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Protecting Ad Revenue Streams with SeaChange Spot+ Software[™]
An Expansion Package for Fault Resiliency and High Availability

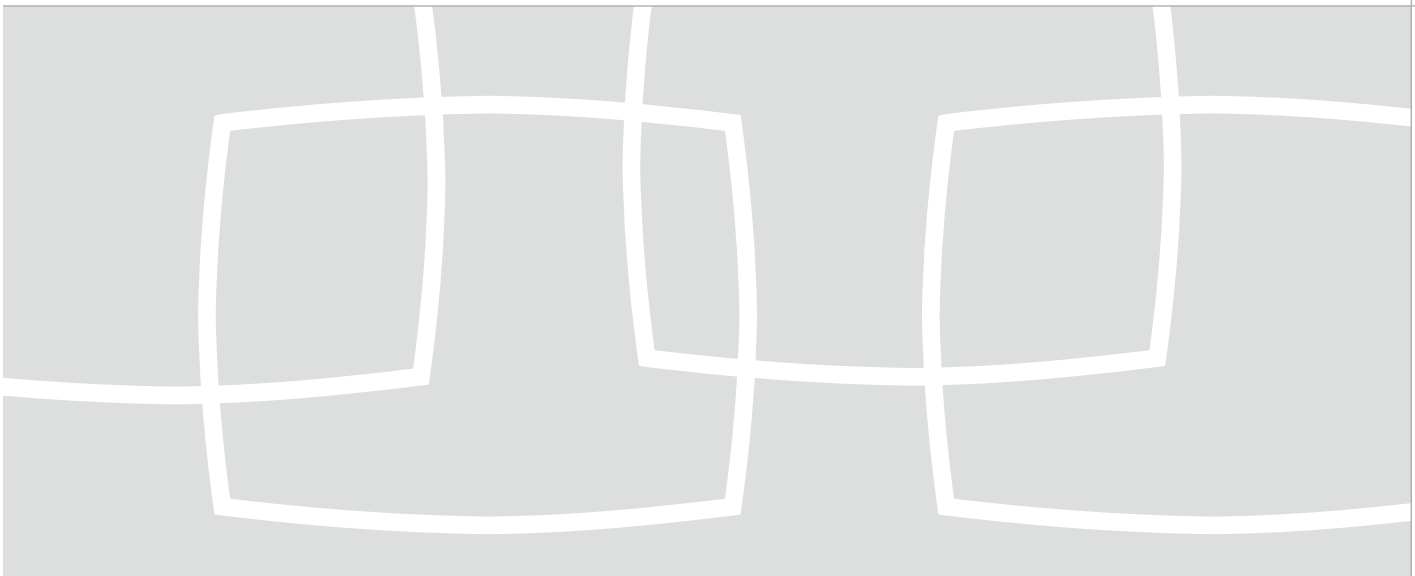
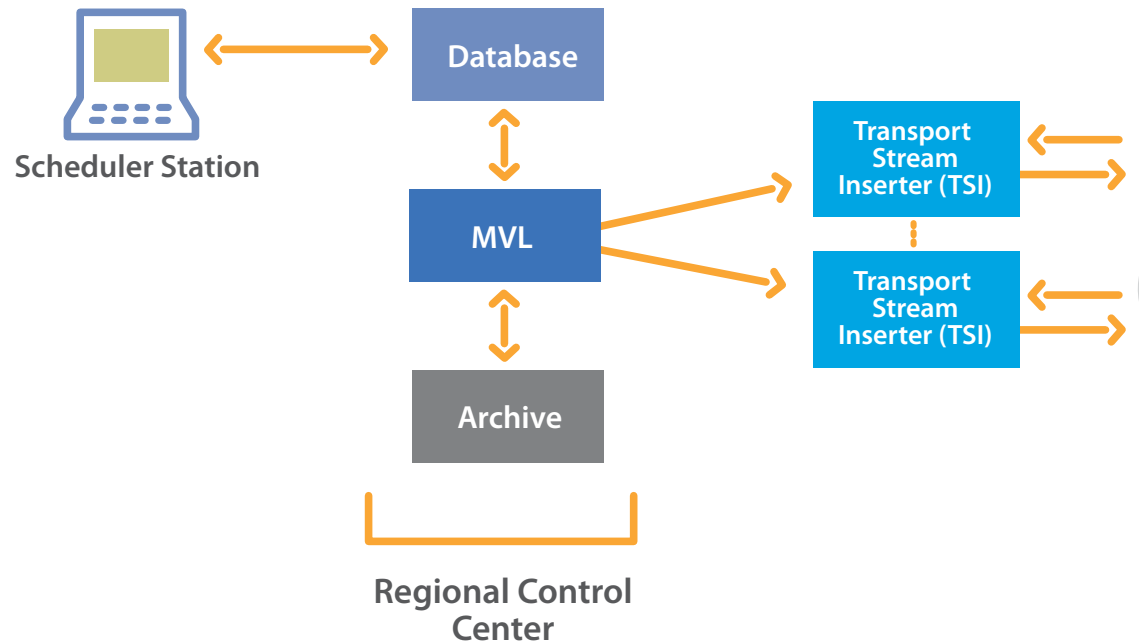
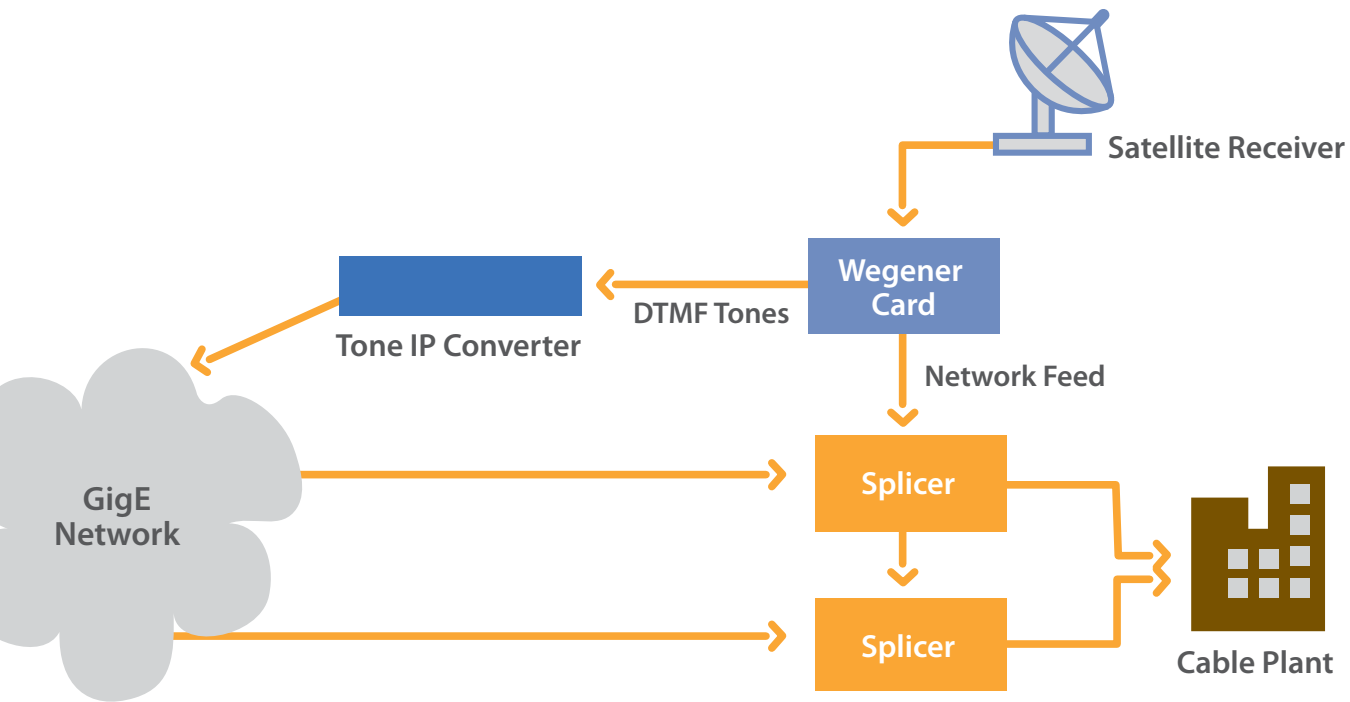


Figure 1 : Centralized Ad Insertion Operations



Cable operators roll out more digital channels all the time for new networks, high definition, and to support digital simulcast. For ad sales, these channels represent not only a new source of revenue, but also an opportunity to improve operating efficiency and lower operating expenses by centralizing operations.

As the advertising business grows and becomes more centralized, systems and services are more vulnerable to outages, and failures that might previously have impacted only a single headend can have much wider-reaching consequences. Operators are refocusing attention on the issue of system availability as a way to improve run rates and revenues.



The SeaChange Spot+ System™ for fault resiliency and high availability protects growing ad revenues by eliminating single points of failure in the SeaChange Spot™ digital ad insertion system. The Spot+ System protects ad insertion at multiple levels:

- By detecting faults and managing failovers for critical system elements that are backed up by redundant devices
- By monitoring the status and managing failover of critical network links that are backed up by redundant links
- By monitoring and reporting overall system health and presenting status and alarms

SeaChange® Spot System Architecture

To understand how Spot+ protects the ad insertion system, it is useful to review the architecture and elements in a Spot ad insertion system. Figure 2 illustrates a typical Spot digital ad insertion system and shows how the key elements work together to deliver an advertisement.

The Schedule Station (SS) enables control and monitoring of ad insertion system operation. Operators use the Schedule Station to configure networks to be inserted, to build and modify ad insertion schedules, to preview commercials, and to monitor the activity of individual elements.

The Master Video Library (MVL) stores the inventory of active spots in compressed digital video files. When prompted, the MVL transfers copies of upcoming spots to the ad inserters.

The Database (DB) provides a repository of all system information. It contains all past, present and future schedules, and it logs all events. When required, the database commands the MVL to send copies of upcoming spots to the appropriate ad inserters.

The Archive Video Library (AVL) stores the inventory of inactive spots in compressed digital format. When needed, the AVL automatically moves copies of spots to the MVL. From there, spots are distributed to the appropriate ad inserter. Because copies of all advertisements generally reside in the AVL, it also provides a back up of current ads in the MVL.

Ad Inserters (AI) insert the content of the spot into the program feed to be delivered to the consumer. For digital inserters, the inserter works with a remultiplexer/splicer to splice the spot into the digital program feed. Special data packets embedded in the streaming media provide the digital inserter and splicer with the exact timing to replace the digital program signal with the spot.

The Data Network (DN) provides communication between MVL and AI. Its primary job is to deliver copies of spots to the AI. This network can include Ethernet, ATM, T-1, satellite or other types of technology.

The Tone Delivery Network (TDN) transports signals to the AI to control the timing of spot insertion. This network can include Ethernet, DTMF or other types of technology.

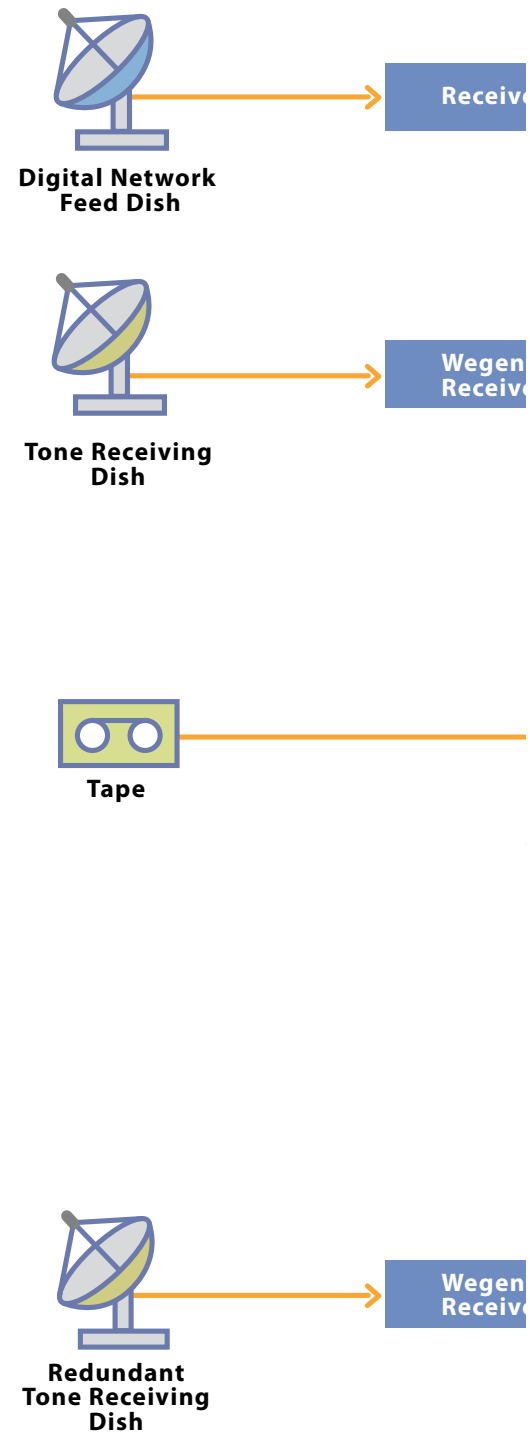
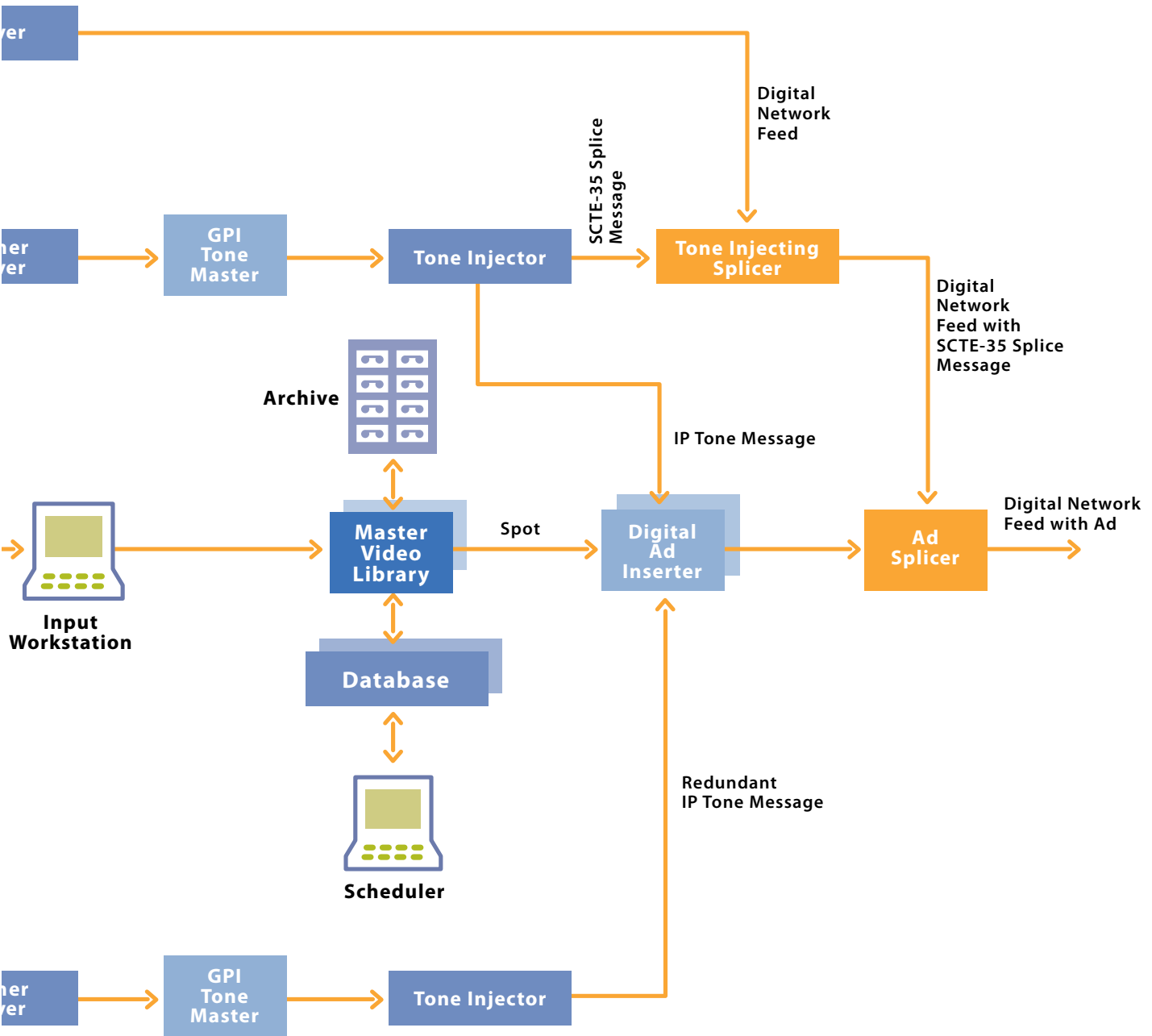


Figure 2 : SeaChange Spot Digital Ad Insertion System



Solid Foundation for the Transition to High Availability

SeaChange is a leader in incorporating redundancy and high availability features in its broadcast, on demand and ad insertion solutions. Most existing SeaChange ad insertion solutions, which support over 4.5 million ad insertions each day, include a range of features to enhance system availability.

- Redundant power supplies and fans
- Optional -48V power supplies
- RAID protected data storage
- Hot swappable drives and power supplies
- Chassis sensors for thermal and status
- Failure detection and reporting

These features enable extensive status monitoring and alarms and support in-service maintenance to key system elements.

The SeaChange Spot+ System™ builds on the foundation of these capabilities and achieves a significant leap forward in ad insertion system fault resiliency. Operators can use the Spot+ System to monitor critical system elements, automatically fail-over to hot standby elements and receive early warnings of impending failures so that appropriate actions can be taken to intervene, including scheduling of in-service maintenance.

General Behavior of Primary & Backup Elements

- Each element determines its role (Primary or Backup) through configuration or negotiation.
- Each element broadcasts a heartbeat message to associated elements.
- When an element fails to receive an expected heartbeat it determines if it has become isolated by a network failure or if the associated element has, in fact, failed.
- When a primary element confirms that its backup has failed, it notifies the monitoring service that it is operating without backup.
- When a backup element confirms that a primary element has failed, it notifies the monitoring service of that failure and initiates failover.

Redundancy Strategies

The SeaChange Spot+ System™ uses a mix of redundancy strategies to protect different elements of the ad insertion network in the most cost-efficient manner. In general, critical elements are protected using one-to-one (1:1) redundancy, also referred to as mirroring, to provide 100% backup.

However, when the number of elements to be protected is large, making the cost of mirroring prohibitive, a one-to-many (1:n) or a many-to-many (m:n) redundancy strategy is used.

Master Video Library Redundancy

As the sole source of spot content in a typical ad insertion system, MVL availability is essential. In most cases, there is only one MVL per system. Therefore, the use of a one-to-one redundancy strategy for the MVL offers 100% fault coverage at an acceptable cost.

On both the primary and backup MVL, high availability services manage the sending and receiving of heartbeats, transmit continuous updates on element status to the monitoring station, and keep states of the primary and backup devices exactly synchronized so that the backup can assume primary operation in the event of a failover.

Database Redundancy

With all system schedules and logs, the database is critically important to the on-going operation of the ad insertion system, and there is typically only one per system. Therefore, like the MVL, a one-to-one redundancy strategy is used to protect the database from failure.

Data Delivery Network Redundancy

With a mirrored pair of MVLs, operators can establish fully redundant data delivery network paths to protect the delivery of spots from the MVL to the inserters. For example, the output of each MVL can run through independent network switches and/or routers and eventually over different network paths.

Tone Delivery System Redundancy

In the case of the tone delivery/tone insertion system, two layers of redundancy are provided. For the tone delivery chain, where DTMF audio tones are first converted into serial data signals in the Master Tone Interface and then into IP cue tones by the Tone Injector, redundant chains deliver two sets of IP cue tones to each inserter.

For network feeds lacking SCTE-35 ad splicing messages, the Tone Injector also signals tone injecting splicers to add such messages to the network feed.

Thus, the Spot+ System protects against failures in the tone delivery/tone insertion system by providing cue tone information from three different paths: a signal to the tone injecting splicer to insert SCTE-35 ad splicing messages into the network feed, a primary IP cue tone to the inserter, and a secondary IP cue tone to the inserter. In this scenario, the primary trigger for the ad inserter is the network feed with SCTE-35 ad splicing messages. However, if that feed is flawed in some way, the inserter can also respond to either the primary or secondary IP cue tone.

In addition, high availability services in the ad inserters monitor all inputs to detect the presence of SCTE-35 cues and IP cue tones. When all are present, the inserter keeps a running account of the offset between the network cues and the IP cue tones. Should it need to failover to the IP cue tones, it uses this information to insert the ad at the correct point in time. These services also report any network cue or IP cue tone failures back to the Spot+ Monitoring Station.

Ad Inserter Redundancy

Due to the number of ad inserters deployed in a typical ad insertion system, use of a one-to-one redundancy strategy for inserter backup could nearly double system cost. To manage the cost of protecting ad inserters, alternate strategies are used.

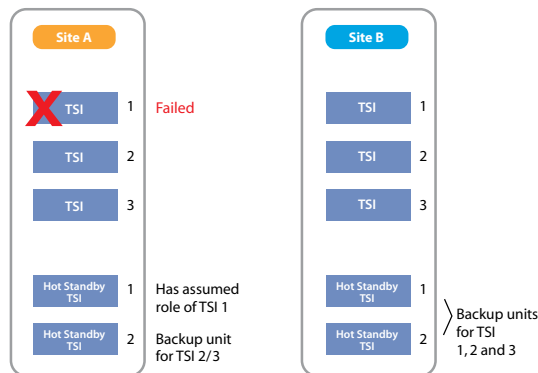
The most basic approach is to deploy a hot standby unit alongside several primary inserters in a one-to-many (1:n) redundancy strategy. As in other parts of the system, the primary units and hot standby unit exchange "heartbeat" signals with each other. Should one of the primary inserters fail, the hot standby unit assumes the role of the errant primary unit.

Of course, the hot standby unit must be ready to assume the role of any one of the primary units to effect a seamless failover. Therefore, the hot standby inserter must contain a portion of the upcoming ad content for each of the primary inserters. This task is performed by the high availability services running on the hot standby inserter. Once it assumes the role of the primary inserter, the device dumps irrelevant ad content from its memory and loads additional content from the MVL to match what was previously sent to the failed unit.

A more sophisticated, many-to-many (m:n) redundancy strategy can also be used, and is particularly useful in scenarios where backup protection is spread across multiple sites. In this scheme, multiple hot standby units are deployed, and any of these units can be called upon to assume the role of any primary inserter that fails. In addition, any of these units can be reassigned to protect elements located in other sites.

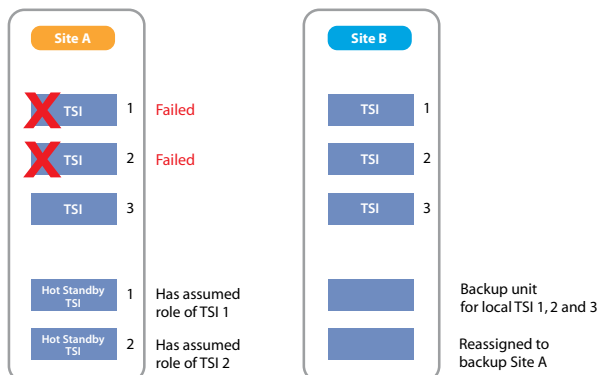
Figure 3a, shows an example with two ad inserter sites. At site A, Hot Standby #1 has already assumed the role of the Failed TSI #1. Hot Standby #2 remains on duty protecting TSI #2 and 3. In Figure 3b, due to the failure of TSI #2, Hot Standby #2 has now assumed a primary role, leaving Site A without backup protection.

Figure 3a: Backup resource available locally



The unprotected elements in Site A notify the Spot+ Monitoring System of their status. This system then initiates a wider search for backup resources. It finds and reassigns Hot Standby #2 in Site B to provide backup services to Site A, and the device begins loading spot content reflecting its new standby assignment. The multiple layers of backup protection insure that advertising operations are highly fault tolerant.

Figure 3b: Backup resource found in alternate site



Redundant GigE Inserter-to-Splicer Links

The last critical link addressed by the Spot+ System is the GigE link between the inserter and splicer. Failure of this link will prevent spot streaming media from reaching the splicer.

SeaChange Spot Inserter 20100 and 20200 devices are now equipped with redundant GigE outputs to support redundant outbound links to the splicers.

Spot+ Monitoring Station

The Spot+ Monitoring Station collects all of the information representing the status of the mirrored MVLs, DBs and Tone Delivery System signal paths and the various primary and hot standby inserters. This station also gathers alarm and chassis information from the Spot alarms package. Armed with this information, operators can monitor system operation and detect system problems long before revenue services are impacted.

System operators are alerted to changes in system status by pop-up alerts, pager alerts, email alerts and similar notification mechanisms. The Monitoring Station also enables system operators to schedule and trigger failovers to permit maintenance of primary units.

Benefits of the SeaChange Spot+ System™ for Fault Resiliency and High Availability

By deploying the SeaChange Spot+ System, operators can achieve measurable improvements in system availability with little to no impact in system complexity or staffing.

Benefits include:

- Early warning of system and network issues
- Ability to schedule preventive maintenance before revenue is impacted
- Make better use of technical staff
- Improved system status information
- Better first-time run rate

Contact your SeaChange sales representative for more information on the SeaChange Spot+ System™

