

Case Study

The Video File Transfer System at ARD

ARD's Video File Transfer System (VFT) was introduced into daily operations in October 2007. A joint development of ARD, IRT (German Institute for Broadcasting Technology), and DAVID Systems GmbH, VFT represents a sleek, cost-efficient alternative to conventional cable transfer systems. It forms the basis for automated and semi automated tapeless workflows across different broadcast networks. This report outlines the concept, development, and structure of the VFT system, and discusses the practical applications and advantages of using MXF-based processes to transfer content between the heterogeneous infrastructures of different broadcast networks.

Development

Following the successful introduction of digital workflows in radio broadcasting, ARD decided in early 2002 to implement digital exchanging of video content via a file transfer system. A working group was established by ARD's PTKO (Production and Technology Commission) to create a video file transfer test system, to optimize this system for practical use, and to introduce the system into daily operations at ARD's broadcast networks and major ARD studios such as the Sendezentrum (Broadcast Center) and Hauptstadtstudio (Capital Studio). Already firmly established as a solutions provider for the file transfer systems at ARD's radio networks, DAVID Systems GmbH was chosen as the development partner for the new video transfer project.

In early 2003, IRT and the PTKO's first participating broadcasters — the SWR and NDR networks and the ARD Broadcast Center — commenced trial operation of the system. Further broadcasters soon followed. Thanks to overwhelmingly positive results from the test system, SWR already introduced several major VFT components into regular operations in 2004, integrating the numerous tapeless workflows across its regional and state studios. At this point, SWR was still using its proprietary video formats, which were fully integrated into the system. The next step was for the Station Management Board (Fernsehbetriebsleiterkonferenz) to coordinate the required system optimizations with IRT and DAVID Systems GmbH and to jointly implement the MXF standard. Following certification of the MXF implementation, the Video File Transfer System was introduced into ARD's regular operations in October 2007.

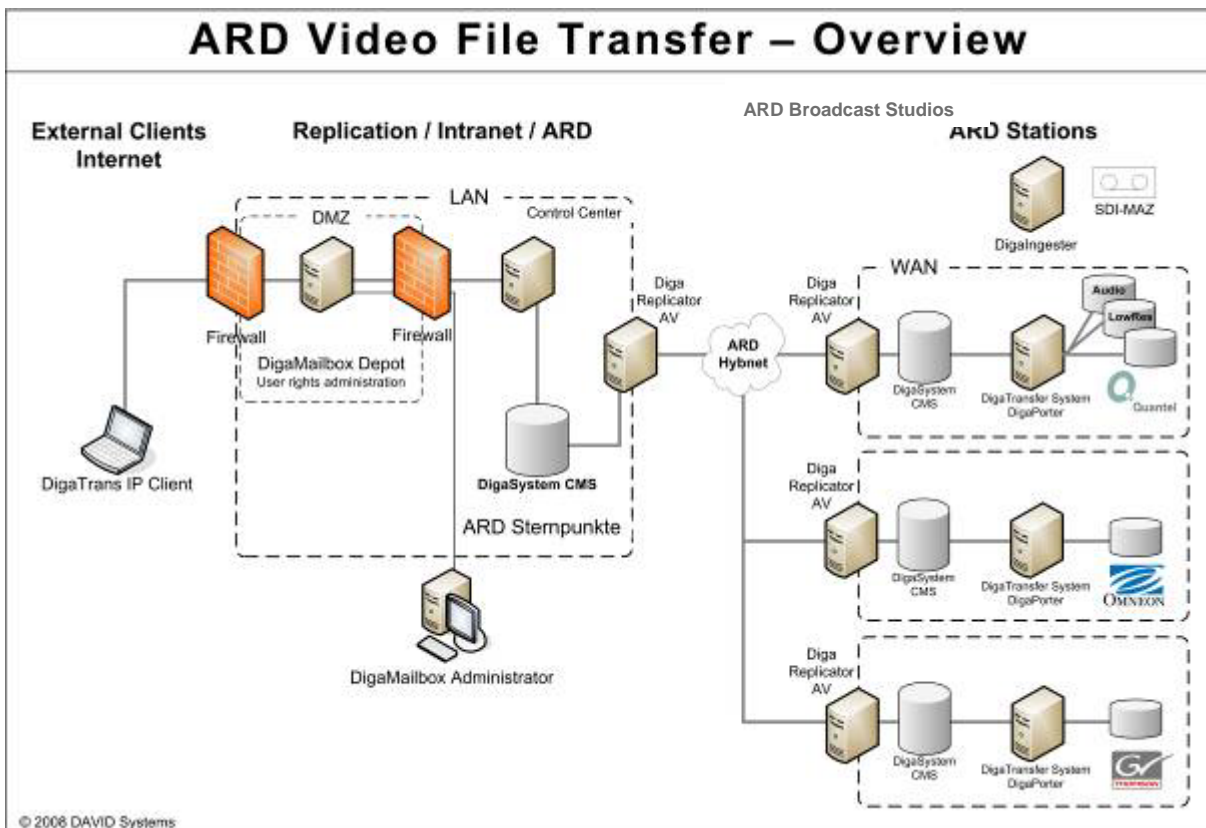
System Concept

The broadcast networks, stations, and studios of ARD employ a diverse range of production and playout systems. The heterogeneity of this system landscape was the biggest challenge for the planned transfer system, containing a wealth of different interfaces, formats, and organizational structures.

In response to this complex structural framework, the Video File Transfer System (hereafter referred to as “VFT”) was conceived as an independent system for transporting/exchanging video content. Much like a head station, the VFT system enables broadcasters to send and receive video files via a separate system layer. All VFT data transmission takes place within ARD’s proprietary HYBNET®-based intranet.

The primary component of the VFT head stations is the replicator. This DAVID Systems-developed component interfaces with the ARD intranet for TCP/IP file transferring and monitors the transmission quality via confirmation messages. In the case of interrupted transmissions, transfers always resume at the point of interruption. Currently, transmission via the VFT is controlled manually, but the broadcast networks are already requesting a transfer scheduling option to transport large data volumes during uncritical and low-demand time slots.

Every file released to the VFT system for transmission has to conform exactly to the agreed upon file specifications (Guidelines for the ARD Video File Transfer System; also see “Compression Formats” below). This restriction addresses the multiplicity of file formats that are currently being used, as otherwise the time and processing power required for file conversion could seriously affect VFT system performance. The receiving stations import the files directly into their production systems according to the VFT specifications. It is entirely up to each station how and via which systems the files are converted before and/or after the VFT transfer; the Station Management Board refrained from instating any restrictions on the level of the individual stations.

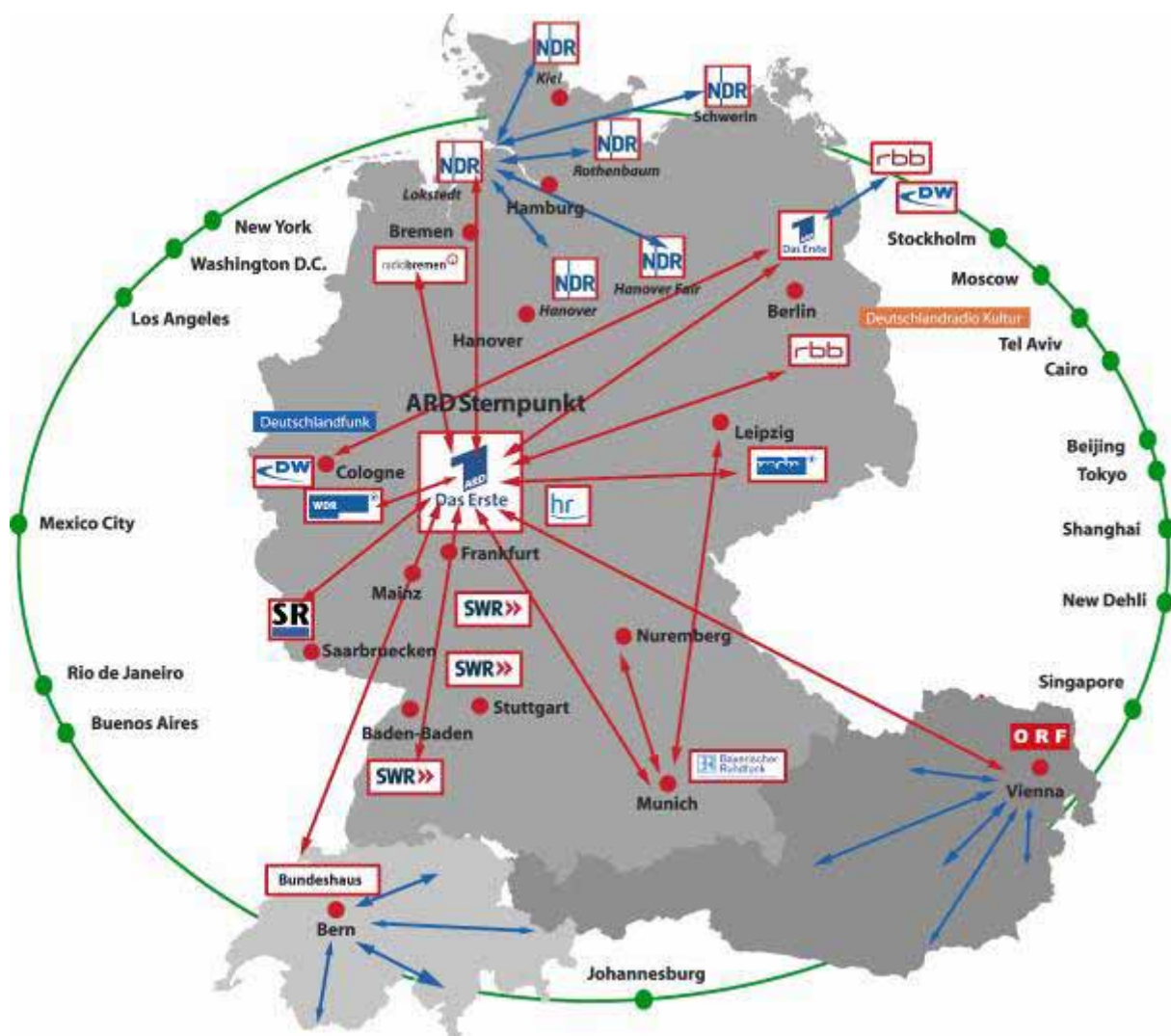


Workflow diagram ARD file transfer system

Currently, VFT file transmission is based on a “push” concept, which means that the sender station has to trigger the transfer of the requested files. The VFT system responds by immediately transferring the transmission file (the so-called “essence”) and its metadata to the receiver station. At the receiving end, essence and metadata are stored on a file server in accordance with the sender’s specifications.

The receiver station’s production system then fetches the data from the file server via a Web service interface for further processing. At broadcast stations that already employ DAVID Systems DigaSystem components, this process can be simplified even further; the replicator fetches essences and metadata directly from MediaStorage and writes the incoming data directly to the DigaSystem.

DAVID Systems GmbH also offers system components for preparing the video material for file transfer. DigaIngester, for example, is an add-on application that lets stations export video tape content directly via VFT. DigaIngester controls the playback and encoding of essences, as well as providing a data entry interface for the required metadata. On the receiver side, the files can similarly be recorded to tape via SDI, and the metadata can be printed out on conventional tape cards using a helper application. Alternatively, the content can stay entirely in the digital domain (as is the case at the ARD Broadcast Center).



ARD replication network (foreign correspondents connected through DigaMailbox IP)

Compression Formats

ARD's many different broadcast stations employ a wide variety of compression formats. In the development of the VFT system, therefore, the PTKO decided to include several formats for compression. Sending stations may freely select from any of the specified formatting options, with preference given to the in-house format. The receiving stations, correspondingly, only need to be able to decode the specified compression formats.

The VFT system permits the following compression formats:

- MPEG 422MP/ML, type D10 (SMPTE S356)
- DVbased/DVbased50 (SMPTE S314)
- DV (incl. MiniDV and DVCAM)

In the case of bilateral transfers and where pre-agreed, formats other than these may also be used.

What are the advantages of this concept?

A limited range of compression formats ensures that video quality does not deteriorate as a result of too many encoding/decoding steps. In most cases, the sending station will be able to provide video content in its native format, i.e., at the best possible quality. This would not be possible with a system limited to just one single format. As the main priority is to provide new video items quickly and at native quality whenever possible, a range of format-related issues—such as MiniDV's unlocked audio/video signals—may need to be addressed by the receiving stations. The decision to recode the received material for further processing rests entirely with the receiving station.

Again, the underlying concept here is that VFT is exclusively responsible for the transport of the files. If any recoding is required before or after the transfer, this is performed at the discretion of the stations involved. To speed up the process, the DAVID Systems replicator can be extended with a range of add-on functionalities to automatically recode content upon receipt, and to provide the recoded files to the processing systems in the required format. The DAVID Systems add-on components are already being used by several stations to automate routine operations within their tapeless production workflows.

File Format and Metadata

The VFT system is informed by the latest advances in format standardization and employs the Material Exchange Format (MXF Operational Pattern 1A) as its wrapping and transport format. Operational Pattern 1A specifies that only temporally connected portions within any given file may be transferred together. If there are sets of multiple items (items containing other items), these have to be transmitted as separate files. In ARD's program exchange system, shows are usually transmitted to the Broadcast Center in their entirety as single

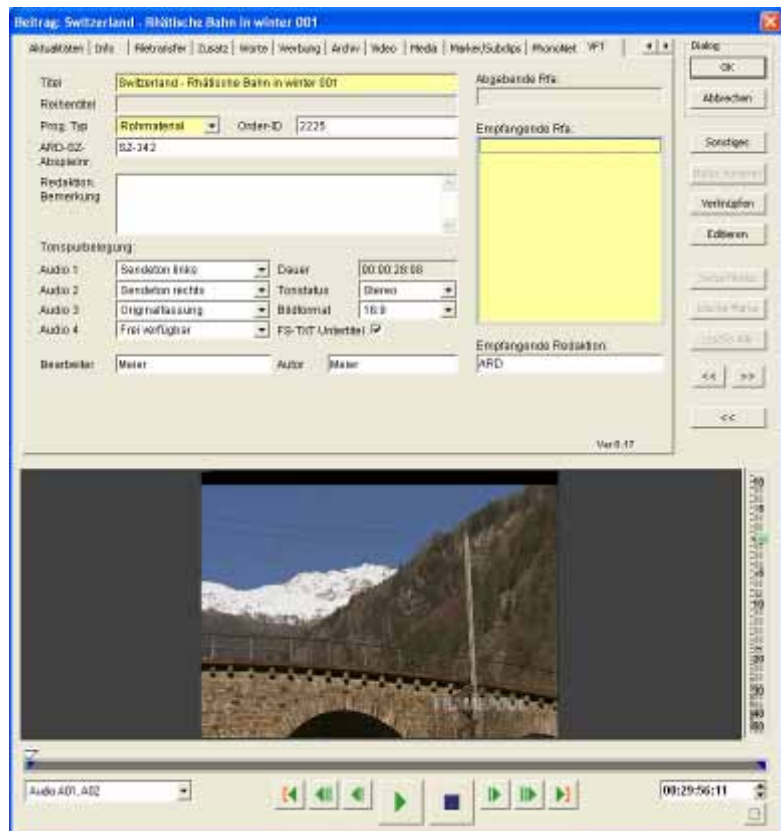
files. This method greatly simplifies the identification and cataloging of transferred items/files.

In the ARD Video File Transfer System, metadata and essences may also be transferred separately, as long as the metadata is transmitted before the essence. All metadata is transmitted using DAVIS Systems' proprietary XML-based .dba format. In principle, metadata can also be transferred directly as XML files (.dbx). Replication ID numbers are assigned to uniquely associate the metadata to their corresponding essences.

As is specified in the German Television Production Guidelines, every video item's metadata contains obligatory fields such as "Title," "Orderer," "Order ID," "Program type," "Source Broadcaster," technical data on audio/video, etc., and a range of optional fields. For items that are exchanged with the ARD Broadcast Center, the metadata must additionally contain the ARD Broadcast Center (SZ) Playback Number. The VFT system automatically detects the video file's length and enters this in the mandatory field "Item Length."

Metadata can be sent to the VFT system via several methods. When video tapes are exported via VFT, the metadata needs to be entered manually during the ingest stage. The data entry user interface is based on the familiar tape card layout (see VFT Entry Dialog Box above). If the broadcast station employs a DigaSystem, the metadata is exported directly from the database. When video files are to be sent from other, nonlinear systems, there is a third metadata option: transfer of the XML file via a Web service. The replication process itself can similarly be triggered from a third-party system. Using a range of VFT helper applications, receiving stations can easily view and update the metadata of all video items received via the replicator.

The structural separation of metadata and essences facilitates tight integration and synchronization with the databases of nonlinear production and playout systems. If the metadata were bundled into the same file as the essence, on the other hand, the MXF file would need to be opened even for the most mundane tasks, such as forwarding the item to regional studios or content programmers.



Objectives

With the introduction of the new VFT system, ARD is pursuing several aims:

- Faster exchanging of current items—reduced transfer times (faster than real time)
- Simpler workflows for exchanging items—less involvement of the station’s scheduling, programming, and planning staff
- No or minimum loss of image quality—recompression is avoided where possible

Interestingly, the focus of these objectives shifted over the course of the project. For example, the working group’s initial discussions predominantly revolved around transfer times. Other early topics included bandwidth issues, priority management for time-critical transfers, and the capability of accessing/processing files during their transfer. Indeed the Video File Transfer System has been designed to provide most of the requested capabilities, particularly faster-than-real-time transmission speeds; however, many of the original aims are now regarded as minor points by the system’s users.

Initial concern about the potential degradation of video quality was dispelled through the adoption of the MXF format and the specification of the video transfer formats. The overwhelming majority of content sent out by ARD stations today is transmitted at native quality and without recompression of the in-house format. In most cases, the receiving stations do not need to perform any recoding either.

Looking back on the practical experiences from the first few months of regular operation, the project focus has very much shifted toward workflow optimization.

Initial Practical Experiences

Officially, regular operation of the VFT system commenced in September 2007. Many ARD stations, however, had already been using the system to exchange items and shows for many months in advance. Today, the system has established itself as a widely used method for sending items to the ARD Broadcast Center. Feature-length items—such as the episodes of the popular *Tatort* series—are also increasingly being sent via file transfer.

In the first nine months of 2007, more than 15,000 items were exchanged via VFT. This is a strong sign of user acceptance and demonstrates the system’s reliability. By comparison, approx. 25,000 items were transferred via the conventional cable system during the same period. For the medium term, the PTKO expects that as the new features provided by VFT become more widely known, another 10,000–15,000 items will be transferred via VFT rather than cable, i.e., the majority of items will be transferred as digital files.

The new system’s flexibility has proven to be particularly advantageous in the course of various system migration projects. An important aspect in the conception of the VFT system was that it should not be limited to the few broadcast stations that were already based on tapeless processes at the time. With the DigaIngestor/Player add-on software, even tape-based workflows can easily be brought into the digital file-sharing domain. In practice, this

means that broadcast stations with entirely different nonlinear systems can efficiently exchange all their tapeless items.

Currently, the VFT and cable systems complement each other, and the availability of two systems guarantees excellent redundancy. More importantly, however, specific usages have been emerging for the two systems. In the foreseeable future, the cable system will continue to be used for live recordings and the transmission of time-critical items; the VFT system's TCP/IP layer is subject to inherent bandwidth fluctuations, so transmission speed cannot always be guaranteed. When it comes to transferring video items outside of the time-critical zone, however, the more flexible and user-friendly VFT system is the preferred choice. Items can be sent from any nonlinear production system without having to rely on centralized scheduling, which saves both resources and time. It is to be expected that usage of the VFT system will continue to increase as more and more stations introduce tapeless workflows.

VFT users are regarding the simplification of the transmission processes as the system's biggest advantage. In cases where the broadcast station's infrastructure fully accommodates the new system, video items can be sent almost as easily as e-mails. Unlike cable-based realtime transmission, file-based transmission does not rely on machines or staff at the receiving end. Of course, server capacities need to be calculated very carefully as file transferring increases. Centralized scheduling for file-based transfers can be completely eliminated at both sender and receiver stations, but this requires the storage capacities to be meticulously planned out in advance.

Future Prospects

At ARD, the VFT system represents a major step toward fully tapeless, cross-location workflows. For stations and studios not yet equipped with nonlinear systems, VFT is a strong reason to embrace this branch of content production. Nonlinear systems will further be encouraged by the increased MXF support that ARD has demanded from production/playout system manufacturers.

The introduction of file-based video content sharing at ARD's SWR network demonstrates the enormous scope of optimization offered to tapeless production environments. SWR uses ARD's VFT components and technology not only for exchanging content with other networks, but also for the internal exchange of current items between the main studio and regional studios (e.g., Freiburg, Tübingen, Ulm). The SWR Executive Board wants all of the network's regional studios to be connected to the replication network by 2008. SWR is taking advantage of the fact that all the DAVID Systems components are based on standard IT components. This makes it feasible to use the existing internal IT networks for file sharing, even if these have completely different topologies to the umbrella ARD network.

Virtually all of SWR's internal transfer processes can be triggered directly by the programmers at their desks, independently of any external scheduling. Unlike the ARD's overall VFT system, the VFT system in use at SWR is not limited to "push" operation. The content programmers at the network's main studio and regional studios have access to an archival server holding more than 50,000 items; as well as freely browsing the stored items, they can actively request them ("pull" mode).

SWR and NDR are also using file-based transfers for an entirely different level of content sharing—integrating their international studios into the ARD replication network. This is facilitated via the MailBox IP add-on software. Currently, studio staff in Rio de Janeiro and Cairo (London, Stockholm, and Asia to follow soon) can transmit video items as files directly via the Internet. The ARD specifications for metadata, video formats, and file formats are all being complied with, so the items can be loaded directly into the replication network and automatically distributed to selected recipients across ARD. Current items can even be transmitted directly from the programmer's laptop computer via any local Internet connection (e.g., hotel); the studio does not need to be physically involved at all. An added bonus of this is that the station incurs fewer costs for satellite transmission.

As the SWR example shows, file-based content sharing offers significant advantages right across the video transfer process. For the networks, the simplified workflows result in major reductions in expenditure for resources and content management.

Should file-based content sharing at ARD increase over the coming years as predicted by the PTKO, there will need to be ongoing investment in the technological infrastructure. Most importantly, this applies to the planned extension of the ARD HYBNET®. As well as the transmission capacities needing to be extended, optimized protocols and packet sizes will need to be introduced. IRT is predicting that once the extensions and upgrades that have been planned in the short term are instated, transfer rates of up to 200 Mbit will be achieved. The highest transfer rates will be facilitated via the new UDP protocol, which is fully compatible with the replication network. The replication systems themselves will also soon need to be upgraded to provide clustering capabilities, as data volumes are rapidly rising and availability bottlenecks are looming.

The individual broadcast stations should now focus on integrating the new functionalities into their workflows and take advantage of their potential for automation. With comprehensive VFT system integration across ARD, both the parent network and the many individual stations will benefit significantly from the cost and time reductions in the field of content exchanging.