

# Rainbow Technology Decidedly Nurtures Storage Trends

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**Abstract**—Rainbow Storage is a group of techniques to store digital data in some colours, colour combinations and symbols in Rainbow Format. The technique is used to achieve high-density storage. With the help of Rainbow system we would be watching full-length high definition videos from a piece of paper! The main attraction is the cheap paper. The Rainbow technology is feasible because printed text, readable by the human eye does not make optimal use of the potential capacity of paper to store data. By printing the data encoded in a denser way much higher capacities can be achieved.

**Keywords**— Rainbow format, patterns, density, RVD, DPI, DataPicture, PBM, Disposable storage, Encryption.

## 1. INTRODUCTION

Rainbow technology is a group of techniques to accomplish high density, high speed, cheap and reliable data storage and retrieval. It is a storage optimization technology based upon the usage of printed shapes on a variety of media, unlike the traditional magneto-optical standard, to store data. This is done by using various geometrical shapes and different colours on the surface used, which could be paper or plastic. Storage density can be dramatically increased by storing a bit pattern on a single dot by using colour substances instead of storing bits (0s and 1s) on one dot. Any type of data can be converted into a picture[1] like format known as DataPicture, and it can be printed in any printable media.

## 2. WORKING METHODS

It uses geometric shapes such as squares and hexagons to represent data patterns, instead of the usual binary method that uses ones and zeros to represent data. Besides, colour is also used in the Rainbow system, to represent other data elements. Files such as text, images, sounds and video clips are encoded in rainbow format as coloured circles, triangles, squares and so on, and printed as dense graphics on paper at a density of 2.7GB per square inch. Rainbow storage targets high availability and survivability of data and performance in the presence of faults and attacks referred as OceanStore[2].

The recording media could be either paper or plastic sheets. The piece of paper or even plastic sheet storing the data has just to be scanned in the scanner and read over the monitor.

### A. Conversion procedures

The following steps are used to convert the original data to the data detected by the rainbow devices.

### 1) Level-1 Data to DataPicture:

Data to DataPicture conversion takes place in four steps. A chunk of data bits are taken from data source (Normally Binary file), which is known as a word. The size of the word can vary according to the nature of writers, readers and storage mediums. The word can be converted into a value that will be unique for each different combination of bits. Thus a picture will be generated by representing values as colours. The value then passes through some error checking mechanisms. After producing some error correction bits, it will attach to the data picture. Header, Picture Boundary Mapper (PBM) (for keeping track of the boundary of data picture), universal Picture Dot (a static value that is used for mapping errors that occurred due to colour fading), etc will be attached to the picture. Thus the final output (DataPicture) will be generated. Now the original data is encoded into DataPicture and it can be now printed in any printable media.

### 2) Level-2 DataPicture to Data:

DataPicture to data conversion uses just the reverse process. DataPicture is taken as an input and the parameters like UPD, PBM, etc are read from the header. The actual data is generated by picture to value conversion. Some image processing methods are used for this stage. Value mapping functions are used for mapping the arrangements done on actual data. Some errors that occur due to colour fading can also be handled at this stage. The values are passed through some error correction mechanisms. Fault tolerance and automatic repair is also performed at this stage[3]. Then the value to word conversion takes place. The encoded DataPicture is hence decoded into the result data which will be the original data.

The paper can then be read through a specially developed scanner and the contents decoded into their original digital format and viewed or played. The Rainbow technology is feasible because printed text that can be read by the human eye does not make optimal use of the potential capacity of paper to store data. By printing the data encoded in a denser way higher capacities can be achieved. The retrieval of data is done by scanning the paper or the plastic sheet containing the data into a scanner and later reading it over the monitor. Instead of using 0s and 1s, we use colour dots where each color dot can represent minimum 8 bits (1 byte). The rainbow picture will be highly compressed and can be represented in any colour medium. For retrieving the contents from the medium, picture can be captured and data can be generated from the colour combinations. "Although environmental light differences and color shading is a problem, they can be overcome up to a certain limit by using efficient mapping functions".

In order to read the Rainbow prints, all that is required is a scanner and specialized software. Smaller scanners could fit inside laptop computers or mobile phones, and read SIM card-sized RVDs containing 5GB of data.

The recording media could be either paper or plastic sheets. The piece of paper or even plastic sheet storing the data has just to be scanned in the scanner and read over the monitor. A scanning drive based on the Rainbow software has simultaneously been developed which will come in smaller sizes to be initially carried with the laptops and later to fit into their bodies.

The technology has used geometric shapes like circles, squares and triangles for computing which combine with various colours and preserve the data in images. An RVD therefore looks like a print-out of the modern art. All kinds of data have to be first converted into a common format called 'Rainbow Format'.

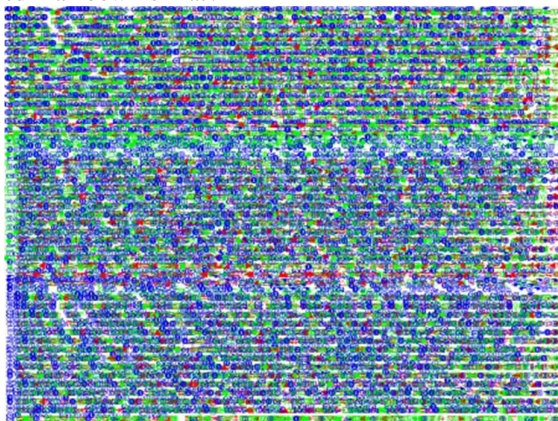


FIGURE 1 EXAMPLE OF RAINBOW FORMAT

### 3. PRINCIPLES USED

This technology is based on two principles:

#### A) Principle I

“Every colour or colour combination can be converted in to some values and from the values the colours or colour combinations can be regenerated”.

#### B) Principle II

“Every different colour or colour combinations will produce different values”.

### 4. ABSOLUTE RAINBOW DOTS

Absolute rainbow dots are used to detect errors caused by scratches, and whether any fading has occurred. Absolute rainbow dots are predefined dots carrying a unique value. These dots can be inserted in the rainbow picture in pre-specified areas. If fading occurs these dot values will change accordingly, and at the reproduction stage this can be checked and corrected. Absolute rainbow dots will be microscopically small so that they occupy very little space in the rainbow picture. These will be coloured differently so that each dot will have its own fixed unique value.

### 5. PRODUCTS FROM TECHNOLOGY

By using Rainbow Storage, we can develop many kinds of products[4]. They include

- 1) Disposable storage
- 2) RVD
- 3) Rainbow cards
- 4) Data centres

*I) Disposable storage:* Rainbow storage can be used to achieve Disposable storage. We can store any kind of data in any kind of media that can represent colour. It can

be used as one time storage. We can use bio degradable materials here (because it is not intended for long time). This category of products can be used for distribution of files, documents, etc. Here we can use even printers, scanners, cameras and so on as input and output devices.

*II) RVD:* RVD (Rainbow Versatile Disk) is another product that can be developed by using Rainbow Storage. We need to develop specific drives for reading and writing. It can hold huge amount of data and it will be very cheap enough to reduce storage price dramatically. The technique Vertical lining is used in RVD to ensure high density. Storage capacity will vary according to the nature of the mediums used.

*III) Rainbow Cards:* Rainbow cards can be constructed as a cheap secondary storage medium for PDAs (Personal Digital Assistant) and other small digital devices. They can be constructed in many standards and sizes. The size can vary from visiting card size to the size of a SIM card. Specific readers need to be attached with such devices.

*IV) Data Centres:* Datacenters are the static storage servers that can hold Peta Bytes of data. It will be a sequential access storage system that can be used for secondary storage of data. We can construct a data centre with a cost of around 35 lakhs.

## 6. ADVANTAGES

- Data can be stored on an ordinary paper.
- Larger amount of data can be had on lesser space.
- The extremely low-cost technology will drastically reduce the cost of storage and provide for high speed storage too.
- Files in any format like movie files, songs, images, text can be stored using this technology.



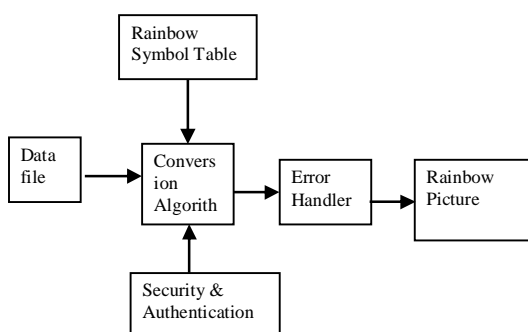
Figure 2: Picture of a wall post containing hidden data in its eyes



Figure 3: Zoomed view of Fig 2



**Figure 4: DataCard (digital visiting card) with mobile camera**



**Figure: 5 Representation of data from a file to Rainbow format**

From the Fig: 5 A chunk of data bits are taken from a data source (Normally Binary file), which is known as a word. The word can be converted into a value that will be unique for each different combination of bits. Thus a picture will be generated by representing values as colours. The value will then pass through some error checking mechanisms. After producing some error correction bits, it will be attached to the data picture. Thus the final output (DataPicture) will be generated. Now the DataPicture can be printed in any printable media.

## 7. CONCLUSION

Once the Rainbow technology is in, soon we would be watching full-length high-definition videos from a piece of paper! With the popularity of the Rainbow Technology, computer or fashion magazines in future need not carry CDs in a pack.

One of the major advantages of the Rainbow system is the fact that it should cost a lot less to produce than the typical polycarbonate DVDs, CDs and now Blue-rays. Huge data banks can be constructed out of Rainbow-based storage medium.

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