



User-Centric Development of New Metadata Tools to Enhance File-Based Newsgathering Workflows

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The inevitable adoption of nonlinear acquisition and storage devices will enable broadcasters to accomplish a complete file-based workflow from capture through to archive. These devices not only reduce time by removing the need for tape-to-file conversions but also facilitate a complete metadata flow throughout the production. This metadata is important because, if captured effectively, it allows files to be accurately identified and presents exciting opportunities for improving the overall speed and efficiency of newsgathering operations. Sony's research and development (R&D) team is working with news organizations throughout the world to gain an accurate understanding of the newsgathering workflows being employed. In addition, the most useful metadata for these tasks, the possibilities for metadata capture, and the best ways in which the metadata may be utilized to support people and their tasks are identified. This paper describes work in R&D to understand the newsgathering workflow and how this knowledge is being used to guide the development of novel tools to improve the effectiveness of future products.

The emergence of file-based content acquisition technologies brings significant benefits to a broadcaster's workflow but also introduces some problems that must be addressed before the technology can be integrated effectively. One of these problems is the need for metadata to be linked to each clip for them to be identified effectively. Metadata is an area that is of great importance to a broadcast organization but is also tedious and time consuming to enter and often bears little benefit to the person entering it.

This paper presents an approach to content markup that reduces the required user effort to a minimum and ensures the consistency of metadata throughout the entire news operation. In addition, the technology also provides functionality that offers benefits to people through adding additional metadata to any content that is captured. This has been achieved by gaining a detailed insight into broadcasters' workflows through observing real-life operations in which this technology will be used. This paper focuses on the area of electronic newsgathering (ENG).

Ultimately, file-based acquisition means that content is becoming separated from the medium on which it is stored. Metadata is important to ensure that a clip can easily be identified from the massive amounts of other clips coming into the newsroom so that it can be edited and put on air as quickly as possible.

This paper describes the system being developed to address the problems described above and how this technology integrates with existing newsgathering workflows. At the time of writing, the technology is still in development and many technical specifications are still under discussion and cannot be reported here. For the development, close collaboration has been established between Sony BPRL in the U.K., the Sony camcorder development group in Japan, and third-party newsroom computer system (NRCS) suppliers.

UNDERSTANDING THE NEWSGATHERING WORKFLOW

To gain an understanding of the existing newsgathering workflow, visits were made to 11 different news organizations across Europe and the U.S. During these visits, news crews were observed performing their everyday tasks for a variety of stories. This allowed an insight into newsgathering practices and provided an indication of the problems and requirements of technology in this area. Although most news organizations claim to have unique workflows, there are common elements that exist across all organizations. The following describes a high-level, generic view of the newsgathering workflow.

1. **Planning:** Creates a plan for the coverage of the day's news stories for transmission. This involves gathering the newswires, creating the news prospects through the assignment meeting, discussing stories, planning the rundown and delegating the assignments to a journalist and crew. Culminates in a planning meeting and the creation of assignments in the NRCS.
2. **Travel to location:** Journalist, crew, and possibly a producer make their way to the location.
3. **Field-based content capture:** Gathers all of the visual content required for the coverage of the story. This involves researching the story; gathering content from the field, satellite feeds and the news library and getting the content back to the newsroom. During content capture, the journalist will take notes of interviewee names, story details, and start writing their piece-to-camera and voiceover scripts based on the content that is being recorded. There also may be multiple camcorders and multiple assignment "angles" for each assignment.

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4. **Send back to newsroom:** Journalist returns to the newsroom with the content for editing. It is now becoming more common for content to be sent back via electronic channels such as 3G, WiFi, or satellite.
 5. **Ingest content:** Make the content available for edit or review. Content from satellite, line feeds, the library, and the field is ingested into the appropriate place on the NRCS, marked-up, and made available to the people that need to access it. Clips can also be segmented and titled during this process.
 6. **Create voiceover:** This involves planning the voiceover during the newsgathering process, writing the voiceover script and recording it into the NRCS ready for segmentation and inclusion in the edit.
 7. **Edit content:** To place all of the content gathered during the day into a sequence. This involves planning the edit during the newsgathering process, selecting the content to use, trimming it to the correct duration and composition, placing the content on the timeline, adjusting the audio levels, conforming the edit, and making it available for transmission.
 8. **Transmission:** To collate all of the news packages and available content for transmission to the public. This involves placing the content into the rundown, playing out the rundown in the gallery and studio and transmitting it to the relevant destinations (TV, mobile, internet, radio, etc.) for broadcast and archive.
 9. **Archive:** To store the news program for posterity and for ease of future retrieval. Different organizations have different archiving processes. Essentially, the process involves adding metadata to the content and placing it into the content store. This metadata often comes from the NRCS.

Not all assignments follow this exact sequence of events. Some steps may be conducted out of sequence, and some steps may not be conducted at all. The following are the most common sequences of core tasks for newsgathering:

1. Field-based content capture, send back to newsroom, ingest, edit.
2. Field-based content capture, ingest, edit, send back to newsroom.
3. Field-based content capture, send back to newsroom (Live).

In the workflows listed, a large amount of metadata is entered at the start of the process during the planning tasks. A small subsection of this metadata is entered again when writing labels on tapes and entered for a third time when the content is ingested back into the NRCS. These repetitions introduce a risk for inconsistent

metadata to be entered into the NRCS, resulting in potential loss of content, which then has to be re-ingested. There is also a large amount of metadata, such as names, addresses, and notes, that are generated during the content capture stage and never associated with the content or the assignment. This problem also exists with file-based acquisition, as described in the following section.

INTRODUCING FILE-BASED CONTENT ACQUISITION

Currently in news, most content is captured on tape. Each tape has a label that tells the person viewing the tape what content is stored on the tape, who shot it, the date, and the name of the journalist. When the tape is returned to the newsroom, the content is ingested as a single file into the NRCS and the file is named with the slug name and placed in a location corresponding to the assignment for which the content has been shot. That file is then segmented during the editing process. The ingest process also provides the opportunity to view content so that people know what is available.

This process is more complicated with file-based acquisition. A linear sequence of content is no longer stored on a labeled tape that can be ingested as a single content item. Instead, there is some form of file storage and a set of individual clips are stored as separate files, each with a meaningless filename. This filename may also be identical to that given to content arriving into the newsroom from other crews.

For disc-based camcorders, each disc can still be labeled in the same way as tape, but each file needs to be marked up on ingest to avoid the situation in which clips coming from several different crews are all titled with the same file name (e.g. C0001, C0002, C0003, etc).

The problem is also experienced when solid-state camcorders are recording onto flash memory cards but it is exacerbated, because flash memory cards cannot be easily labeled, single clips can span over multiple cards, and content needs to be removed from cards at the earliest opportunity so that they can be reused.

In addition, there is an increase in content being sent back to the newsroom via electronic channels such as 3G, WiFi, or satellite, meaning that effective and consistent markup is even more important because random files start appearing in the content management system.

From earlier discussion it is possible to see the importance of effective metadata management when introducing file-based acquisition into the newsgathering workflow. The following section describes technology being developed to address these issues.

METADATA TECHNOLOGIES SUPPORTING FILE-BASED ACQUISITION IN ENG

The main objective of the technology is to provide a mechanism for attaching useful metadata to content with a minimum amount of effort and disruption to the crew, journalist, or newsroom staff. The development has been based on the findings of the workflow studies.

The principal idea is to utilize metadata that is entered into the NRCS during the creation of the assignments and send this metadata to the journalist or crew via mobile phone (**Fig. 1**). They can then send this metadata to the camcorder, which will automatically assign the metadata to the clips as they are recorded. Additional features are provided to support journalist tasks and allow them to send additional metadata back to the camcorder that will assist in the final edit and the creation of voiceovers. This means that metadata is entered just once during the planning stage; the same metadata is attached to the content as it is created, and consistency is maintained as the content is ingested back into the NRCS.

To achieve this, the integration between all of the system elements had to be seamless. This required close collaboration among Sony BPRL, the camcorder development group in Japan, and the third-party NRCS suppliers. The following sections describe the different elements of this system and how they work together.

Devices and Applications

It was thought that no additional tools should be introduced beyond what is currently carried or is potentially emerging in the domain. In the first instance, this meant utilizing the camcorder and mobile phone technology and, in the second instance, a laptop. Current mobile phones under investigation are Windows Mobile, Apple iPhone, and Blackberry with Wi-Fi capability (hereon referred to as smartphones).

Figure 1 gives a system overview showing an email being generated as a result of an assignment being created in the newsroom. This email is received by an application on a smartphone, and the assignment data can be viewed. Additional metadata can be added here, and updates can be sent back to the newsroom.

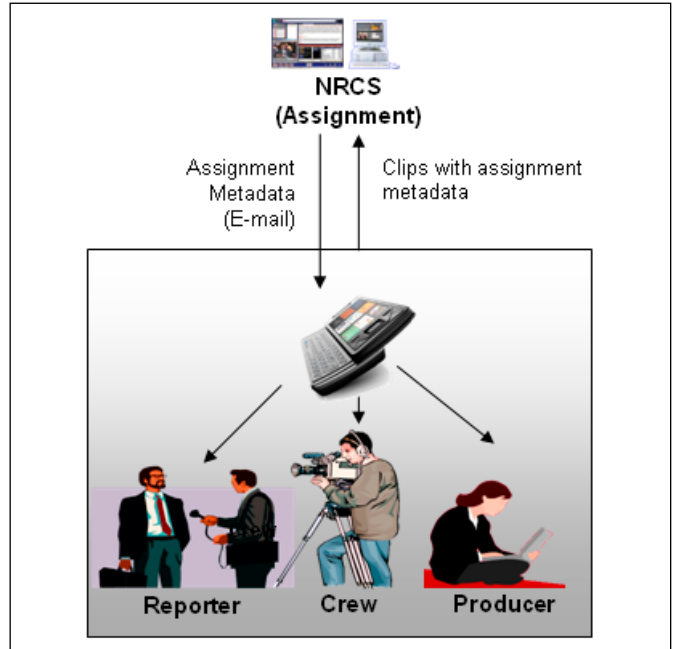


Figure 1. Metadata markup overview.

In the field, the assignment is sent to the camcorder via an 802.11g Wi-Fi connection provided by a simple Wi-Fi adapter that is plugged into the camcorder. On receiving the assignment the camcorder displays the slug name in the viewfinder, and each clip recorded from this point forward will be allocated to that assignment. The journalist can also use the smartphone to view a live stream of what is being recorded by the camcorder and add essence marks and shot categories over the Wi-Fi connection.

A concept application has been created that allows the content on the camcorder to be browsed on a laptop and for simple edit lists to be created. The application also provides a facility for a voiceover to be written and recorded based on an edit list. The edit list, voiceover scripts, and the voiceover audio file can all be saved back onto the disc and associated with the assignment. Screenshots from the smartphone application and the laptop-based journalist tool are shown in **Fig. 2**.



Figure 2. Smartphone application (left) and laptop reporter tool (right).

News Metadata	
From Newsroom to Field	From Field to Newsroom
Slug ID and slug name	Scripts
Assignment description and instructions	Proxies and thumbnails
Names and contact details	GPS data
Assignment updates	Clip information (durations, timecode)
Stock shots and user generated content	Essence marks and shot categories
	Edit lists

Table 1. Summary of metadata in newsgathering.

When the assignment is complete, the content on the disc can be sent back to the newsroom and ingested automatically into the NRCS with meaningful filenames and all of the associated clip lists and voiceover content.

Metadata and Storage

In news, the key metadata item for maintaining the continuity for effective asset management is the slug ID. This is the metadata item that will associate the content to a particular story within the NRCS. Additional information that is useful to the journalists in the field is the assignment description and instructions, background information, and potential stock content that could be used in the coverage. For content being returned to the newsroom, it is useful to see previews of the content, scripts, GPS data giving the location of the shot, the type of shot, and the durations. This gives the newsroom a good overview of the content that they have to work with.

To maximize the potential for integration with this technology, the metadata had to be stored in an accessible location on the camcorder and be in a readable and open format. For this reason, the metadata is stored in a single XML file and located in an accessible, general purpose area of the camcorder's disc-based storage. The main metadata items stored or referenced in the metadata file are listed in **Table 1**.

The metadata file for a single assignment is stored in multiple locations (the camcorder, the mobile phone, and the NRCS), and there is no constant connection between any of these devices. This means that some form of versioning strategy has to be adopted. The fundamental rule is that the metadata that originates from the NRCS is dominant and should not be changed, unless within the NRCS itself. Once a change is made in the NRCS, this triggers an update to the smartphone and subsequently to the camcorder. This maintains the consistency of the NRCS metadata. Additional metadata can be added in the field to complement the story. This gets ingested back into the NRCS to complement the assignment data.

The metadata on the smartphone will be synchronized to the camcorder whenever a connection is made. This maintains an up-to-date version of the metadata on all devices.

Metadata Transfer

During the newsgathering process, the metadata file will be transferred between many devices (**Fig. 3**). Initially, the file needs to be transferred from the NRCS to the camcorder. This is achieved when an email is sent from the NRCS to a smartphone and the XML file is sent via Wi-Fi or Bluetooth to the camcorder.

In the field, the smartphone can receive a video stream from the camcorder to enable the journalist to view what is being recorded. This is a proxy version of the content that is streamed over the Wi-Fi connection while the camcorder is recording.

A laptop can be connected to the camcorder to copy the proxies over Wi-Fi, a wired i.Link or Ethernet connection. These can then be roughly edited, and a voiceover can be scripted and recorded. Both the voiceover and script can be sent back to the camcorder and referenced within the metadata file.



Figure 3. Metadata transfer.

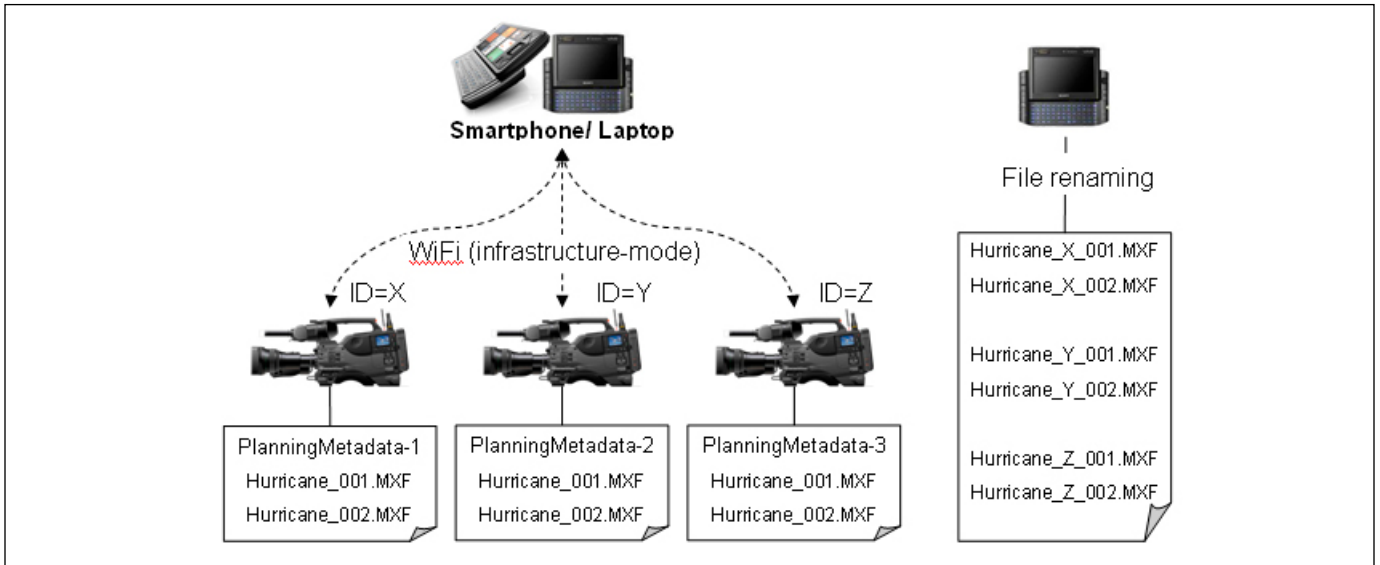


Figure 4. Clip naming for multicamera shoots.

Although the smartphone has a connection with the camcorder, any proxies, clip information (duration and timecode), scripts, and edit lists will be sent from the camcorder to the smartphone.

At any point during the coverage, metadata and proxy footage can be sent back to the newsroom via the mobile phone network. This is extremely useful for the early publication of updates onto the news organization's interactive services.

Integration

To achieve a workflow that had the least impact on the journalists, crews, and newsroom staff in terms of additional workload, it was important to achieve a seamless integration among the NRCS, smartphone, and camcorder. This meant that it was vital to establish close working relationships with Sony BPRL, the Sony camera division, and NRCS suppliers.

The integration with the camcorder is seamless. As soon as the metadata file is sent from the phone to the camcorder it is automatically detected and subsequent clips will be titled with the appropriate slug ID with no intervention required from the camera operator. The slug name automatically appears in the viewfinder to inform the camera operator what each clip will be called and the assignment details can be viewed on the LCD panel.

When an assignment requires multiple camcorders, the same metadata file can be sent to each camcorder. When the camcorder is connected to the laptop to preview the clips, it recognizes that there are multiple camcorders working on the same assignment and each clip is renamed with the slug name and the camera ID, as seen in **Fig. 4**.

Integration with third-party NRCS meant that the creation of an assignment would automatically trigger an update to the journalist on their smartphone. This meant that no additional tasks were introduced into the newsroom operation. In addition, when the

content returns to base and is ingested, it has all of the relevant metadata associated with it and is searchable within the NRCS.

NEW ELECTRONIC NEWSGATHERING WORKFLOWS

The previous sections have described the technologies facilitating new and enhanced workflows to support file-based acquisition through metadata. This workflow allows metadata transfer with the minimum of user effort through the utilization of devices (e.g., mobile phones) that are already carried by journalists, producers, and crews. The workflow also reduces the need to rename clips as they are returned to the newsroom, thus eliminating the risk of inconsistent metadata.

In addition to the core requirement of transferring metadata from the newsroom to the camcorder, functionality has been included that provides added value to the journalist from the available connection between the camcorder and the smartphone or laptop. These include a live preview of what the camera operator is recording and the opportunity to create simple clip lists and a voiceover.

The workflow presented in this paper is not fixed and adaptations are possible, to tailor workflow to the individual broadcasters' specific requirements. The following describes some alternative workflows.

A news operation that has a centralized structure from which all journalists and crews are dispatched from the newsroom could place the assignment metadata directly onto the disc or memory card before leaving the newsroom and then distribute them to the relevant crews. This means that the crews and journalist are not affected by the new workflow in any way.

Alternatively, a 3G dongle could be plugged directly into the camcorder so that the metadata file can be sent directly to the camcorder with no human intervention. However, this may limit the amount of additional metadata that can be added during shooting.

This technology is not only a useful tool for news broadcasting, but also has value for other domains such as drama and sport.

CUSTOMER FEEDBACK

This technology has been shown to a variety of news broadcasters at various trade shows and through customer visits. From this exposure it has been possible to get valuable initial feedback regarding the acceptance, usability, and interest in this technology. Overall, the customer feedback has been extremely positive and this technology is seen as a vital aspect to supporting content management as broadcasters move into an era of file-based content acquisition.

CONCLUSION

This paper has described metadata technology to support the introduction of file-based acquisition into the newsgathering workflow. This technology has been developed based on a detailed understanding of real-world newsgathering that was obtained from an extensive study of journalist and crews working in the field.

The technology allows metadata to be entered just once, as an assignment is created in the NRCS, and the same metadata is transferred and automatically attached to the content as it is created and

ingested back into the NRCS at the end of the day's shooting. This ensures consistency within the metadata, allows for effective content management, and avoids the risks of inconsistent and erroneous metadata associated with repeatedly entering and re-entering metadata.

The human-centred approach to the development of this technology has resulted in a fast turnaround from concept to demonstrable technology. There is also an increased confidence that the technology being developed actually meets the needs and requirements of the end users.

ACKNOWLEDGMENTS

The authors would like to thank the organizations involved with this study for their contributions to this work in terms of access to their journalists and crews. We would also like to thank the NRCS suppliers involved in the project for their help with the integration of their systems.

They would also like to thank Sony Corp. for their permission to publish this paper.

First published in the IBC 2008 Conference Proceedings, Amsterdam, The Netherlands, September 11-15, 2008. Copyright © International Broadcasting Convention.



Trepress

David Trepress started working for Sony BPRL in 2000 after completing a Ph.D. at Staffordshire University, studying the cause and effect of human error in online collaborative working environments. Since starting at Sony, Trepress has been working as a human factors engineer, emphasizing the needs of the customer in the development of future Sony technologies. Most recently, he has been involved in the development of systems for navigating and browsing large video archives and is currently working on an extensive project to understand the newsgathering workflow to guide the development of future XDCAM products.



Kotaka

Nobuhiro Kotaka started working for Sony in 1989 as an engineer of inspection facilities for cathode-ray tubes. Since 2003, Kotaka has been working as a metadata software engineer of the XDCAM products and has been in charge of product development. Kotaka's latest work is to implement a broad range of metadata, including the newsgathering workflow, in the XDCAM products as a chief software engineer.