

# REALISING COLLABORATIVE FILM AND TELEVISION WORKFLOWS

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## ABSTRACT

In film and television production and post-production, tasks are often outsourced to specialist providers. The complexity of doing this is one reason that the benefits promised through wholly tapeless working has yet to be fully realised. In this paper we present the approach of the UK-funded MUPPITS project in tackling this problem. We examine the significant challenges to the media creation industry that led to the formation of the project, and propose an architecture that will help overcome these challenges. This architecture makes use of collaborative middleware techniques that were originally created for other industries. We outline two specific scenarios for this approach, namely digital dailies and post-production rendering, and describe the project's work on developing demonstrators for these scenarios.

## INTRODUCTION

The production and post production industries currently face a number of management challenges arising from the increasing digitisation of their processes. On the one hand, they are faced with many new, capacity-hungry, formats such as HD, 4k and 3D. On the other hand they must support new routes for the delivery of content: for cinema release, for HD or SD TV distribution, for delivery to mobile devices or delivery over the internet. On top of all this, productions are demanding ever more technically demanding effects with ever decreasing deadlines and budgets. The need to scale up and down cost effectively has become a necessity to meet exacting production requirements and demands.

It was in the light of these seismic changes in the industry that the MUPPITS project (1) was founded, bringing together significant production and post production professionals with IT specialists to develop a new approach to handling and managing the lifecycle of media content in this new all-digital world.

The many challenges addressed by MUPPITS are those arising from the need to manage the many different digital operations involved in the file based production and post-production workflow. Paper-based tracking has served the industry well for many years, and has been developed into an art form by production offices. However, it is increasingly difficult to maintain its efficacy in a file-based production environment; the paper trail and the content it tracks can easily diverge or become inconsistent, with chaotic results.

MUPPITS introduces the ability to plan and control these digital operations. The project uses concepts taken from the Service Oriented Architecture (SOA) (2) approach adopted in other industries, where operations that process the content in different ways are offered

as “services” over IP networks, and in particular the Internet. A client uploads the input content and asks for the operation to be performed, upon which a server carries out the operation and returns the result. Examples of operations relevant to the production and post production community that can be offered as services include:

- Batch transcoding between formats (for example from MXF or QuickTime originals to an H.264 review version)
- Rendering by applying textures and ray-tracing wire frame models to produce video.

Offering compute-centric services over the Internet requires secure collaboration and content exchange. Offering them on a commercial basis also requires management of service quality and accounting. Since users are paying for the service, they can reasonably expect some guarantees as to how well it will be delivered, and once it is delivered, the provider needs a means of tracking how much the user owes them.

MUPPITS tackles these requirements through the use of secure middleware structures which allow services to be invoked, tracked and paid for under control of contractual conditions embodied in Service Level Agreements (SLAs) (3). This concept has been successfully introduced in the aeronautical, automotive and pharmaceutical sectors (4), and it is a blend of this deep commercial understanding of resource trading with an understanding of the needs of the production and post production community which gives the MUPPITS approach its unique strength.

In the following sections we describe the architectural approach taken by the MUPPITS project, and give two example scenarios being developed as proof of concept within the project, which demonstrate the advances being made and their benefit to the community. A critical design feature of MUPPITS is that it is a flexible architecture, extensible to many and varied operations that are offered as services, both now and into the future.

The project is supported by the UK Technical Strategy Board, and comprises partners Digital Television Group, BBC R&D, Pinewood Studios Group, Smoke & Mirrors, Molinare, IT Innovation, HDDC, Ovation Data Services and Sohonet.

## **REQUIREMENTS GATHERING**

To confirm that there is a demand for the collaborative operation that MUPPITS will facilitate a survey form was generated and a selection of companies were interviewed. The interviews spanned post production houses, broadcast operations and programme producers.

Not surprisingly the interviewees wanted to streamline their businesses and add extra opportunities. Producers were very interested in the possibility of setting in place workflows customised to their production with automation for many of their regular processes. Smaller bespoke houses specialising in, for example, CGI for commercials were interested in coping with peaks and troughs in processing storage demand by hiring in computing and storage resource. They also commented that the booking processes used today may not track accurately enough the actual resources used for a production or post production task, therefore MUPPITS as an internal tool can optimise profitable use of the available resources even if the company wishes to carry out all operations in house.

Another very important requirement identified by the survey is the efficient use of resource from a logistic and power point of view. Finding a building to set up a new post production company in London’s Soho district is very difficult as not only does floor space need to be sourced but there is also the need for several megawatts. Soho power supplies are at saturation now as demonstrated by a substation failure under Leicester Square caused by extra desk top fans being used on a hot summer’s day. The air conditioning chillers may

also be creating a microclimate. MUPPITS will facilitate the delegation of processing power or storage to geographically well resourced locations.

## THE MUPPITS ARCHITECTURE

Figure 1 shows the principal components of the MUPPITS architecture, spanning the content production lifecycle from ingest through to the creation of a completed product. A digital capture system records one or more video and audio sources, and generates accompanying metadata about this content. The content and metadata are stored in the MUPPITS “Data Warehouse” (DWH), a “smart repository” to store and process production content for one or more productions. Video and audio are stored as files, whilst associated metadata is stored in a database that is synchronised to the content.

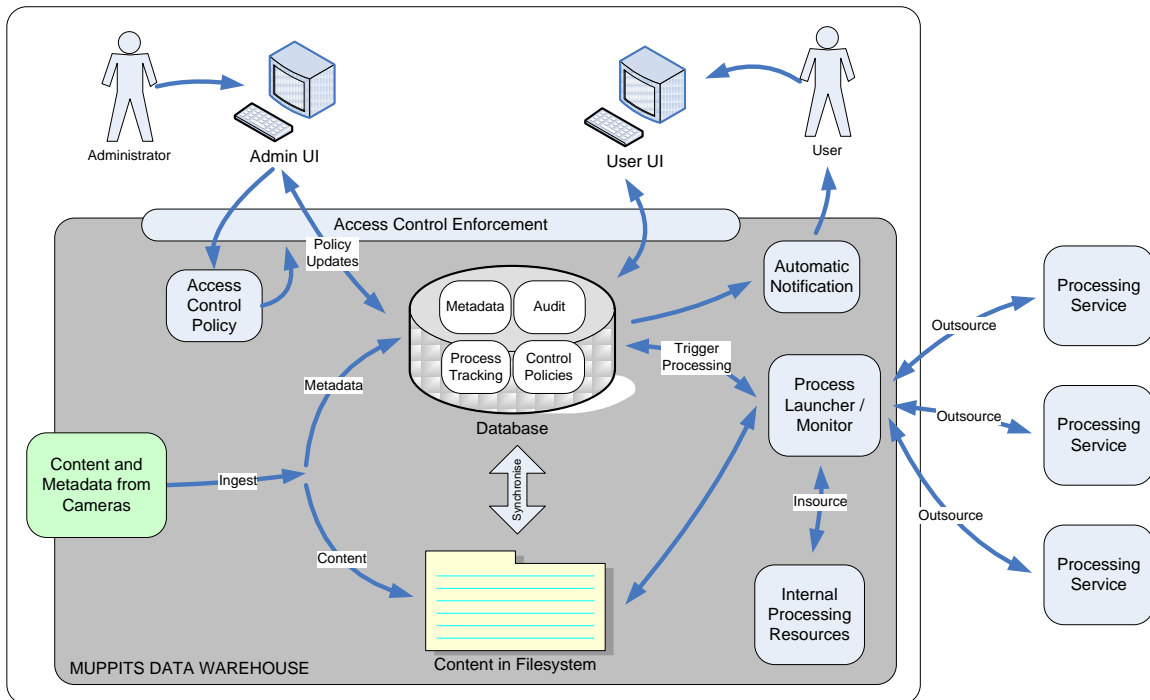


Figure 1 – The MUPPITS architecture

The DWH provides more than simple content storage. At the start of a production, the production office can define “control policies” that can trigger operations that can be automated (such as transcoding, encoding, colour balance, scratch removal, bug insertion and so on) in response to certain events (such as the arrival of content marked up with certain metadata). The DWH can process, transform and store content automatically under the control of the needs of the individual production. The architecture has been explicitly designed to be flexible enough to accommodate control policies to account for many events and actions, and not to be tied to one particular set of working practices.

An operation can be either run in-house, or outsourced to a third party who offers it as a service. Third-party services can be managed using an SLA that contains a description of the contractual terms to which the service must comply. Examples of such terms include:

- Quality of Service terms such as turnaround time
- Payment tariffs
- Non-Disclosure stipulations

Outsourcing is managed using GRIA (5). This is an open-source service-oriented middleware designed to support B2B collaborations. GRIA has two major components, the GRIA client and the GRIA service provider. An organisation wishing to offer an application

as a service deploys their application into a GRIA service provider, which is hosted at their organisation. Users can access this service using the GRIA client. GRIA provides secure invocation, SLA management, together with account management recording the user's expenditure at the provider.

The MUPPITS approach adds enormous flexibility to the production and post-production process, since it now becomes possible to use resources that have not previously been available to users because the users can rent the resources as they need them, rather than have the considerable capital expenditure of a resource that is only occasionally used, and therefore may not be a justifiable expense. MUPPITS also enables working methods to be specified by the needs of the production and managed by a production's administrators through the creation of control policies and SLAs with providers offering services required by the production. The MUPPITS approach even accommodates future operations that have not yet been defined. In addition, since the SLAs and control policies can be created and modified in response to the short term demands of a production as well as the longer term planned operation, the whole system can be re-configured very quickly and easily to respond to changing demands.

Note also that services can be made available independently of their source or format, and this makes the MUPPITS system totally agnostic to either vendor or operation, and allows it to sit alongside existing workflow and data management solutions, integrating the many different operations which need to be performed.

## **EXAMPLE SCENARIOS**

The following section identifies two use cases that are being developed within the MUPPITS project in order to illustrate the applicability of the technology to the media application domain and the requirements of productions. Whilst the use cases may not of themselves be unique, as part of an overall lifecycle we believe that the use of a service oriented architecture and supporting middleware components provides a new and highly desirable approach to this new operating environment.

### **Digital Dailies**

Dailies (also known as rushes) are the quickly-processed results of a day's shooting on a film set. In traditional film-based production environments, dailies involve the development of the negative film as shot in the camera, and a print struck from the negative. The dailies are then set up in a projection room for senior production members like the director, producer and editor to view. The purpose of this is to enable them to make early decisions as to the content shot that day or to inform them about any modifications needed for the next days' shooting. With digital production methods, there is no need for film or processing, and further with the tapeless approach advocated by MUPPITS, the results of the day's shooting can be made available much more quickly to those that need it than before. With a data warehouse holding all the content as it is shot, the dailies can be delivered to the production team, wherever they are in the world over the internet, and comments can be recorded for different takes.

A significant feature of the project's approach to this scenario is that it encompasses the many different working techniques that are used in different genres of production, applying equally well to:

- film and drama production, which operates over a shooting timescale of months and a planning timescale of years,
- current affairs production, which can operate over weeks and involve significant editorial input, and

- sport feature production, which has very short timescales.

In all cases, the director or producer will see content shot and stored onto a data warehouse, with immediate access to that content for review. Editorial decisions made on set or during shooting (such as selection of key content for compilation programmes in sport) are carried with the content into the data warehouse and will be available for use throughout production. The number of cloned copies is controlled and minimised, thus making it easier and more efficient to manage the production process.

Although several production and post-production companies currently offer web-based viewing of rushes, these are tied to particular workflows. By contrast, adopting the MUPPITS architecture will allow a greater degree of flexibility in how productions can work. For example if it is necessary to support new video formats then the architecture allows transcoding operations to be sent to a new service provider.

The MUPPITS project is developing a Digital Dailies demonstrator with the following features:

- Studio action is recorded using the BBC's Ingex recording system (6,7). The video and audio are recorded as MXF OP Atom files (8).
- The MXF files are delivered to the MUPPITS Data Warehouse (DWH), along with metadata about the recordings, presented as XML-formatted AAF files.
- The DWH can be located remotely from the recording. The delivery mechanism is based on standardised techniques, with the Media Dispatch Protocol (9) used to manage the delivery.
- The DWH can be configured by its administrator so that different users are granted permission to view the content.
- The DWH content is automatically transcoded into appropriate viewing formats.
- Different users may have different format requirements for dailies (e.g. Quick Time, Windows Media or AVI); content is automatically routed to the most appropriate service to provide each version.
- Once the transcoded content is ready, the user can then view the content by accessing it over the internet.
- Dailies are visibly stamped with text, to provide information and to help deter unauthorised distribution of the content.
- The user can also make comments on the content. These are recorded in the MUPPITS DWH and associated with the content.

This internet-based version of the daily viewing of rushes means that the concerned parties no longer have to be in the same room where the rushes are being projected, thus removing a significant constraint on their diaries – commenting on the rushes can be done at the convenience of the individual rather than requiring them all to be present at one location at the same time.

### **Post-production Rendering**

The second scenario being produced within MUPPITS is concerned with the challenges facing post-production facilities in an environment where increasingly complex render requirements are overlaid on the limitations of a fixed resource infrastructure and often very short timescales for producing results. Some render jobs can be sufficiently complex that they tie up hundreds or even thousands of processing nodes for weeks, and this can seriously hamper the ability of a post production operation to schedule smaller, but equally

urgent, jobs.

This situation points to the need for a secure system that allows a post-production facility to outsource processing to another provider in order to even out the load and manage their business more effectively. Post-production houses have not been able to do this in the past because of concerns of commercial security, but MUPPITS allows them to set security conditions and control which external suppliers are used. Such security stipulations can be managed through the SLAs defined for the service. A good example is a non-disclosure clause, which states that a provider processing a consumer's data will not disclose it to any third party. If the consumer finds the provider has done this, then the SLA provides a statement of the provider's commitment, which has been broken. The consumer has then clear grounds to sue the provider.

The benefits to the post-house are that they can manage those occasions when local resources are inadequate without needing to invest in extra hardware, thus saving not only capital costs, but also space, energy and air conditioning requirements. Equally, when a post-house experiences a period of low demand on their processing resources, they are able to offer that processing as a service to others, thus enabling them to achieve a return on their investment in the computing resources. The creation of incentives to buy and sell computing resources enables a market-place of resources to be established, with benefits for both consumers and providers of those resources.

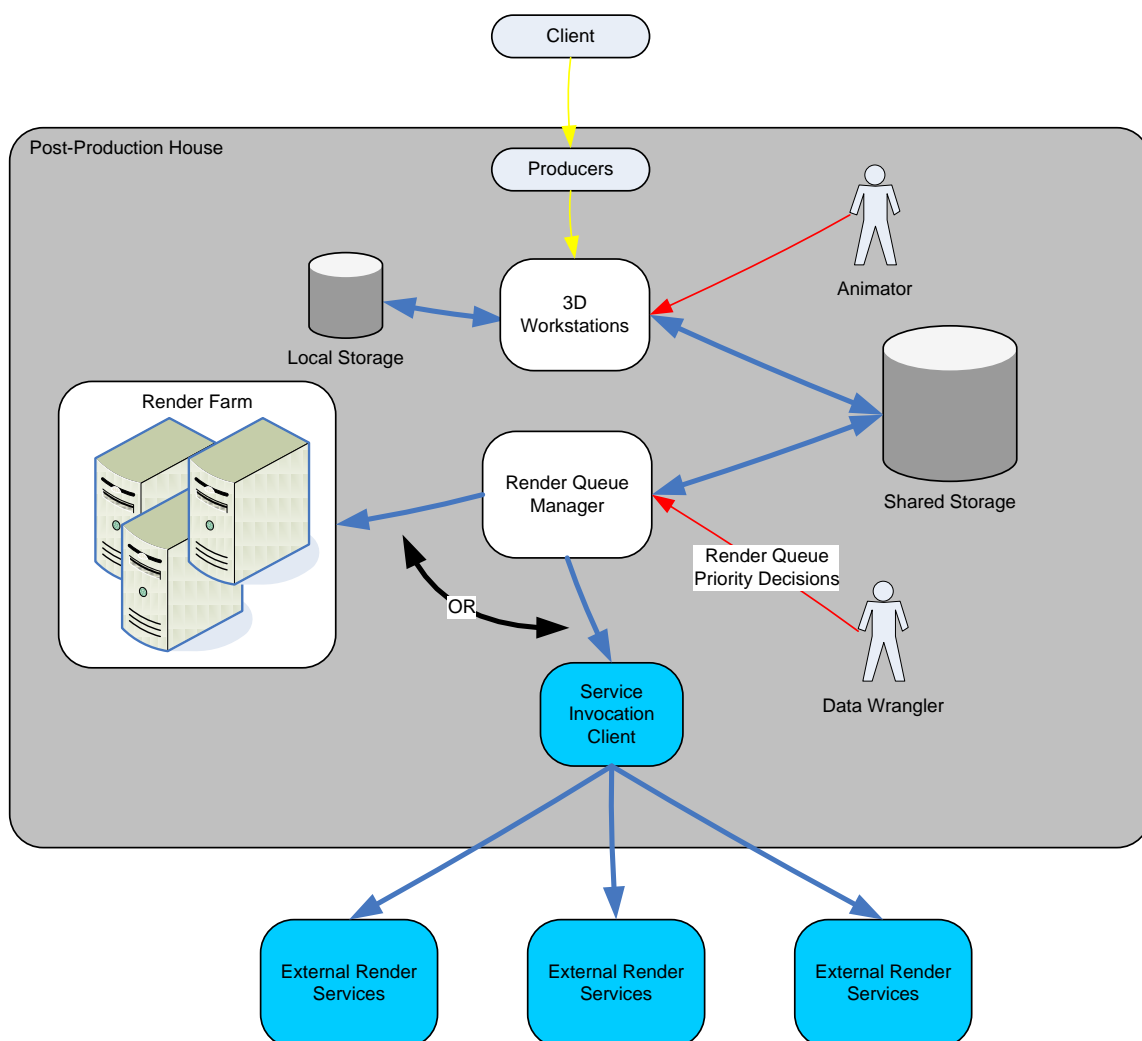


Figure 2 – Outsourced rendering scenario

In the outsourced rendering scenario being created in the MUPPITS project (illustrated in

Figure 2) the render queue manager is able to track the render jobs and their estimated complexity, and has the option to tag those jobs for rendering using local resources or external processing. The conditions which the manager will be able to consider when making a decision to outsource any particular job will include:

- urgency,
- sensitivity (level of security necessary),
- anticipated render time,
- anticipated processing demands,
- relationship and SLA with the organisation offering the processing facilities.

## **CONCLUSIONS AND FUTURE DEVELOPMENT**

In this paper we have described the drivers behind the MUPPITS project and the novel approach being taken, which draws upon experience in many industrial sectors outside the media production industry. Applying this approach to the broad requirements of the media industry offers the prospect of significant benefits in operational efficiency, use of resources, integration of many processes and improved management of costs.

The project is developing demonstrations for two significant areas of operation: dailies creation and viewing, and post-production rendering. Each demonstration will show how operations can benefit through the proposed approach.

The partners in the project, conducted under a collaborative UK programme, are all represent significant players in this arena, and are therefore well suited to contribute to and develop realistic and effective solutions to what is currently a major challenge in the transition to fully tapeless production.

In summary, the principal features of the MUPPITS approach are:

- Content is stored on a data warehouse, a robust repository for media files and their metadata.
- Content can be searched & retrieved using terms familiar to the production.
- Automated content processing can be launched according to rules established by the production office and stored as control policies.
- All operations are auditable – what processing occurred to what content, which user made what comment to a piece of content, for example.
- The administrators of the system have full control over the authentication and access control of other users ensuring users only have access to the content to which they are authorised.
- Operations can be performed in-house, or they can be outsourced when the need arises. When operations are outsourced as services, commercial elements such as security, billing for services and QoS are managed by the system.
- The architecture is designed to be very flexible, since it can accommodate many types of processing service or resource, and new processing services can be created to meet the needs of the task in hand.
- The MUPPITS system can create a marketplace defined by a production project where post-production services can be bought and sold, allowing external providers the same opportunities to contribute to the production as local providers.

## ACKNOWLEDGEMENTS

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