One of the major challenges facing broadcasters today is preparing for the continuity of their business following a possible catastrophic event that disables the operation of their transmission facility.

Whether referred to as “disaster recovery” or “business continuity,” such a contingency plan must be flexible enough to accommodate both short and long-term outages of the primary transmission site. At the same time, plans to survive an unlikely catastrophic event must also make sense within the economics of an ongoing business.

Scenarios Requiring BCP

Considering the need for BCP should include scenarios for both short and long-term outages of the primary transmission site.

Short-term outages from a few hours to a few days might result from unscheduled interruptions of public power or broadband communications, or from scheduled downtime for facility maintenance or upgrades. Some broadcasters use regularly scheduled, on-air operation of the backup site as part of their BCP to maintain backup readiness.

Long-term outages exceeding a few days can result from catastrophic damage to the primary site following a natural disaster such as hurricane, fire, tornado or earthquake — or from a man-made incident of environmental hazard, bombing or other acts of sabotage.

While some broadcasters view the need for short and long-term backup separately, and deploy different backup solutions, the considerations and options described here apply to both scenarios. However, the importance of certain decisions can vary greatly with the length of the outage, and the BCP operational model may have to change as an outage transitions from short-term to long-term.

The BCP Planning Process

A business continuity plan requires consideration of its effects on all aspects of the broadcast business, not just engineering and operations. Decisions made for business reasons or for logistical compatibility with existing operations will drive the operational requirements, and those in turn will define the technology requirements when choosing a solution.

We will look at four aspects of the decision and planning process for business continuity:

1. Business Considerations
   Why have a backup site? What service must it provide to sustain our business? What cost is justified?
   The fundamental decision to proceed with a business continuity plan should be based on its importance to the survival of your business:
   Why is a backup transmission site needed? What do we stand to lose if no backup is available? How closely must the backup site replicate our primary site transmission? What initial and ongoing costs can be justified for a backup site?
   A related BCP decision that should be based on your business objectives is the operational mode or readiness of the backup site:
   Do we need to have a backup site that can take over transmission at any time on short notice, or would one that requires hours or longer to begin backup transmission be adequate?

2. Logistical Decisions
   Where should the backup site be located? How will it be staffed? How will it communicate with the primary site? What capability for remote control is needed between the sites?
   The decision on backup site location will drive much of the cost of BCP. In addition to the facility cost itself, the choice of location also affects staffing and communications — both major cost components.

3. Operational Requirements
   What are the operational processes (workflows) required to maintain the readiness of the backup site during normal operation and to operate it during primary site outages?
   Once backup service level expectations are set and a site is selected, the next step is to understand the operational requirements for the backup site. For example, the decision on backup site readiness and viewer Quality of Experience (QoE) will define the requirements for the ongoing transfer of content and operational data.

4. Solution Technologies
   What solutions are available for cost effective backup transmission? Which solutions provide the flexibility to allow other uses of the backup site now and expansion in the future?
   To meet the operational requirements for BCP, what capacity and performance are required from the solution components? What technology and which specific products provide these capabilities at the lowest initial and ongoing costs? Will the chosen solution support other uses of the backup site without compromising backup readiness? In the event BCP requirements change, does the selected technology provide the desired scalability?

In this paper, we review the major components of a Business Continuity Plan (BCP) by looking at the requirements to be met, the decisions to be made, and the solution options available. We’ll look at four aspects of the planning process: business considerations, logistical decisions, operational requirements and solution technologies.

The BCP Decision Process

<table>
<thead>
<tr>
<th>Business</th>
<th>Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Replication Process</td>
<td>Type of Facility</td>
</tr>
<tr>
<td>Operating Data Compatibility</td>
<td>Location</td>
</tr>
<tr>
<td>Evergreen Content Management</td>
<td>Staffing Model</td>
</tr>
<tr>
<td></td>
<td>Remote Control Requirements</td>
</tr>
<tr>
<td>Operations</td>
<td>Technology</td>
</tr>
<tr>
<td></td>
<td>Solution Type</td>
</tr>
<tr>
<td></td>
<td>Initial and Ongoing Cost</td>
</tr>
<tr>
<td></td>
<td>Flexibility for Other Uses</td>
</tr>
<tr>
<td></td>
<td>Scalability for Future</td>
</tr>
</tbody>
</table>
Business Considerations

Quality of Experience vs. Cost

Once a decision is made that some type of BCP is needed, the next step is to decide on the Quality of Experience (QoE) the backup site must deliver for the viewer. In other words, how will transmission from the backup site compare to transmission from the primary site? What QoE is required to maintain viewership and advertiser revenues during short or long-term outages?

The objective of a QoE decision is to strike a balance between the cost of the backup site and any negative effect on revenues or subscriber base during a primary site outage. There are several factors to consider that affect the cost of installing and operating a backup site, each of which has a corresponding effect on QoE:

- **Program Currency** - Will the backup site transmit the very same mix of primary content that would have been transmitted from the primary site, or will some “evergreen” content be used to reduce the need for program content replication and backup site storage capacity?

- **Transmission Crafting** - Will backup site transmission include full “crafting” with secondary events and effects as used for primary transmission? In other words, does the transmission from the backup site have to include all the graphics, effects and overlays that are part of your normal transmission, or will some type of “clean feed” suffice?

Readiness of Backup

Another decision that affects both cost and QoE is the required readiness level of the backup site. In other words, how quickly can the backup site be brought into operation after a primary site failure? In general, this “failover time” is inversely proportional to the operating cost for the backup site, i.e., a shorter failover time means higher operating cost.

The options here range from a “hot” backup site which can be brought into service within seconds or minutes – picking up the primary transmission schedule within a few events, to a “warm” or “cold” site which might require hours or even days to bring into service.

Maintaining a **hot backup site** requires near real-time synchronization of the primary and backup site transmission systems. In other words, both sites must have access to current content files and operating data at all times. Furthermore, any schedule changes and associated new content must be available to both sites in advance of the scheduled air time for the affected events.

In essence, a hot backup site is the functional equivalent of a redundant transmission system located at the primary site, but providing the additional protection of a remote location.

A **cold backup** site is one in which the transmission system is not maintained in a “ready” status, but rather will be brought into service from a “not ready” state after the primary site failure has occurred. This may include powering up hardware, configuring software and routing input and output signals. This scenario also includes the inherent risk of an unforeseen problem arising during this start up.

Required content files and operating data may be replicated to the cold backup site periodically, or these data transfers may not begin until after the primary site failure has occurred. In either case, bringing the backup transmission system to a ready state and transferring the initial content files and operating data to begin transmission can take a few hours to a full day or more.

The decision to deploy a cold backup site may be driven by the need to minimize additional staff (e.g., primary staff must travel to the backup site) and/or the operational cost of inter-site communications for content replication and remote control monitoring. The increased startup time of a cold site can also be justified by the level of redundancy provided at the primary site. In other words, a highly-redundant primary site reduces the likelihood that the backup site will be needed at all, or that it will be needed on short notice.

As mentioned above, the readiness level of the backup site can have a major impact on the cost of BCP. This is due both to the communications costs for ongoing content and data transfer, and to the associated staff hours required to monitor these processes and the status of the backup site systems. It should be noted that with a warm backup site, some of these costs may be offset by utilizing the backup site systems for secondary channel transmission during normal primary site operation.

The objective of your decisions on these business considerations for BCP should be to sustain your business through an outage with a projected loss of subscriber and/or ad revenues that is less than the actual, incremental cost of the deploying, maintaining and operating backup site.

In this context, a “secondary” channel is a low-value channel – such as a news replay loop – whose transmission can be interrupted to provide backup for a high-value channel under BCP.
Logistical Decisions

Choosing the Backup Site

After deciding that a backup site is justified, choosing a location is probably the single most important decision to be made in BCP. For some broadcasters, the ready availability of an existing, alternate site reinforces the decision to move ahead with BCP. For others, the cost to acquire a new site or to use an outsource facility is the largest part of BCP cost justification.

While no two broadcasters are in exactly the same situation regarding possible backup sites, the most common choices include:

• An existing, separate facility already owned by your company (e.g., an opposite coast facility for a network)
• A partnership with another broadcaster (e.g., two broadcast station groups providing backup facilities for each other)
• An outsource facility from a service provider (e.g., broadcast ASP, cable headend, etc.)
• A new facility purchased or constructed by your company

Regardless of the type of backup site selected, its location relative to your primary site and the planned operational mode will have a major impact on cost. One cost element almost entirely determined by location and operational mode is staffing, since the distance between the primary and backup sites — and the required readiness level of the backup — will determine the feasible staffing options.

The three most obvious staffing options are: using primary site staff by relocation or daily commute, adding new permanent staff or outsourcing backup site operations. In some cases, hybrids of these options can provide the best solution. For example, during the initial stages of an outage, current primary site staff could relocate or commute until new staff is hired or outsourced for the longer term.

Operational Requirements

Content Replication Process

Among the processes necessary for maintaining a ready backup site, the replication of content from the primary site to the backup during normal operation is one of the most challenging.

As an ongoing process during all periods of normal (i.e., primary site) operation, content replication to the backup site can be one of largest components of your ongoing BCP cost. In making the decisions that determine which content must be replicated to the backup site, it is important to keep in mind that there are multiple cost components of content replication. These include:

• Operating cost of broadband communications for content transfer
• Operating (staff) costs for managing the content replication workflow
• Capital cost of content storage at the backup site

The magnitude of these replication costs is directly affected by your decision on the Quality of Experience (QoE) required from the backup site. Since the majority of content (by duration) is programs, your decisions on program currency and signal quality from the backup site will have the greatest impact on the required content storage capacity and the volume of transfer required each day.

Remote Control

Another logistical issue that is affected by backup location is the requirement for remote monitoring and control between the primary and backup sites. The required performance of this remote control (i.e., reliability, availability, responsiveness) is determined largely by the planned operational mode of the backup site. For example, a hot backup site requires remote control workstations at the primary site that provide the same level of full-time control for backup site systems as do local workstations controlling primary site systems.

At the other extreme, a cold backup site could be deployed without remote control or with “on-demand” remote control from the primary site, such as VPN over the public Internet.

While the most compelling need for remote control is for monitoring backup site systems from the primary site during normal (primary site) operation, the inverse case is also important and sometimes overlooked. In the event the primary site becomes uninhabitable but remains operational, such as might result from a chemical spill or biological threat, remote control of the primary site systems from the backup site is also needed.

The objective of these logistical decisions should be to support both the required readiness of the backup site and the ability to sustain backup site operation during long-term outages.

To reduce the resources required for storage and transfer of program content, business continuity plans often include reducing the quantity of current (i.e., new) programming maintained at the backup site by using some “evergreen” program content to replace programs that are not replicated. While the use of evergreen can reduce the resources required to maintain the backup site, its use also requires additional capability within the backup site systems to manage the insertion of evergreen programs into the transmission schedule. In a multichannel operation, the insertion of evergreen content into backup site schedules by manual editing quickly becomes unmanageable. To facilitate this process, the backup site transmission solution should include an automated insertion process for evergreen content.

For non-commercial interstitials (promos, IDs, PSAs, etc.) and secondary content (graphics, logos, VOIs, etc.), storage cost and transfer time are normally not significant factors since these items are typically much smaller than program content. More likely, the workflow cost of updating these content items at the backup site with the same frequency as the primary will determine their inclusion in the BCP. In other words, is the cost of keeping the backup site fully up-to-date with the latest interstitial and secondary content justified? Would weekly or monthly updates be sufficient?
With any of these decisions to limit the type of content to be replicated to the backup site, the process of selecting items to be included in or excluded from the daily transfer is not something that can be done manually. For this function, the backup site solution must provide an automated process driven by easily maintained “rules” for each channel. These rules need to accommodate multiple criteria such as:

- **Content Type**: “Replicate programs, commercial spots and station IDs, but do not replicate promos or PSAs”
- **Day-of-Week**: “Do not replicate syndicated programs on weekends”
- **Air Time**: “Do not replicate any programs scheduled to air between midnight and 6 am.”
- **Program Name**: “Always replicate episodes of Wheel of Fortune, but do not replicate The Jerry Springer Program”

A QoE decision to transmit a lower signal quality from the backup site (e.g., SD instead of HD) can also reduce storage cost and replication time. However, this decision usually makes sense only if the lower resolution copies of programs are already available, or the backup transmission system can do the down conversion in real-time. Otherwise, the equipment and staff time costs to convert HD programs to SD prior to transfer can offset any savings in backup site storage and transfer time.

The decisions you make on program currency, signal quality, interstitial currency and secondary content each have different effects on the above costs. For example, a decision to utilize evergreen program content at the backup site might reduce the cost of required storage, but increase the staff costs required to select programs to be replicated each day and to insert evergreen content into the backup transmission schedule.

### Sizing Content Replication Requirements

Once you have determined the volume, selection and frequency of content to be replicated to the backup site, you can use these requirements as part of the specifications for your BCP solution. Your content replication requirement can be quantified by answering four questions:

1. **Transfer Volume** – Based on the QoE required for the backup site, what is the maximum volume of content files (in gigabytes) that must be transferred each day? This volume is simply the total duration of content to be replicated daily, multiplied by the bit rate of the encoded content files.

   For example, if the daily requirement is to transfer 7 hours of recorded content encoded at 8 Mb/s, the daily transfer volume is:

   $$\frac{((7 \text{ hours} \times 3600) \times 8 \text{ Mb/s})}{10} = 19.7 \text{ GB}.$$  

2. **Replication Window** – How much time is available between the release of the next day’s schedule by traffic and the start of the transmission for that day?

   For example, if traffic releases the next day’s schedule at 5:00pm for the next day beginning at 6:00 am, the available replication window is 13 hours.

3. **Minimum Transfer Rate** - Using the Transfer Volume and Replication Window, determine the Minimum Transfer Rate (communications bandwidth) required for the daily replication of content.

   Using the examples above, this would be calculated as: $$\frac{(19.7 \text{ GB} \times 1000) \times 10}{(13 \text{ hours} \times 3600)} = 4.2 \text{ MB/s}$$

4. **Worst Case Transfer Rate** – Does some of your content arrive on the same day it must air? What is the worst case for a limited time available to replicate a program to the backup site before it is scheduled to air? In other words, what is the worst case combination of large program size (duration) and short available transfer time? You can determine this by comparing the ratio of program file size to available replication time among all late-arriving content.

   For example, if your worst case for late-arriving content is a one-hour program that is ingested and encoded at 8Mb/s by 12:30 pm each day at the primary site for airing at 1:00 pm, the interval available for replication to the backup site is 30 minutes.

   In this example encoded program file size of: $$\frac{(1 \text{ hour} \times 3600 \text{ seconds} \times 8 \text{ Mb/s})}{10} = 2.8 \text{ GB}$$

   must be transferred within 30 minutes, requiring a transfer rate of: $$\frac{(2.8 \text{ GB} \times 1000) \times 10}{(0.5 \text{ hours} \times 3600)} = 15.5 \text{ MB/s}$$

   While the late-arrival scenario doesn’t apply to all operations, if it applies to yours, the worst case transfer rate becomes your required bandwidth for content replication. Otherwise, the minimum transfer rate will define your bandwidth requirement.

In planning your inter-site communications, it is important to remember that the calculations suggested above are based on optimal performance of the broadband connection. Such performance is almost never possible in practice, so your actual bandwidth requirement should assume an efficiency of no more than 75 percent of optimal performance. In other words, plan on at least 33 percent more bandwidth for content replication than your calculations estimate you will need.
Operational Data Exchange

In addition to the transfer of content files, the operation of a backup site requires access to the same operational data used by the primary site. This includes the exchange of schedules and as-run logs with the traffic and billing systems, as well as content metadata exchange with any program management or other systems that manage content rights and acquisition.

An essential objective of the Business Continuity Plan should be to make any differences between the primary and backup transmission systems transparent to the planning systems. This means that your primary and backup transmission systems can use the same file and messaging formats for the exchange of operational data with your planning systems.

If your primary and backup sites use transmission systems based on the same automation system, you should be able to use the operating data from your planning systems interchangeably, with the exception of any schedule changes required for the insertion of evergreen content.

With different automation systems in the two sites, you have at least two options for normalizing the exchange of these operational data:

• Require that your traffic system provider and both automation systems providers support the SMPTE Broadcast Exchange Format (BXF) standard for the exchange of schedules, as-run-logs and content metadata.

• Require that the supplier of your backup site automation system support the data exchange formats already in use between your traffic system and primary site automation system.

BCP Solution Components for Replication and Data Exchange

To emphasize a point that has been suggested above: The processes of content replication and operating data exchange should be an integral part of your BCP solution. In other words, the solution components required for these processes should be an integral part of your backup site solution, not an extension to your primary site systems. There are two compelling reasons for this:

1. **Primary Site Stability** - Deployment of a BCP should not compromise the integrity of the existing primary site systems for content acquisition and transmission by requiring significant architectural or workflow changes to these systems. The first rule of BCP should be “Do no harm” – in other words, don’t risk the stability or performance of your primary site operation to support BCP.

2. **Content and Data Compatibility** - Since the objective of these processes is to deliver content files and operating data that can be used on short notice by the backup site transmission system, the seamless compatibility of these files and data with the backup site transmission system is paramount. The best way to ensure this compatibility is to include these processes in an integrated backup site solution along with transmission.

By requiring that your backup site solution include content replication and operating data transfer, as well as backup site transmission, you’ll avoid likely “finger pointing” among your backup site, primary site and traffic system solution providers.
BCP Solution Technology

Technology Options

Until recently, choosing a transmission solution for the backup site meant replicating or scaling down the solution already in use at the primary site. In other words, if the primary site used a conventional “transmission chain” consisting of a chosen mix of broadcast hardware (video servers, router, master switcher, DVE, logo inserter, etc) controlled by a separate automation system, the most obvious and simplest path for the backup site was to deploy the same proven and familiar solution. In the interest of minimizing the cost of backup, a common associated decision has been to eliminate some of the capability of the primary solution. For example, you might have decided that for the backup site, a “cuts only” playout sequence without squeezebacks was adequate, enabling you to save the cost of a master switcher and DVE at the backup site.

In the past few years, the trend toward IT-based solutions for broadcast applications has been accelerated by rapid advances in the performance of IT hardware. One result of this progress is a new option for the broadcast transmission chain – software/IT-based transmission systems.

In simple terms, a software/IT-based transmission system replaces most special-purpose broadcast devices -- such as video servers, master switchers, DVEs and logo inserters -- with software having the same capabilities. Moreover, this software is designed to operate on a standard IT client/server platform, using enterprise-class IT servers designed for high-availability applications such as banking and telecommunications.

Among the most significant advantages of this new technology — although not easily quantified — are the inherent flexibility and scalability of an IT-based solution. With all the functionality of the automated transmission chain contained in software, new channels and alternative channel mixes are available by simple software configuration and/or the addition of standard IT servers.

For a backup site, this new technology option has some compelling advantages as a transmission solution and should be evaluated based on the objectives your overall operation and specific business continuity plan.

Choosing a Solution

Evaluation of the available solutions for backup site transmission should include three considerations:

1. Technology Benefits

Which of the two available technologies provides the most benefits, while meeting the objectives of your business continuity plan?

- Replicate the primary site, conventional solution with the same or reduced functionality
- Deploy a new technology solution based on a software/IT-based transmission system

2. BCP Objectives

What are the major objectives for the backup site transmission system?

- Lower capital cost (as compared to primary site solution)
- Simplicity of operation, including primary-backup system compatibility of content files and operational data
- Low operational cost

3. Parallel Objectives

What other objectives (besides BCP) do you have for a backup site transmission system?

- Secondary DTV, mobile or specialty channel transmission
- Confirmation of new technology for future upgrade of primary site
Comparing the Benefits

Choosing a transmission system for your backup site that replicates your conventional primary site solution does eliminate some of the unknowns that a change in technology entails. With this approach, the hardware and automation software are known, and the cost of operation can easily be estimated using the primary site as a model.

Moving to a software/IT-based transmission system requires some staff training and revised workflows, but can provide both lower capital costs and a reduced cost of operation. With these cost benefits and the possible additional advantage of supporting your parallel objectives, a software/IT-based transmission system can be a compelling choice for your backup site.

As mentioned earlier, the compatibility of content files and operational data should be a requirement for the BCP solution with either technology, removing these two issues from the comparison of benefits.

The Transmission Chain Footprint

So far we’ve been comparing the operational and functional benefits of conventional and software/IT-based transmission solutions. Now let’s look at the impact of these two alternatives on the required backup facility and cost of operation.

In other words, how does the hardware required by a software/IT-based transmission system compare to a conventional transmission system of broadcast equipment and separate automation system with respect to required space and power consumption?

The diagrams below show the typical hardware and connectivity required by conventional and software/IT-based transmission chains for a single channel, including redundant playout resources. In the case of the conventional solution, redundancy is provided by dual video servers for mirrored playout of primary content (i.e., video clips). For the software/IT-based solution, redundancy is provided by dual “channel servers” for mirrored playout of all scheduled content, including such items as logos, stills, voice-overs and transition effects.
As you can see, there is a dramatic difference in the complexity of these two transmission chains in terms of the number of “boxes” and connections. In general, more boxes mean more rack space, more power consumption and more connections as potential points of failure.

Using these typical transmission chains, we did a detailed comparison of the space and power required for a mid-sized backup site originating 12 channels. This comparison uses the space (rack units) and power consumption of current models of widely-used broadcast devices (video servers, CGs, mixer/DVE, etc.) and of enterprise-class IT servers with redundant power supplies and internal RAID (disk) storage. As shown in the table below, the requirements for space and power are both significantly reduced with a software/IT-based solution as compared to a conventional solution.

The top half of the table above lists resources shared by all channels, such as the A/V router, automation framework (infrastructure), database servers and content storage. The bottom half of the table lists the required components for each channel, and then extends those for twelve channels.

The site totals at the bottom include both the shared and per-channel resources for the twelve channel installation and the percentage reduction in resources realized with the software/IT-based solution.

### Transmission Chain Space and Power Comparison

<table>
<thead>
<tr>
<th>Component Type</th>
<th>Conventional (Space (RUs), Power (Watts))</th>
<th>Software/IT-Based (Space (RUs), Power (Watts))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shared Components</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A/V Router</td>
<td>3 1,500</td>
<td>0 0</td>
</tr>
<tr>
<td>IRDs</td>
<td>3 1,500</td>
<td>0 0</td>
</tr>
<tr>
<td>Automation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automation Server (Note 1)</td>
<td>1 500</td>
<td>0 0</td>
</tr>
<tr>
<td>Framework/Database Server (Note 2)</td>
<td>1 500</td>
<td>0 0</td>
</tr>
<tr>
<td>Device Control Server</td>
<td>1 500</td>
<td>0 0</td>
</tr>
<tr>
<td>Operator Workstation</td>
<td>1 250</td>
<td>0 0</td>
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<tr>
<td><strong>Content Storage (8TB):</strong></td>
<td></td>
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<tr>
<td>Video Server Storage</td>
<td>3 340</td>
<td>2 680</td>
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<td>IT Storage</td>
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<td>1 345</td>
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<tr>
<td><strong>Shared Components Totals</strong></td>
<td>16 4,930</td>
<td>6 1,595</td>
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<tr>
<td><strong>Per Channel Components</strong></td>
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<td>Channel Server (Note 3)</td>
<td>1 500</td>
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<td>Video Server (Notes 4,5)</td>
<td>2 350</td>
<td>0 0</td>
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<tr>
<td>Master Control/Branding</td>
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<td>Character Generator</td>
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<td>Master Switcher/DVE</td>
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<tr>
<td><strong>Per Channel Component Totals</strong></td>
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<td><strong>Twelve (12) Channel Component Totals</strong></td>
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<td><strong>SITE TOTALS</strong></td>
<td>160 19,990</td>
<td>54 13,995</td>
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<tr>
<td><strong>Savings with Software/IT-Based Solution</strong></td>
<td>68%</td>
<td>30%</td>
</tr>
</tbody>
</table>

**Notes:**
1. For a conventional solution, each Automation Server is assumed to support four (4) channels.
2. For a software/IT-based solution, one Framework/Database server supports all channels.
3. Dual Channel Servers per channel provide full redundancy of all functions.
4. Each channel requires two video server outputs for transitions and DVE moves.
5. Dual video servers provide mirrored playback of primary video clips.

### Meeting Your BCP Objectives

Developing a business continuity plan that both meets your operational and cost objectives requires that you consider BCP in the context of your ongoing business, not simply as a current task to be completed. In the rapidly evolving environment of broadcasting today, BCP is an opportunity both to meet a current need and to position your operation for future requirements.

As with any decision process, the essential rule is to keep sight of your major objectives and their relative priorities. List your objectives for BCP and check that each decision you make supports them. Consider what new requirements are probable or possible in the next few years and ask how your BCP plan will support them or at least coexist with them. Be open to alternative solutions when they make sense for your operation.