printhead
- Each PCC has user-configurable I/O
- The PCC design is printhead-agnostic and can be used with any type of printhead

Meteor data rates

Meteor data rate availability:

- 50MBytes/sec peak rate to each printhead
- 30MBytes/sec sustained rate to each PCC (shared by 1-6 printheads)
- >100MBytes/sec sustained rate from a PC using multiple USB interfaces

Typical printhead peak data rate requirements:

- 1.3 MBytes/sec for a 1-bit binary printhead with 256 nozzles at 40kHz
- 4.6 MBytes/sec for a 4-bit greyscale printhead with 760 nozzles at 12kHz

Typical printer average data rate requirements:

- 30 MBytes/sec (continuously variable data) for a 600m2/hr scanning printer
- 40 MBytes/sec (mostly repeated fixed data) for a 150mm-wide single-pass printer

Meteor Head Driver Card

- The Head Driver Card (HDC) receives all its power and data from an Ethernet cable attached to one of six outputs on a PCC
- The HDC contains all printhead-specific electronics
- Each HDC also has user-configurable I/O for control of peripherals (sensors, header tanks, UV lamps, heaters etc)
- The size and cost of each HDC depends on the printhead type it supports
- Different printhead HDC variants are being developed and supplied as customer orders are received by TTP

Meteor Head Driver Card example: HDC-S

- The HDC-S supports:
  - Fuji Dimatix Spectra Galaxy
  - Fuji Dimatix Spectra Nova
  - 2 x Fuji Dimatix Spectra S-class: SL-128, SM-128, SE-128
- Two thermistor inputs for monitoring jetting assembly temperatures
- Ethernet cabling
  - >10m long
  - Low cost standard cable
  - Flexible (tight bend radius)
- Unallocated I/O for peripheral control

Meteor Head Driver Card example: HDC-S (continued)

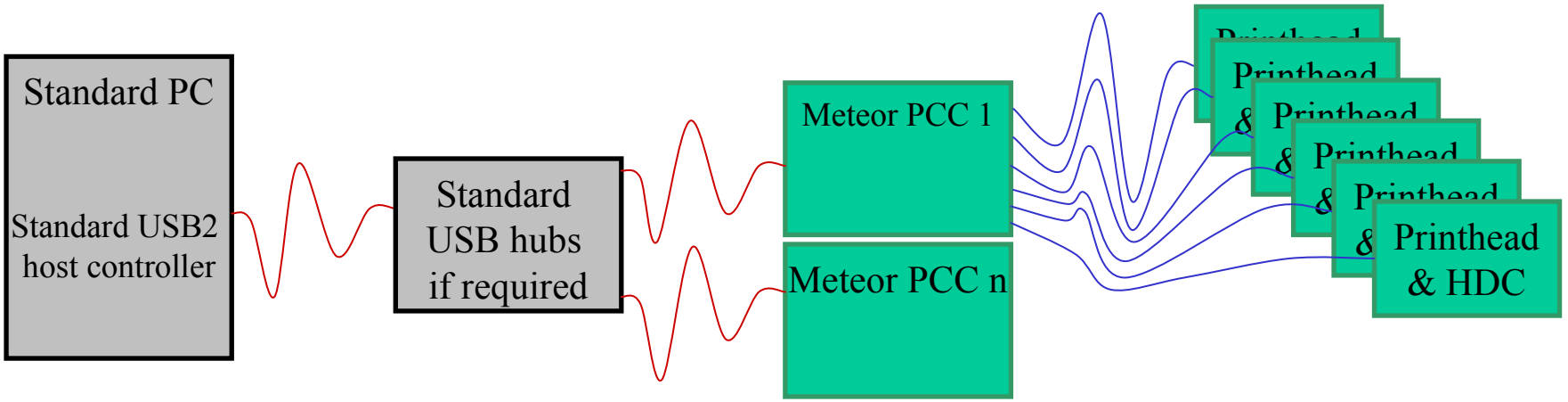
- The HDC-S provides data for binary firing at up to 40kHz on all printhead types
- The HDC-S creates a digitally-defined pulse shape for each 64-nozzle piezo crystal within each printhead. This enables:
  - Calibration of manufacturing tolerances between piezo crystals and between printheads
  - Optimisation of drop formation for different inks and conditions
- In mass production Q2 07

Meteor Head Driver Card example: HDC-L

- The HDC-L supports:
  - Xaar Leopard / OM318
  - Toshiba Tec CA3, CA4, CE2*
- Unlimited access to printhead capabilities:
  - Greyscale 7-drop, 15-drop, or as configured
  - 4.8kHz, 6.2kHz or as configured
- Ethernet cabling
  - >10m long
  - Low cost standard cable
  - Flexible (tight bend radius)
- Unallocated I/O for peripheral control
- In mass production Q1 07

Meteor

Standard commercially-available cables are used to connect Meteor components to produce any necessary configuration



- n Meteor PCCs support 6n printheads or 6n clusters of jetting assemblies
- Peripheral pumps, motors and sensors can be controlled via I/O on each Meteor PCC and HDC

Cable type	Signal type	Max length
USB	USB2	5x5m (82')
Ethernet Cat 5	LVDS	>10m (>30')

Meteor commercial offering

- Meteor components are available from TTP:
  - Integration support and software license
  - PCCs
  - HDCs for your printhead type
- Non-compete Meteor design licenses are available from TTP:
  - Whole system design
    - with HDC for your printhead
    - with support for integration into an existing printer
  - Digital pulse-shaping HDC design
    - with support for integration into an existing data path

Summary

TTP is:

- 300-strong technology services group based in Cambridge, UK
- 20-year experience of contract R&D working across many industries
- Engineering services available across all types of inkjet product development from small to large

Meteor is:

- A commercially-available universal printhead control system for all your printer / print system needs

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