# An untraditional approach to the development of untraditional tapeless TV technology

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***A tapeless news-processing facility is currently in the process of pilot operation with Bulgarian National Television. Based on the most powerful multi-initiator high bit-rate network technology, and incorporating the hardware and software resources provided by inexpensive and widely-used computer systems, it offers several advantages over traditional tapeless systems that are based on computer technology using real video servers.***

***By extending this subsytem to include other similar subsystems for TV production, post-production, scheduling and archiving, the Authors outline their proposals for a fully-integrated tapeless TV production facility.***

## 1. Introduction

The recent advances in digital TV technologies have led to dramatic changes in our ideas about and our understanding of television – in terms of not only its possibilities for artistic and creative accomplishment, but also the technical quality of the finished TV product.

The efforts to achieve more rapid production and bigger volumes of higher-quality TV information have made the data-processing and transporting technologies industry face new challenges. Digital "island" technologies for TV studios are already stepping back to give way to high-tech computer-integrated production systems.

The question arises: *by means of what investment and costs could the implementation of such an integrated system be expedient?*

The world of computer technology was called upon to respond to these challenges by developing new technologies that are capable of ensuring the desired functional and technical characteristics, at the lowest price possible.

In order to meet the demands of the TV world, the price of traditional data-processing server architectures has climbed to more than 1.5 million US dollars, which makes them unacceptably expensive for most clients. One of the most promising solutions to this problem is to use the

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hardware and software resources provided by inexpensive and widely-used conventional computer systems [1]. Today we are witnessing a dramatic development of these resources which are almost on the verge of changing the entire philosophy of digital TV studio production. *So, what are the latest achievements?*

- We have already seen the development of a large number of hardware and software products for video and audio data-processing by means of conventional computers (PCs) – with "broadcast" quality.
- New network-based "multi-initiator" technologies of Fibre Channel (FC) and Serial Storage Architecture (SSA) have been designed to ensure the access of a group of PC-based workstations to the subsystems of shared conventional disk storage, without the use of a real video server [2].
- A high bit-rate communication (up to 1 Gbit/s) has been achieved between customer computers and the intelligent subsystems of the shared disk memory, by means of inexpensive data hubs.
- The means of wiring the intelligent units have been developed, with characteristics that are suitable for TV production applications:
  - with *copper cable* a range of up to 25 m is possible while, with "boosters", the range can be extended up to about 200 m;
  - with *optical cable* the range is of the order of a few kilometres.
- Appropriate "server software" for multi-initiator technologies has been developed for the control and management of the data, thus ensuring a real-time synchronous dialogue between the client machines and the subsystems of the shared disk memory.
- And finally, these multi-initiator technologies ensure a sufficient technical capacity for data processing and transfer, with similar characteristics to that of the "real" traditional video-server.

There are serious enough arguments in favour of a restructuring of the video industry, based on the principles of these novel computer technologies. It is highly commendable that some daring consumers, such as Bulgarian National Television (BNT), have already decided to

## Abbreviations

| | |
|---|---|
| **AS** | Administrating station |
| **DLT** | Digital library tape |
| **DLTU** | Digital library tape unit |
| **EW** | Editing workstation |
| **FC** | Fibre Channel |
| **FCSSAN** | Fibre Channel switched storage area network |
| **IEC** | International Electrotechnical Commission |
| **ISO** | International Organization for Standardization |
| **LAN** | Local area network |
| **M-JPEG** | (ISO/IEC) Motion - Joint Photographic Experts Group |
| **PAL** | Phase alternation line |
| **PW** | Playout workstation |
| **RW** | Recording workstation |
| **SCSI** | Small computer system interface |
| **SSA** | Serial storage architecture |
| **VCP** | Video cassette player |
| **VDP** | Video disk player |
| **YUV** | The luminance (Y) and colour difference (U and V) signals of the PAL colour television system |

design and accomplish tapeless production technologies through the use of conventional computer technologies.

## 2. Early benefits of the BNT solution

On 14 July 1997, the Expert Technical Council of BNT approved a Technical Assignment for the development of a complete tapeless TV news-processing system for BNT, based on "multi-initiator" computer technology as proposed by the Authors.

Along with the functional, qualitative and quantitative characteristics of the proposed TV news production system, the Assignment included a brief to develop a solution based on multi-initiator computer technology.

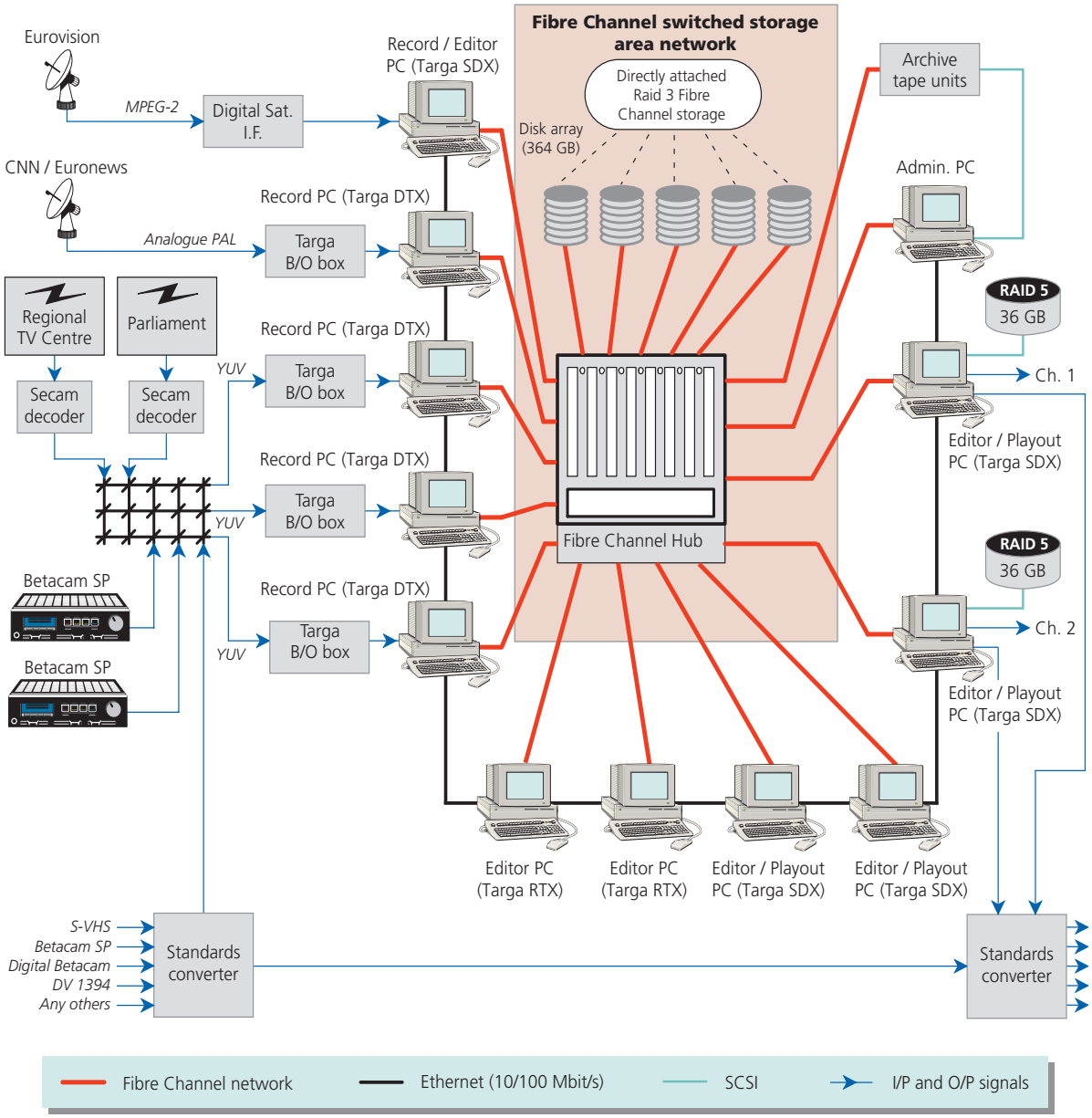


**Figure 1**
**Physical level of the BNT tapeless TV news system.**

In October 1997, BNT opened direct negotiations with several companies who could participate in the realization of the project, in accordance with the elaborated Assignment. The result was that BNT signed a contract with the "Number 1 GM" company for the delivery and implementation of a tapeless TV news-processing system, on the basis of a technical project which was to be worked out in co-operation with BNT.

The resulting system is now in the process of pilot operation. Its implementation in the actual production environment of BNT will follow shortly.

# 3. The BNT news-processing system

## 3.1. Description of the computer technology

As shown in *Fig. 1*, the system includes twelve PC Pentium II workstations, interlinked via two networks:

- ⇨ a computer network for processing the video and audio data;
- ⇨ a secondary 10/100 Base T Ethernet network for data control and management.

The audio/video data processing network, based on FC Arbitrary Loop technology, guarantees in duplex mode a data transmission rate of 200 Mbit/s over distances of up to 200 m. It was developed on the basis of hardware products from Adaptec, and "Suite Fusion Pro Version 3.0" software from Mercury Computer Systems. The on-line (RAID-3 protected) system storage has a capacity of 360 GB and includes five housings, each containing eight Fibre Channel 9 GB disk drives. Data exchanges with the clients are accomplished via an FC hub.

Truvision hardware and software products for the video and audio data processing are used in the workstations. According to their functions – such as recording, post-production, play-out or combined applications – the workstations are equipped with appropriate processor cards (Targa 2000 RTX/DTX/SDX) and software packages (D-Vision On-Line SW RT/XT Version 3.5 and Sound Forge SW D Version 4.0.).

The software for the video and audio data-processing operates under the control of Microsoft Windows NT 4.0.

The administrating station controls the state of the central database by means of the Fibre Channel network and the state of the client machines by means of the secondary 10/100 Ethernet network.

## 3.2. Functional characteristics

The TV news processing system has a number of functions which are briefly described in this section.

### a) Recording (digitizing), logging and management of the incoming news feeds and of ENG material originated on tape

These functions are accomplished with the help of five recording workstations, one of which is capable of operating also as a post-production workstation.

The system guarantees simultaneous recording of data from the various workstations onto the common disk storage system. The video signals fed from the data input channels and from the video tape players are heterogeneous as regards their coding standard, and are allocated casually in time. Therefore, they are first decoded and distributed together with the accompanying audio signals to the recording workstations, by means of a YUV / audio matrix.

The aggregate quantity of input information over a period of 24 hours amounts to about 18 hours. When using a compression coefficient of 1.8:1, the system disk storage area can keep an 8-hour record of the M-JPEG encoded video signals; when using a compression coefficient of 4:1, a 20-hour record can be maintained.

### b) *Post-production processing including video and audio monitoring and editing with real-time video effects and graphics ability, character generation and subtitling, selective video-clip grabbing and voice overdubbing*

The post-production processing is effected basically by four workstations, two of which are capable of operating as playout workstations. Simultaneous operation of all workstations is possible without disrupting the digitizing workstations. The duration of the TV topics is usually between 30 sec and 80 sec. The total amount of TV topics produced in one day is approximately two hours.

### c) *Playout of seven TV news broadcasts for both national TV channels*

Two playout workstations link the produced TV topics in on- / off-line time series, on the basis of a playlist. Both playout PCs copy the video / audio files from the central storage system before being locally played out. Both workstations have 36 GB of usable (RAID-5 protected) SCSI storage, giving a total of more than 1 hour of playback TV information.

### d) *Archiving of video / audio information*

Archiving, controlled by the administrating station, is accomplished by means of digital library tape (DLT) units. The system supports a one-week archive, recorded on DLT cassettes.

### e) *Text data exchange with the existing BNT "newsroom" text-processing system [3]*

The transmission of video / audio data to the "newsroom" system – for the purpose of monitoring and Internet broadcasting, and the receiving of Internet video / audio data from this system – is planned to follow at a later stage.

## 4. Advantages of the system

The tapeless system described in *Sections 2* and *3* ensures the following advantages over traditional tapeless systems based on computer technology with a real video server:

- ⇨ lowering of the initial investment costs by a factor of several times;
- ⇨ higher productivity when a greater number of client machines is used;

- unification of the hardware and software on the basis of conventional facilities and technologies (thus ensuring easier and cheaper maintenance, and more flexible reconfiguration of the TV technology when the production environment is changed).
- more possibilities for extending the system.

## 5. Prospects for development and integration

While the application of multi-initiator conventional computer technologies in the TV news production area is already a reality, the time when their application will also include the production of artistic TV programmes is not far ahead. There are already real prerequisites for it.

The advance of multi-stream super-high-bit-rate data transport technologies (e.g. "switched fabric topology") leads to an ever higher bandwidth. The organization of shared storage permits an expansion of its volume simply by increasing the number of intelligent subsystems. Some well-known producers like Mercury Computer Systems Inc. are developing network software options which ensure simultaneous synchronized access to the system disk storage for more than 20 clients. Ever more powerful video/audio data-processing hardware and software products are emerging.

For the production of artistic TV programmes, one might use the same computer platform, where the functional and technical characteristics of the system are determined in accordance with the specifics of each particular application.

This may require a wider bandwidth, faster data-processing and transmision of the bitstream, and low- or non-compressed video data-processing for higher picture quality, but the same principles apply.

As is well known, because of the discrete character of the TV programme production process, it is necessary to store the input, intermediate and output products, i.e. it is necessary to create heterogeneous video, audio and text databases.

The centralized recording of all databases in a common storage area makes their processing in one network loop difficult, because of the increasing number of processed data streams.

The data-processing analysis in [4] shows that databases can be distributed for processing into at least five major groups, in accordance with the sequence of the production technological cycles:

- internally-produced TV products;
- foreign TV products;
- TV news;
- TV products for broadcasting;
- TV products ready for broadcasting and already-broadcast TV programmes.

The data processing analysis [4] gives grounds for a synthesis of a tapeless TV production system, capable of processing each of the five database groups in an autonomous tapeless TV subsystem which has an organization analogous in principle to the computer platform shown in *Fig. 1*.

*Fig. 2* illustrates a possible method of integrating the five autonomous tapeless TV subsystems.

Each subsystem supports in its disk area a limited amount of data for current processing, and a significantly higher data volume in its digital library tape units (DLTUs). The recording and reading of video / audio data in each subsystem is controlled by an administrating station (AS) with the help of a 10 / 100 Base T Ethernet network, as described in *Section 3* and illustrated in *Fig. 1*. By means of the DLTU, subsystem 5 and subsystem 3 exchange TV products with the long-term TV programme archive, and respectively with the long-term TV news archive.

As shown in *Fig. 2*, the five subsystems are equipped as follows:

- subsystems 1 and 2 with recording workstations (RWs) and editing workstations (EWs);
- subsystem 3 with RWs, EWs and playout workstations (PWs);

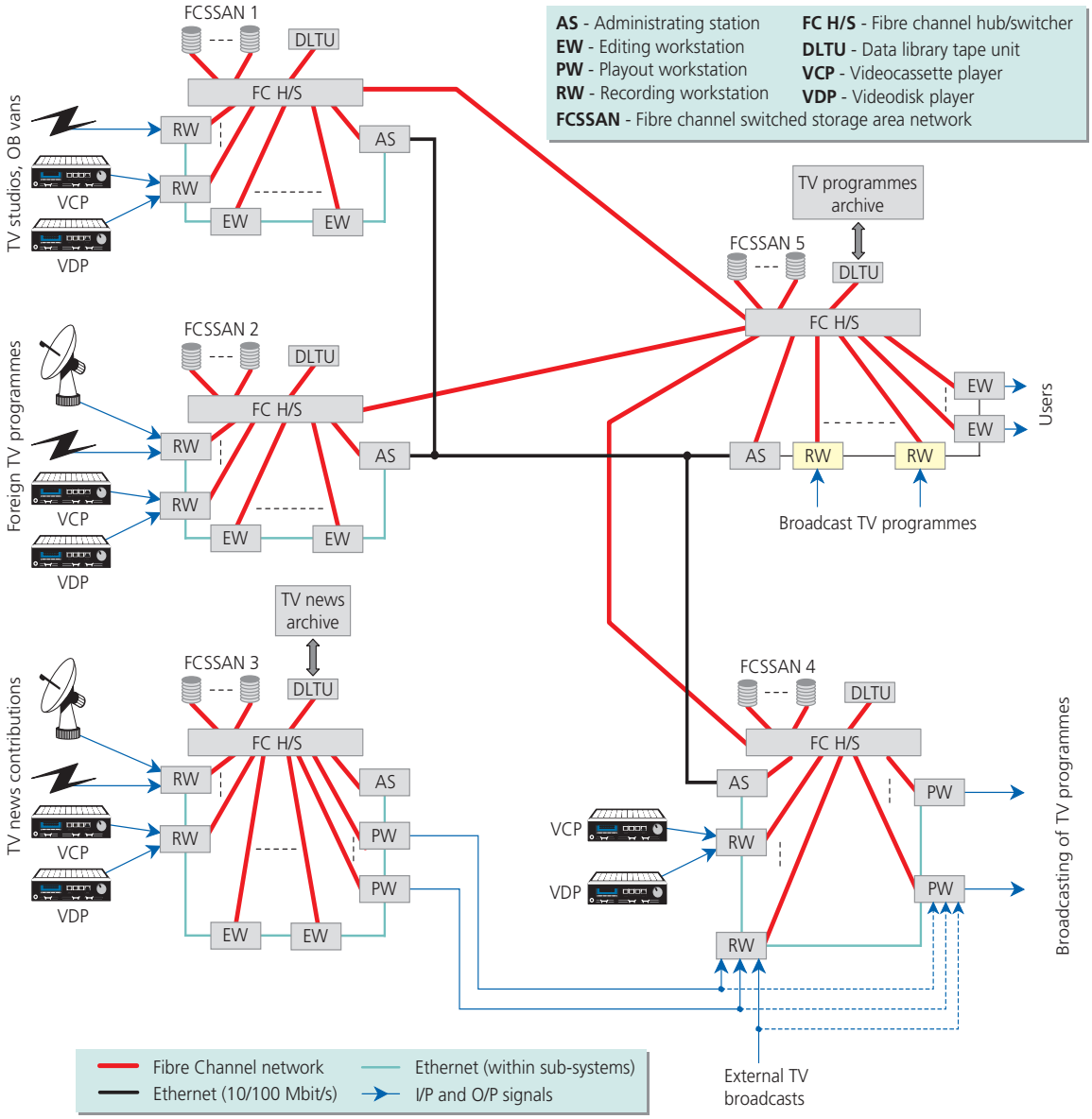


**Figure 2**
**Physical level of the integrated tapeless TV production system.**

- subsystem 4 with RWs and PWs.
- subsystem 5 with EWs, and with RWs for recording TV programmes at the time they are being broadcast;

With the help of the EWs, the following is accomplished:

- *subsystem 2* – predominantly subtitling, and overdubbing of the sound;
- *subsystem 1* – all kinds of post-production processing;
- *subsystem 5* – monitoring, restoring of archived TV products and the transmission of archived TV products to different users.

By means of the PWs, subsystem 4 transmits TV products for broadcasting in a scheduled order.

TV news and external TV broadcasts can be included in TV programmes as they are being broadcast – synchronized with them and practically in real time – in one of two ways:

- by input to an RW of subsystem 4;
- by input to a PW of the same subsystem.

Input to an RW allows the incoming material to be recorded in the network storage area of subsystem 4 for the purpose of archiving.

By means of the RWs of subsystem 5, TV programmes may be recorded during the time of broadcasting.

The integration of the FCSSANs of subsystems 1, 2, 4 and 5 (in the manner suggested in *Fig. 2*) would allow the transfer of data files between them. Recording and reading of video / audio data between the storage areas of the four subsystems can be controlled by means of their administrating stations. The operation of the ASs can be co-ordinated by the AS of subsystem 5, by means of a common 10 / 100 Base T Ethernet network.

Thus:

- subsystem 1 receives archive TV products from subsystem 5 in order to process them;
- the new TV products produced in subsystems 1 and 2 are transferred to subsystem 5 for storage;
- subsystem 4 receives the newly-produced and archive TV products from subsystem 5, and transfers the already broadcast TV products and programmes to subsystem 5 for archiving.

In case the financial opportunities are limited, the implementation of the fully-integrated tapeless TV production facility described here could be done stage by stage. On the basis of the data-processing analysis already carried out [4], the following programme for the implementation of the subsystems can be recommended as the most effective one:

**Stage 1:** *Subsystems 3 and 4*
(the digital archiving of products already broadcast could start within this configuration).

**Stage 2:** *Subsystem 5*;

**Stage 3:** *Subsystem 2*;

**Stage 4:** *Subsystem 1*.

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