

Building the Definitive Fail-Safe Switching Solution

Crystal Vision Safe Switch 3G Application Note

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Being a Broadcast Engineer for 20 years has given me a real appreciation for a properly designed and implemented fault tolerant transmission system. Such systems make use of back up or redundant transmission paths which can be switched to when a fault occurs. These systems come in all shapes and sizes, but all can be defined into one of two categories.

Those classifications are 1) backup and 2) fail-safe.

Usually the determining factor of the system type is how the signals are monitored and switched in the event of an error or alarm. A backup system is generally monitored visually by an operator and switched manually if an error is present. A fail-safe system is monitored and error checked automatically and switched immediately if an error occurs.

This paper will discuss redundant system factors and highlight the specifications that make Crystal Vision's Safe Switch 3G the first product in the industry that allows for a truly fail-safe redundant system.

Anatomy of a Backup Redundant System

Building a backup redundant system may, on the surface, seem like a simple proposition. You budget for two of every piece in the chain, building two identical signal paths. Many facilities install a primary “A” chain and a secondary or “B” chain. While that is the basis for a backup redundant system there are several factors in the implementation and operation that are not so simple.

Will the backup be identical to the main? The cost of a complete duplicate transmission chain can be prohibitive and so the backup chain may be simpler with less processing boxes. This will lead to differences in the timing, or system delay, of the two signals.

How will the main signal be monitored to confirm it is still valid to broadcast?

What will initiate the switch to the backup chain?

How will the operators be told that there is a problem and a switchover has occurred?

When should the system switch back to the main chain?

Should the switch back be automatic or by manual intervention?

Is it likely that you will want to switch to the backup even when the main chain is good?
This might be for testing or maintenance purposes.

The weakness of many backup redundant systems has been how the two chains are linked together, monitored and switched to the final transmission output. Addressing all of these factors properly is a must in order to achieve a fail-safe system.

Monitoring and Switching of a Backup System

With the time, effort, and capital that goes into designing and building a 3G or HD system you would assume that monitoring and error checking of the system would be equally elaborate.

What we find many times is much less elegant than one would expect. Many stations rely on the operator in the control room to watch the outgoing programme. Although the eyes on the system are many times aided by multi-viewers and test equipment with alarm capabilities, at the end of the day it's still an operator that is ultimately responsible. An issue with visual monitoring is the fact that many facilities are producing multiple output streams. One set of eyes in many cases are now responsible for multiple channels.

A quick scenario: a broadcast station is on air with the primary chain active, when the video freezes due to a playout server failure. An alert is signalled from a multi-viewer alarm and the operator visually confirms the frozen frame. The operator begins the pre-determined plan of

action to recover the signal, verifying the backup signal is valid and manually switching to it. The main problem with this scenario is the amount of time that has elapsed from error to solution. Remember the old adage: if the operator sees it, so does everyone else. What is worse is that in today's competitive environment it could cost you money – either directly if it occurs during a commercial break or indirectly through a reduction in viewer numbers.

A well thought out system should have some ability to automatically switch to the secondary chain on a failure of the primary. Either to reduce the possibility of an operator not seeing it or perhaps during times of unattended operation, which is becoming much more prevalent in the industry.

Crystal Vision's Safe Switch Solution

The main application for the Safe Switch 3G is to create a fail-safe system. It ties the main and redundant chains together, provides monitoring of signals and auto-switching upon alarm, all the while protecting the integrity of the output stream. Allowing a broadcaster or content provider the peace of mind that outputs will remain proper and valid even under the most adverse conditions.

The Safe Switch 3G is a 2 x 2 intelligent switch that provides user-defined alarms and reactions to those alarms, programmable GPIO control and status, manual and automatic switching. That switching of critical outputs is performed "safely" at all times. By safely, we mean *switching the video stream to a redundant system cleanly and synchronously, even under the most adverse conditions such as loss of house reference, such that the viewer sees no disruption.*

This means that the output stream will be protected from disruption or glitching when an error has occurred on the main "on-air" stream. At the heart of the Safe Switch 3G is a 3G synchroniser on both inputs. This allows for mistimed inputs to be switched cleanly. As mentioned the backup chain may not include the same processing elements that are used in the main chain. For example, it may not include graphics boxes, DVEs, data inserters and so on. Either due to reasons of cost or for the desire to have a simple basic backup transmission path that will be more reliable. Although this might only result in milliseconds of timing differences between the two signals, a simple hard switch would cause a disruption to the SDI stream and lead to equipment downstream, such as MPEG encoders, failing for one or two seconds. By including full frame synchronisers this Safe Switch 3G was designed to keep MPEG encoders and viewers equally happy at all times. The feature also comes in handy during maintenance time when you may activate the switch to the backup even when there are no issues with the main.

Of course in order to synchronise you need a separate reference signal which provides a source of timing that is independent of your two input video signals. As with many products in your system this would be normal analogue Black and Burst.

This however then creates another possible signal which might fail and so provision needs to be taken to deal with this situation, again without creating any disruption to the outgoing video stream.

The switch is designed to lock to normal Black and Burst house reference when present. In the event of a reference loss, the switch slowly migrates its lock to a valid input. The slow drifting of reference ensures the output stream is valid at all times. This feature is unsurpassed in the industry and truly makes the Safe Switch 3G the ultimate solution for tying together redundant chains.

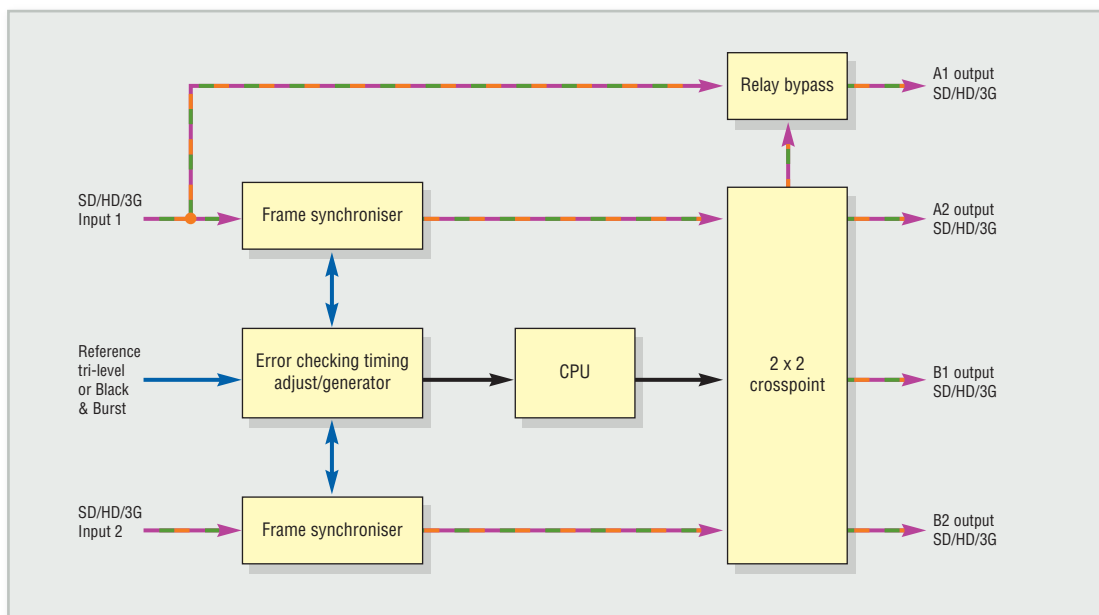


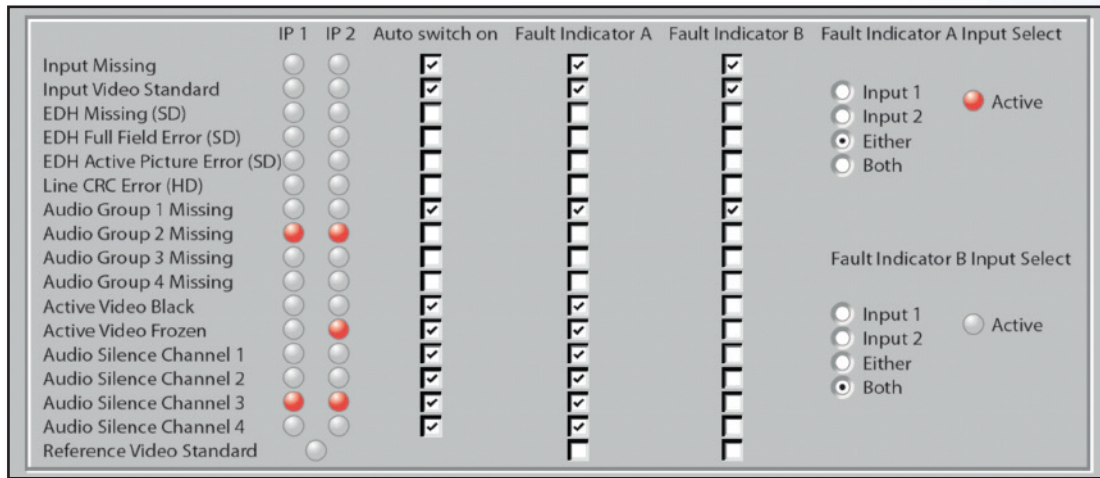
Figure 1 Simple Safe Switch 3G Block Diagram

Spotting a failure

It is fairly obvious that if the main signal chain fails because the signal is completely lost, for example because a cable breaks, then you should switch to the backup chain – but often with today's equipment the failure does not always result in a complete loss of SDI signal.

If, for example, a server fails then it may continue to output some sort of signal. It could be a frozen picture or a valid black signal. It could be that the audio fails and the device just produces silence.

There are also many video processing boxes which – if they lose their inputs – will output a frozen video frame or a valid black or colour bars signal. This can mean that, unless some further analysis of the signal is done, then it may not be obvious that a failure has occurred. That's why the Crystal Vision Safe Switch 3G will check the picture and the audio for these conditions. Of course different users may want to set different fault criteria and so the Safe Switch 3G is fully programmable.



There is the option to switch automatically or just raise an alarm. These alarms can be interfaced to the operator or to an overall monitoring system by GPI or SNMP.

Applications

The Safe Switch 3G has many applications and placement in signal chains. The following are a couple of examples.

1. Broadcast Master Control Programme Stream

The Figure 2 block diagram shows a traditional application of monitoring and switching the output of two redundant programme chains. This is a simplified master control block with full redundancy. The Safe Switch 3G constantly monitors the parameters set by the user to determine that the input being used is correct, and the unit is ready to switch to the secondary chain in the event of a failure. All of this occurs seamlessly. This is also a good example of being able to safely switch to the secondary chain for maintenance of systems. It makes a firmware update and re-boot of an “on-air” system much simpler. In this scenario, monitoring of signals would include black video, frozen video, audio silence, missing audio groups etc.

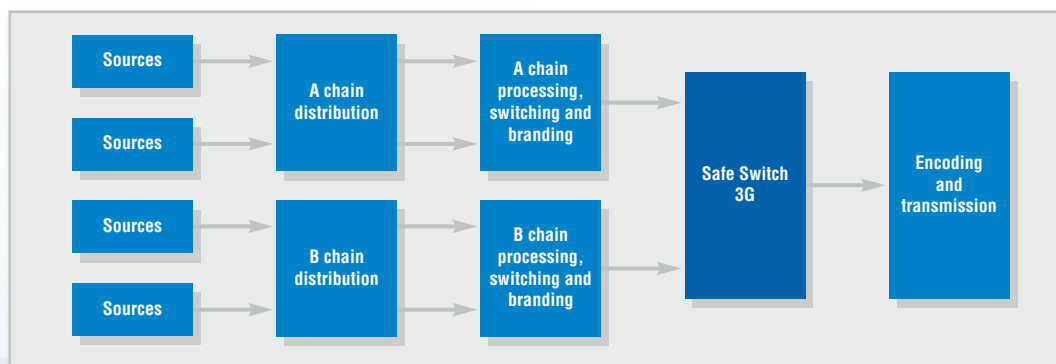


Figure 2

2. Live Programme Feeds

Figure 3 shows an application of the Safe Switch 3G on the input side of a live production. In this example, two satellite receivers are receiving live critical programme content. The primary feed is a Ku Band reception, the secondary is a C Band backup feed. In this example, the Safe Switch 3G will ensure that the video stream does not suffer from inherit Ku reception issues such as rain fade. If the primary signal freezes or goes to black, the switch will provide the backup feed to the broadcast centre automatically. The onboard synchronisers also allow for an untimed satellite feed to go to air properly.

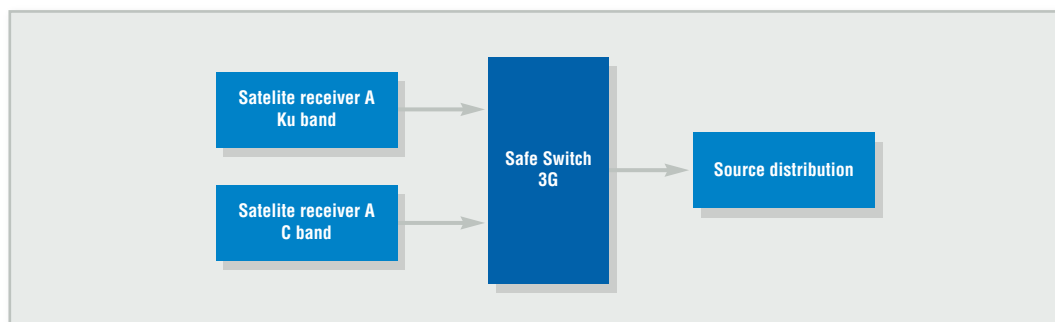


Figure 3

Complete Fail Safe Redundancy

All redundant systems have to be tied together at some point in the chain. The Safe Switch 3G is the best engineered product to link SDI video transmission systems together where a disruption-free output is required. The Safe Switch 3G is the way to guarantee a clean, safe switch of redundant programme streams.