Teatro alla Scala – Video Production System

TECHNICAL RECOMMENDATIONS

Sandro Frei / David Horswell

The setup of a production environment with remote control PTZ cameras follows specific workflows, in many respects very different from standard TV broadcast operations.
On the basis of several years of experience with designing and operating fixed and mobile installations in opera and concert we want to point out the main factors to be considered and share recommendations for types of equipment.

1. SYNCHRONIZATION

Every up to date digital videomixer has a framestore on each input, which seems to solve all the problems of analog equipment. For a small setup, where you just want to get a mixed/cuted sum which is recorded/streamed live, this is a feasible approach.
A professional multicam production, however, where all cameras are recorded independently (ISO) for postproduction purposes, timing and sync are crucial.
In this production environment it is absolutely mandatory that all cameras work on the same timebase - like in old analog times - in order to be easily editable later on in the production process. All cameras have to be synced by a studio master clock (Tri-Level-Sync - not Black Burst!) and all recorders also get the Studios Timecode (LTC).
If the cameras are not synced, your recording looks ok, in postproduction you will recognize that that the recorded files will drift of by several frames within a 2 to 3 hour recording, which ends up in very time consuming corrections in postproduction.
An important option is to be define the timecode (LTC, SMPTE standard) independently from real time, to help identify multiple recordings for postproduction workflows. If not, recordings of two performances on two consecutive days at the same beginning time (e.g. from 7-10 p.m.) will have the same timecodes, making it hard to be correctly identified. Shifting timecode for day 2 by 6 or 12 hours resolves that issue easily.

RECOMMENDATION
Studio master clock / Tri-Level-Sync (not Black Burst), all recorders connected to the (LTC) timecode of the studios, option to disconnect timecode from real time

2. CAMERA CONNECTION SDI

The Panasonic UE-150 offers (as one of the first PTZ cameras) different video outputs which can be assigned with different signals/resolutions and different functions. One of these functions is OSD – OnScreenDisplay: It provides the fastest way for the Vision Engineer to access the camera settings (including some deep colour settings like the matrix) by recalling the OSD via the RCP panel. This is very relevant especially in live production of opera with constantly and often drastically changing lighting conditions and colour spaces.
During live production, however, all other team members would be extremely distracted by OSD, and need a clean image.
This is why the camera's second video port (3G) has also to be connected to the main router. It can be set to show the OSD only on this 3G SDI Port, while putting out a clean 12G SDI signal on its other video port: So the vision engineers can adjust settings at any time without disturbing the production workflow.

RECOMMENDATION
Connect all cameras with 2 SDI Signals (12G & 3G) to the central rack room

3. CAMERA CONNECTION NETWORK / SYNC

In addition to the video/SDI signals, cameras have to be connected (as mentioned above) to Sync (Genlock) as well as with network to the studio / machine room.
One solution would be the MUX-22 by BROAMAN. It can connect up to 4 cameras with all required signals to the central machine room via fiber, it is fanless and noisefree.
Another option would be Topas 4K device by the French company ERECA bringing all required signals to 2 fibers.

All camera control signals are transported via network, also the live movement controls - so network speed and reliability are absolutely crucial. The topology of the network has to be carefully designed, connecting studio and camera into one network environment, and making sure nothing else is can interfere with this broadcast system.

Make sure that all SDI cables used in the studio and the building are 12G rated. Bad cables may cause serious problems in a 4K workflow.

4. MULTIVIEW – TALLY – ROUTER – SWITCHER

The remote camera operator's workplace consists of 3 main elements: a multiview / split screen, a switched monitor to show the current selected camera, and the Panasonic RP-150 remote control panel.
The multiview screen has to support RED Tally, green is a good add-on but not a must. Ideally, every operator workplace split screen can be individually set up, e.g. quad split or 16 split. The studio design should allow flexibility to make it sustainable for different production workflows.
The switched monitor always has to show the selected camera, so the RP150 control panel has to be connected to the main router. Though this can be achieved in several ways, we recommend a LAWO VSM system, because it would solve other challenges as well. The switched monitor needs red/green tally as well, which has to be dynamically negotiated with the switched source / selected camera.
IMPORTANT: Selecting a camera must not involve pushing more than ONE button only.
IMPORTANT: Framerate / resolution is 4K 50p throughout the whole studio, including MV´s.

RECOMMENDATION
The Ross Ultrix Router Platform and the Ross Carbonite Ultra Switchers provide multiview and tally, the tally control protocol TSL allows to also smoothly integrate third party products.

5. DISPLAYS / MONITORS

All displays need to be professional with 12G SDI Inputs and UHD (4K) Panels.
For camera operators and directors the displays need to show a relevant picture, but it does not need to be CLASS1, e.g. Lilliput Q-series (available from 23-31").
However the vision engineers displays need to be Class1, 4K, HDR, e.g. the 31" TV Logic
At least one of the Vectorscope should have an option to measure the timing, recommended e.g. Telestream PRISM.

As for the display size, anything from 24" to 31" for Operators is good, it should not smaller and does not need to be larger. Mounting has to allow flexible adjustment to seating positions and body height of operators, since they work for up to 5 hours per opera without breaks and shouldn't have to twist or turn heads causing neck or back problems.

The directors workplace should have a 43“ UHD Reference Monitor as multiview, eventually larger depending on room size, distance to the director and mounting possibilities.

6. VISION ENGINEERING

The key instrument for shading is the ROP device (Remote Operation Panel). Though cheaper third party products are available (like skaarhoj), in fact there is only one suitable device: the Panasonic HRP-1000. The cheaper HRP250 gives only poor direct access in color correction, the HRP-1005 is slower in operation.

7. STUDIO MANAGEMENT

Producing live or recording from different locations with a greater number of cameras from one video studio requires carefully designed management options: it has to be possible to switch from one location (like the main hall) to another (like the Ridotto Toscanini or the Museo) by one push of a button. Manual operation is error-prone and takes a lot of engineering time.
We strongly recommend a powerful studio management solution, like LAWO VSM, to enable this one touch operation for switching between any of the PTZ enabled spaces.

RECOMMENDATION
LAWO VSM is a bit pricy in installation, but saves money in everyday operation.

8. RECORDING

Producing in UHD / 4K creates huge amounts of data which need to be handled. Software recording solutions are very flexible, hardware solutions are very stable.
A good, reliable and reasonably priced solution combines both worlds. AJA 4K recorders e.g. offer an integrated option to offload the recorded files directly via network. Software recording solutions can handle different file qualities at the same time, which is a tremendous benefit.
A deeper analysis and recommendation will be delivered on this topic.

9. POST PRODUCTION

To work on a international standard and have a decent workflow with the audio department, we recommend to use Avid Media Composer for NLE (Non Linear Editing), the most stable multicam editing tool on the market. Both Windows and Apple support Avid Media Composer and UHD HDR workflow. Including a BlackMagic DeckLink will moreover make it possible to clock the edit suite and enable safe bi-directional workflow to and from the production studio. Combined with an Avid Nexis storage, this gives a strong backbone for post production.
Every editor has his/her approved display setup, however at least one reference monitor has to be identical to the one in the production studio. For color correction and grading, Blackmagic DaVinci Resolve software together with a Blackmagic Mini Panel provides the most effective and cost efficient workflow. For reliable color grading the postproduction workspace shall use the same Class 1 UHD HDR reference monitor as the vision engineer in the production studio. Editing and colour grading can be performed on one computer/mac, the editing and grading suite should be situated in a room separated from the live studio (e.g. the RAI vision engineers space), quiet, with good airflow and the possibility of darkening.