On the Systematic Production Data Messaging between Publishers and Commercial Printers: The Press Frontend

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Abstract: Printing and postpress operations have been computerized much later than the prepress and design functions of publishers. Printing plant automation can be built mainly in two ways. High flexibility is obtained by using digital printing lines but their limited capacity, quality and high unit cost are competitive with real mass printing methods, e.g. web offset, only in very small jobs. Integrated systems for press control, postpress and material handling have been used in modern printing plants. Software and messaging for production data between the subsystems are now urgently needed. The main problem is how to organize the system interfaces between publishers and printers. The product, resource and process data, must be defined and acquired from the local subsystems, i.e. from the prepress network of the publisher, and similarly from the systems of the printing plant. The data messaging has to be based on the process definition of the subsystems, and on the intersystem and the global needs. A new concept, called the **press frontend**, is introduced for the publisher-printer interface. Other relevant interfaces include press-mailroom and publisher-distribution. The job data at the press frontend has been roughly analysed. It will typically include very large files. The subsystems of the press frontend must input and hold the job files, veri fy the and inspect files before the output, and support a flexible job flow with a complex product structure up to the ready plates.

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Introduction

Many recent reports on modelling production management systems (PMS) cover the approaches for prepress (1, 2), press (3, 4, 6) and postpress (4, 5, 6) processes in large highly automated printing plants. While the feasibility range of the electronic printer lines is slowly expanding large press sheets and high speeds, beyond 10 m/s, are only found in the **web offset** presses.

These are normally devided into one-web and multiweb (hybrid and coldset) presses. The hybrid presses mostly include only one heatset web. The coldset or newspaper presses often have the capacity for 16 broadsheets pages per unit in the so called collect run (3). Today, many 4-high tower presses with 4+4 colour-webs have been installed. Most of the printers set the need for colour capacity from 50 to 100 per cent process colour printing in newspapers and similar products. The high fixed costs of the big presses have to be allocated to products and jobs with more value, and one component of these efforts is the colour.

In this kind of production environment certain technoeconomic features gain importance. Materials handling and a high degree of automation are typical of the modern printing plants. There has been some integration like the press-mailroom mechanization and the control systems or the computer-to-plate (CTP) systems. Today, a long and complex **production chain** is still typical:

- RIPs, film recorders, normal or CTP platelines, OPI and jobservers
- Plate scanning, punching/bending, and delivery to the press room
- Plate mounting robotics or manual plate fitting routines on the press
- Paper handling from trucks to automatic high stores
- Transfer from the store to the stripping and presplicing stations
- Automated trucks (AGV), and reel mounting on the reelstands
- Paper, print and mailroom waste handling up to the waste bales
- Press lines and their integrated control systems and subsystems
- Ink containers and pumping systems to the inkers of the presses
- Blanket-washing automation and the solvent recovery system
- Fountain solution chemistry, control, delivery and circulation
- Possibly a heatset dryer with its auxiliary gas, air and cooling water
- Mailroom lines with inserting, addressing, stacking and buffer stores
- Truck loading lines and load forming using conveyors, pallets or racks
- Transportation to specific delivery sites and distribution

This listing includes 15 production stages of which many could still be divided into substages and respective subsystems. To manage this long series of stages and to connect their inbuilt systems will require control and planning. Many stages are quite automatic, and have their control systems, while some still consist of mainly manual routines.

The concept of production management systems (PMS) may be defined to apply the typical methods of **data management** to improve the quality, productivity and flexibility of the work flow through the plant and its processes. Data management normally means structured data, formats, networks (LANs), their operating systems (NOS), servers, data flow and database technologies. In the PMS these basic functions and methods are called data infrastructure (1, 3, 4). The hypothesis is that all data from the subsystems of the production chain should be collected as automatically as possible. Accepted data formats and PMS software are needed for this **infrastructure** , as pointed out (3).

The purpose of this paper is to define how the production data should be organized and used at the main interfaces of the printing plant and especially at the interface between the publishers (customers) and the commercial printers (subcontractors). Special software and re-engineering is needed for the efficient management of the production chain. The intersystem control and the global production management have to be based on the reliable data sources, i.e. the local subsystems of the production, and on the PMS software using proper databases and servers.

Product, Resource and Process data

To define the processes as data sources and data users we need to understand the different points of view of the main actors, in this case the publisher and the printer. The publisher has to get the job done and needs to control the total delivery, quality and the product definition. Printers look at the jobs as sets of loads for their processes - the job has to match the resources. The different views are pointed out in the following **Table 1.**

Job features and files	Publisher's view	Printer's view
Pages	Number, formats	Signatures
Colour	Absolute (displayed)	Paper/ink-bound
Colour separations	Operations Outsourced films	Dot gain factors
Delivery times	Strict (mostly)	Scheduling/Steps
Addresses	Additional data	Mailroom data
Press configuration	Limitations	Resource data
Press sheet	Volume steps	Number of webs

Table 1. The views of publishers and printers on the job features and data

These different views may easily cause difficulties in the matching of products to processes. They should be the key factors in defining a more functional production interface between the publishers and the printers.

The publisher who has a clear view of the printing service can save in many job details and sort out the best capacities from the available printers. The printers are in the position of subcontractors and have to offer their capacity in a structured manner. Selling many difficult web leads and incomplete signatures makes the production expensive and risky. Now, if both production chains - the prepress and press - are digitally controlled the concepts of product data, resources and process data may be used in the production management:

• **Product data**: The product definition includes much data of the volume, design and quality of the product components. In prepress the logical (e.g. SGML code) and physical design leads to certain standard format page descriptions, using PDLs. Additional image input data (cast, key tones, frequences, scaling, softcopy) may have some relevance to the printing. The screening and resolutions are fixed before the image output on films or

plates. The post-imposition data is useful to relate the local ink requirement to the presetting of press inker zones. In the mass production different larger units, e.g. inserted copies, addressed bundles, and editions represent the product hierarchy and contain product data (3, 4, 5).

• **Resource data**: The availability and capacities of the production units, data networks, staff, materials (plates, paper, inks, including their quality parameters), transport equipment, storage space and number of lines in printing and mailing. The resources are often more or less fixed. From the scheduling point of view the prepress and the printing are discrete, multimachine and complex production chains of a batch nature (3, 7, 8).

• **Process data**: The states and their changes (events) in all production stages ,while the product is really put through, schedules, dynamics, bottle- necks, delay propagation, speeds, variations and disturbances. There are a priori data, e.g. time schedules and observed real events, changes, failures, deviations and delays (3, 4, 5).

In a more complex situation where various jobs load the lines of the production chain in a great number of ways, we may also speak about manufacturing data and plans which express how the entering jobs are timed and how they load the necessary stages and systems. Rough **a priori** loading plans for long-term contract jobs with regular deliveries are common. These plans handle the jobs as rather rough entities and their scheduling is based on rules of thumb.

In manually controlled production some of these figures, particularly the product data, were included in the **job form**, a paper filled in before letting the job enter the production. In some cases it is successively filled in while passing through te production stages with the job. Many early production control systems were based on the concept of a job form.

The PMS data (3) is not only product data but also resource and process data as shown above. Beside, in a long and complex production chain the resources are not equally available and constant in all instances and thus dynamics has to be developed (3, 4, 5, 7) to handle the product data, resource changes, the process events and timing problems. In commercial production the flex in the product variation is a great benefit. There are more and more concurrent features in the production of time critical printed communication products.

Press Frontend: A New Concept

In some earlier reports we have briefly discussed the subsystems on the frontend of a modern printing plant (3, 6), using the term Orders Frontend to point out that the film-plate output in the printing plant uses equipment similar to the socalled prepress backend. The real need for the commercial printer to make his own plates (or films) and to widen the concept of his service is based on the fact that the product exists in a digital format (e.g. a set of PostScript files). The jobs can thus be **transmitted** (and saved) to the printing plant. After some consideration, this concept is named the **Press Frontend**.

To define the press frontend we may say that the printer´s service begins at the press frontend which is the receiver system, i.e. a job-server capable of receiving large files and a storage system for the jobs. The press frontend systems also output the printing plates for the specific presses. In Fig. 1 we illustrate the subsystems at the press frontend.

From the publisher´s point of view the press frontend is an **interface** for delivering prepress ready jobs to be printed. The publisher may also buy postpress, inserting and

mailing services. He may deliver data through another interface, e.g. address data from his subscriber register, for the printer's mailroom and distribution (4, 5).

In a printing plant with several printing and finishing lines, the sales and customer support must be highly data-driven to offer and sell more production-optimized jobs for the customer publishers (Fig.1).

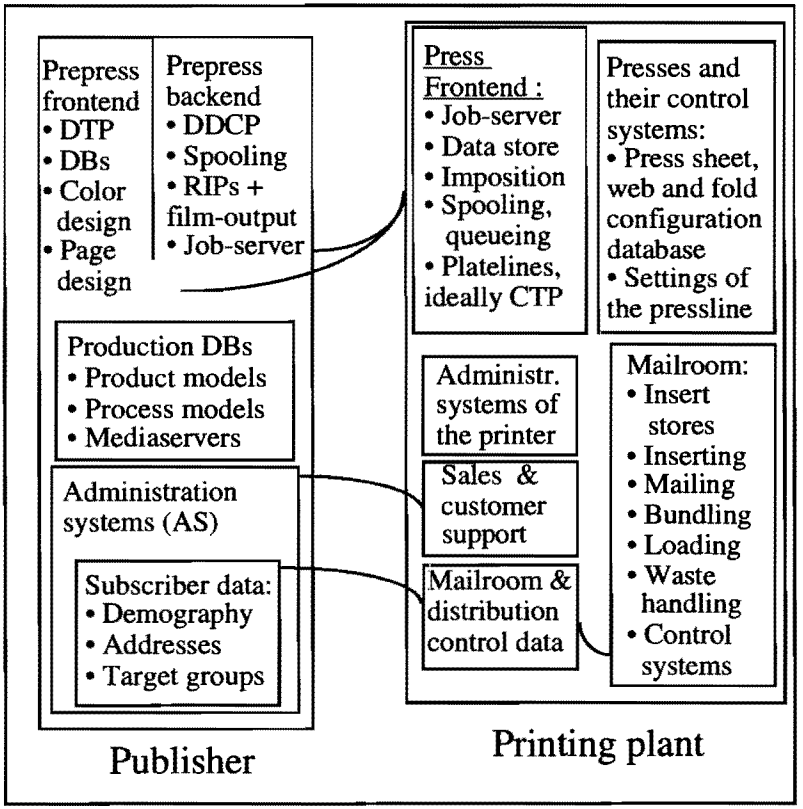

Fig. 1 The concept of the Press Frontend of the printer : Including the receiver job-server, data store and output, e.g. Computer-to-Plate (CTP), and the surrounding functions of the publisher-printer interface. The product intelligence of the publisher includes product and process models and intelligent archiving in mediaservers. Other interfaces include buying mailroom and distribution services and offering and supporting jobs.

System Challenges of the Press Frontend

By letting the printer output the final films or plates - with the specific impositions in the plate formats of presses - the publishers will not lose anything. The future role of the publisher will gain more value by developing **product intelligence** and products which may partly or mostly reuse, retarget and repurpose information material e.g. contents, graphs, pictures, data, templates and models, e.g. structured SGML documents and databases, of previous or parallel products. The search and choice of the proper printer may also become easier by using such systematic data.

To separate the large volume presses from the digital printing markets, we must remember their large press sheets, wide webs and the high press speeds. These unique features of the today's web offset presses lead to a basically high productivity and low cost. The only problem is to make such high-capacity production units more flexible and faster in their throughput. Many presses are too fixed while others may be too complex.

The low cost is a concern mainly in the competition between the best web printers. To integrate the publisher's systems with the printer's systems the press frontend is the **most active interface**. Therefore we must discuss the new requirements and system challenges to be used at this interface, and particularly at the press frontend of the printer.

In addition to the press frontend, many other types of **automation** seem to penetrate the modern printing plant. These have been mentioned and analysed in some earlier papers (3, 4, 6), and they include the integrated process control systems of the presses and mailroom lines, materials and waste handling (in press-postpress), insert and bundle handling before loading and distribution.

To understand the meaning and payoff features of the press frontend - again new expensive systems for the printing plants - one has to consider the possible risks, like the delays in the press starts, job changes, and relevant print quality parameters (inker presetting, colour register, dot gain) which may depend on the delay, mistakes or failure in the entering product data and plates.

The building of a press frontend, with a high data capacity and adequate connections to other processes, will lead to a new spectrum of supporting systems, functions and processes, which have been listed in **Table 2** . The processes need to mature but their outlines are quite evident.

Systems	Processes and functions
• **Job-servers**	To receive and hold the big job files, to spool, route and queue the jobs before the output processes (proofs, DDCP, films or plates)
• **Integrated imposition**	Using the job file attributes* and the press sheet***, folder, and the press configuration data of the press in question, the imposition places the pages in correct order on the plates
• **Visual inspection**	Before the RIPing or right after it (bit maps), i.e. before the final exposure of the plates, imaging, softcopy, DDCP and autoinspection may be used to verify that pagings, colours, and the whole press sheet is OK.
• **Proofing and DDCP**	Integrate the direct digital proofing (DDCP) of the final press sheets. Another alternative is to acquire and move the final on-plate data in the form of softcopies to the printing control. There are different possibilities of using the image data for inspection, printer´s softcopy, and inker zone presetting (8, 11)
• **DDAP**	Integrate and apply direct digital ads (12, 13), file-enabled ad pages or other similar files from foreign sources, e.g. ad distributors, or newspapers, to be stored and input in the impositions and on the final press sheets***.
• **Distribution flex**	To open the press sheets*** for any pages or foreign files to use the specific structure of the section, zone edition, the time-windows of successive editions, or the entire paper and their respective distributions.
• **Inserts, sections**	Enable the digitally received inserts or remote-edited sections to be stored for the imposition , production of plates for preprinting, or for the inclusion in the main copy** (3). Improved capacity utilization is achieved by preprinting inserts or sections in two successive waves and combining the main copy in the mailroom.

Table 2 continued

• **Flexible production**	To use the flex of digitally controlled presses by speeding up the press sheet changes and the respective **late changes** in the press webbing, colour and folder settings when the successive jobs or editions are run with different press sheets*** . To support the respective makes of plate sets for the pages and sections of the zoned or successive editions.
• **Mass data stores**	Connect additional mass storage systems for the short- or long-term holding of large jobs and files, using various types of mass memory and optimizing the cost, security, availability, import and access times (see Appendix 1).

* **File attributes** are data describing the structure and order of the pages in the job file, e.g. page numbers, colours/page, sections, ads or other production relevant data for the later production stages

** **Main copy** is the latest copy which serves as a "jacket" for the preprinted sections and inserts (3)

*** **Press sheet** is a concept and product component describing the total printing area (all pages of the sheets of each web) of a multiweb job, defined in more detail by ref. (3). The webs may have varying widths, and run either collect or straight, the press sheets may vary in a large number of alternatives. This means a major flex in the capacity of multiweb presses. In one-web and sheet-fed presses, the press sheet is a much simpler and more fixed concept. Variable print length presses also produce a number of press sheets.

Table 2. The **Press frontend** will widen the system concept of the printing plants by linking the publishers and prepress optimally and by bringing forth many new requirements and possibilities.

New Types of Job Flows

Many commercial system families already include some of the features and new processes of press frontend. In fact these integration, job flow and management functions are becoming an essential and profitable segment of the systems for the prepress backend and the press frontend (8, 9, 10). Today, the whole complexity of modern printing plants is still in an early stage and therefore the needs for an effective press frontend are largely undefined. Compared with the massive capital investments to be made and applied in the

printing plants the press frontend processes, i.e. from the pages to print-ready plates, have been analysed and discussed too loosely.

What is new at the interface between the publishers and the printers is that the publishers wants more and better service. The printers have to respond to the change in the market and adapt to the increased complexity, i.e. more titles, split products, more colour and smaller jobs. The printers have to become more flexible. The only way of doing this with their high- capacity resources, such as the press and mailroom lines, is to develop and use automation, production control and production management systems, PMS. The new features in the processes described in Table 2 are:

• The use of networked **file transfer** to entirely substitute the physical materials such as diskettes or films. CTP technology is a part of this new work flow.

• The **imposition** has to be integrated as the CTP will be widely applied. In broadsheet jobs the natural position for the imposition software is the press control system. In the case of multipage plates, the plate imposition must be integrated before the plate output and linked to use the press sheet alternatives, i.e. the press configuration data from the press control system

• An adequate set of separate and high-capacity **servers and data stores** and maybe also **archiving** systems for the jobs and their component files for possible regular reuse in the production. High capacity means here the range of tens and hundreds of Gigabytes, and soon much more, even if the data may be compressed in some instances (see Table 3).

• Other **new job flows** may appear, e.g. required by target-oriented and **split** products, such as sections, zoned and successive editions, and **included** subproducts, like inline prints (e.g. inkjet personification), shared ads, remote sections and various types of inserts. DDAP and other page size document inclusions (12, 13) will be integrated in the press frontend stage while smaller-than-page documents need to be pasted on pages in prepress workstations.

• For all these press frontend systems to be feasible, the printer has to be both **flexible** and **productive**. The modern printer has to process, store, and possibly reprocess a large number of daily jobs in 2-4 shifts per 24 hours, seven days a week, and only in the digital job flow mode.

• For more revenue, the printers may **serve the publisher**, if he does not want to invest in storage functions, by offering archiving over various time frames. There are similar arrangements between the ad agencies and their repro work files at the prepress shops. In general the press frontend means better service and cooperation.

On the other hand, the cost of the hired storage may push the publisher to re-evaluate his own data store needs and solutions. In general the massive stores of data will soon become a standard key resource for both the publishers and printers.

Most mass storage technologies are already very cheap and the prices continue to fall. In **Appendix 1** we have collected some basic facts of data storage technologies. To match these possibilities to the needs which soon will be observed in the printing plants and their press frontends we have collected some typical data of the job-files in **Table 3.**

Jobs	100 tabloid pages or 50 broadsheet pages are a typical size
Colour	Between 50 and 100 percent of the pages are in 4-colour
Page files	About 2 Mbytes/tabloid and 4-5 Mbytes/broadsheet (B/W)
Color page	About 15-20 Mbytes/tabloid and 30-40 Mbytes/broadsheet or more if no compression is used or with finer screens
Job files	About 2 Gbytes if 100 % and 1 Gbytes if 50 % colour
Press	Typically 2 monounits (1+1 or 1+2) and 2 4-high towers or four 4-high towers with 100 % 4+4-colour webs.

Table 3. High share of colour pages leads to very big job files on rather modest number of pages - for instance 100 tabloid pages as above.

Obviously there is a need for a more flow-through type of a **job server** which will receive the jobs and through which they are, with or without the imposition, output to the RIPs and the CTP lines. This more functional server is completed with **storage servers** in which the jobs may be hold or archived for shorter or longer periods.

To hold the job files or parts of them may be needed for example to give time to the most priorized jobs, to wait for combining inserts, or to the **verification** of the data of the large job files. The **inspection** and fault elimination before the plate output will be major problem in the future press frontends. We have to develop automation for the verification of the page and press sheet data. The amounts of data are of such order that any manual or interactive methods, like softcopy, opening the files for display, or DDCP, are far too slow and expensive .

There are concepts like the hierarchical storage management (HSM) which may compensate the rapid growth of the mass memory capacity by grouping various types of mass memory capacities into a single optimizable storage system (9). The idea is to classify the files in relation to their apparent re-usage and then store them transparently, in the order of decreasing reusage, on successively cheaper and slower media. Basically same idea was used in the main frame computers to hold data on expensive disks and less expensive mag-tape-streamers. Now the mass memory media are much cheaper, available in numerous brands in standardized, easy-to-integrate **subsystems**, and with a large choice of features and prices (See Appendix 1).

Key Connections and PMS

Most printers have daily difficulties with the incoming jobs and the materials - files and films - received from various customers. The number of formats and their versions, the fonts and the included but incomplete indexing and attributes cause daily confusion and

mistakes. Even the most regular publisher customers do not always follow the quidelines possibly set in mutual agreements or manuals.

To make the daily **dialogue** between the prepress and the press frontend as efficient as possible, and to obtain a job flow with a high security, reliability and speed, a wide variety of PMS connections are needed. The publisher has to collect and code products and process data, feed it forward to the printer's PMS, and use process and resource data from the printer. Similarily, the printers numerous systems must use data and connections to adapt their processes to the customer publishers' job flow, and arrange his resources to offer jobs specified for the best troughput and customer service. Some examples of the connections relevant to the publisher-printer interface are listed In Fig. 2 .

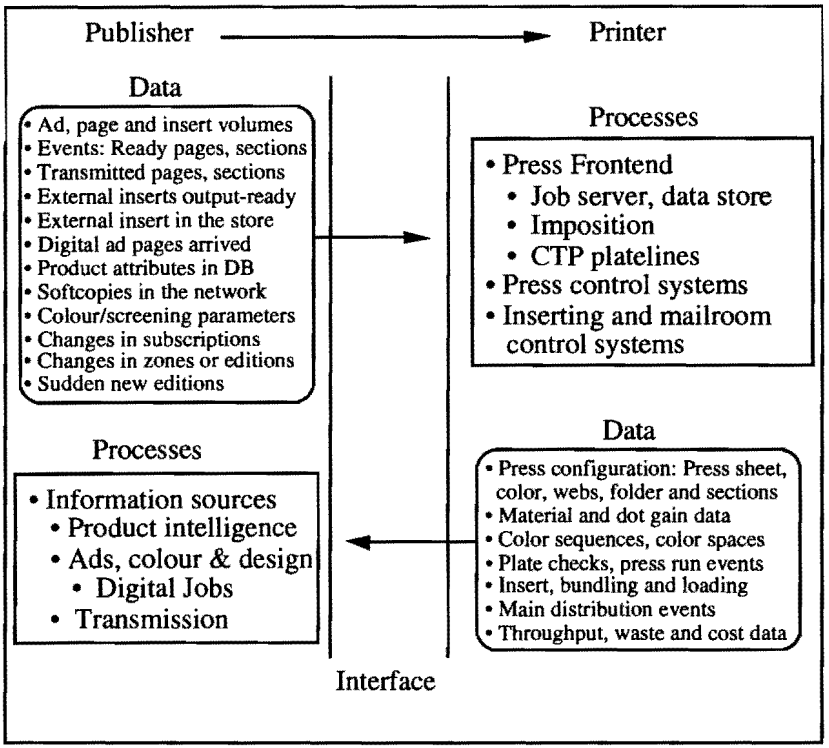

Fig. 2 The sources of data on each side of the publisher-printer interface without any exact reference on how the data was captured or where it will be used. The number of subsystems is very high on both sides of the interface.

The throughput of a job in the printing plant greatly depends on the job itself. However, some estimates of the press make-ready and run times can be scheduled for the product alternatives. The total schedule must begin with the needs of the distribution timing (4, 5). As pointed out earlier, the PMS connections are not only needed between the closest

successive stages but in the whole production chain. The whole production chain is so long and complex that exact models or optimization approaches are out of question, which is often the case in other applications as well (7).

Conclusion

Buying printing services from a web offset printing plant and from multi-web presses is an environment with hard requirements. Although the publisher has his own point of view of the publisher-printer interface new systems need to be developed to receive and store manageable digital jobs from the publishers to the **press frontend** systems of the printer . A rapid increase is expected in the file sizes and production management data .

A new concept of the press frontend is a set of integrated systems for the printing plant to receive digitally formatted jobs in a continuous job flow, and to produce them with short job changes and make-ready times in a multishift operation. These processes include efficient job and archiving server configurations, integrated imposition and other global production control activities before the output on the plates.

The press frontend will increase the capacity of the printing plant and it also offers new possibilities to develop the **flexibility** in the two main directions: adaptation to product splits and versions , like zoned and successive editions, inserts, inline prints, and the flexibility of the press and post press processes and resources. The press frontend will automate several subprocesses and complete the plant-level automation of printing. It will set higher requirements for the process data, automation and production management of the whole printing plant.

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Appendix 1

A short listing of the useful mass memory media

• SLED, single large "expensive" disks, a term or a nickname for various hard disk configurations. There is also a product category called ultra-large-capacity single-drives. Their prices are falling and are below USD 1 per Mbyte. Capacity is rising from 0,5 Gbytes to 2, 4 or even 9 Gbytes.

• RAID, the redundant array of independent disks. The stored data may be rebuilt after a drive failure or corrupt data from blocks created on the in the stage of input. Compared with the SLED, the RAID (10) may provide high reliability in various combinations of cost, speed (rates in and out of the storage) and system design. The price of storage is about USD 0,5 per Mbyte. Typical capacities are from 4 to 30 Gbytes.

• MOD, the magneto-optical disk, a rewritable medium - cheap optical disk, alaso available in the form of jukeboxes with varying capacity. The price is about USD 0.1 per Mbyte.

• CD, the compact disk, available in various formats (such as CD-ROM, CD-R, CD-Audio, Photo-CD, CD-I) and read-only and recordable types. There are multi-disk jukeboxes to multiply the capacity. The prices in large units are USD 0.02 per Mbyte. The read-only (ROM) formats are popular mass distribution media.

• DAT, the digital audio tape, a cheap slow-access driver, using a cheap magnetic tape with medium capacity.

• DLT, the digital laser tape, faster than DAT. The drive is more expensive than those of DAT.

• HSM, the hierarchic storage management, a seemingly endless capacity where data is saved in the order of frequency of its use, using hard disks, MODs, DATs and DLTs. Novell NetWare™ compatible HSM-products from e.g. Palindrome and IDAS are examples of this principle. Capacities grow and reach easily hundreds of Gbytes.