White Paper

Broadband Gets Power Hungry

ALPHA TECHNOLOGIES

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Change is the only constant" is an oft-used but appropriate theme for the broadband industry. Changes and developments seem to occur almost daily, affecting everything from the business structure of the industry to the technology required to deliver new and enhanced communication services. Expanded video offerings such as pay-per-view (PPV) and video-on-demand (VOD), as well as internet access and telephony are regular topics of discussion. And while few would disagree that it's an exciting time to be involved in the industry, the volume and extent of change has created both opportunity and challenge.

System reliability is one of the most critical technological challenges facing today's broadband communication service provider. The world's communication infrastructure supports more business, entertainment and education than at any other time in history. Billions of dollars are transferred daily. Thousands of lives depend on the immediate and unquestioned forwarding of emergency response information. Data is retrieved and sent from one side of the globe to the other with hardly a thought of the sophistication of the delivery network.

It's no longer merely an inconvenience to have communication services interrupted. Downtime is simply not an option. Power disturbances—originating from either the utility provider or a secondary source— have been clearly identified as one of the most common causes of downtime. As a consequence, system operators are focusing on increasing the reliability of their standby power systems as a first step in efforts to improve overall system reliability.

Today's communication service customer cares little whether a power disturbance is caused by a spike due to lightning, a transient harmonic brought on by utility switching, or a sag resulting from increased single-point utility demand. It simply doesn't matter to the consumer if the problems can be traced to the utility provider, the environment, or the end-users themselves. The result is interrupted service to the customer caused by what may have been a very brief and very avoidable power disturbance. The service provider may get a nasty call from an angry customer—or worse yet— may never hear about the problem and simply lose the customer altogether. With this in mind, the responsibility of establishing a reliable source of clean, uninterrupted power shifts from the utility to the service provider—who in turn looks to industry powering experts for solutions.

But what determines reliable power? Reliable power begins with a power system designed specifically for the application. This commitment to application-specific technology must be carried all the way through to component specifications, manufacturing standards, operating efficiencies and maintenance programs. The key issue is technology appropriate for the application.

Technology continues to change and develop, and new technologies emerge. In the future, even more than in the past, broadband network designers will be faced with questions of appropriate technology. There may be a perceived need to consider new or alternative technology—perhaps smaller, lighter, cheaper. But do such proposals represent appropriate technology for the application? To answer this question, one must recognize the unique nature of broadband powering. Broadband power requirements are unique—very unique. Knowing the demanding characteristics of these delivery networks is essential to properly evaluating proposed solutions.

Nonstop Power

Uninterruptible power supplies (UPS) and systems were introduced to the broadband communication industry in the late 1980s. Until that time, traditional cable television content and its delivery system could easily accommodate the 8 to 12 milliseconds transfer time typical of standby power systems. Traditional telephony delivery systems had adopted UPS-grade power much earlier as a requirement to providing more critical voice services.

In recent years, as combined voice, video and data services emerged as the communications content of the future, it became very clear that even milliseconds of interruption in power could have serious consequences on digital signals. Power systems were developed to meet the extreme environmental conditions of broadband applications as well as the new requirements of seamless power transfer to and from system batteries that constituted the primary backup power source.

Today, UPS-grade power systems with backup power capabilities are a baseline requirement for broadband networks. The backup power component of these systems has also been dramatically improved, incorporating integrated engine generators, dual power grid switching and enhanced thermal battery management. Such improvements provide much longer backup runtime in the event of extended utility power outages as well as enhancing battery life— both contributing to improvements in the overall reliability of the network.

Making certain power remains constant during the transition from utility to battery, however, is not enough. Equally important is the nature of that power and the effect of the transition on power characteristics. Without output waveform control, unstable power can introduce frequency transients and other disturbances that can interfere with the signal and the operation of processing equipment.

The output waveform can be distorted when utility power is interrupted and the backup inverter takes over, but it can also be interrupted when transferring back to utility power. It is important that the power system have the capability to analyze the utility waveform to make certain it is stable before switching back to utility power. Then, when the transition is made back to utility, it is also important that power from the power supply's inverter is synchronized with the utility power waveform. Popular power supply circuitry thoroughly analyzes utility power and provides a synchronous, seamless transfer—from utility to inverter and from inverter back to utility—without compromising efficiency or battery life.

More Power

The increased number of communication service users and the added sophistication of the networks used to deliver these services, has resulted in a dramatic increase in power demand. Because power requirements and their associated costs are increasing, the power efficiency of each component in the system is carefully scrutinized by system designers. This is especially true of larger systems where efficiency losses can be high. Conservative estimates have shown that just a 5% gain in power supply efficiency when multiplied over 200 power supplies can result in an annual power cost savings of $50,000 per year—or $250,000 over five years. Many networks require far more than 200 power supplies, greatly increasing the importance of this consideration. It is clear that efficiency is an important criteria in power supply selection.

Full and Partial

While power supply efficiency has become a familiar topic, the issue goes much deeper than just a single efficiency rating. Broadband power loads are not constant. Telephony and other related communication services, for example, can double the power load during peak demand periods. Since it is unusual for a power supply to operate consistently at 100 percent load, it is important to evaluate efficiency in partial, full and even overload operating conditions.

One of the most important and unique characteristics of broadband powering is this high level of load variation. This condition, when combined with wide variations in utility input voltage typical of broadband applications, places additional demands on the power system. Wide differences in utility voltage can reduce the life of the power system and severely impact the reliability of the delivery network if appropriate provisions have not been included in power supply design. At the same time, broadband power supplies are subject to extreme load variations caused by changes in user demand as well as system startup demands. Appropriate power supply technology must effectively tolerate such load variances.

A wide input voltage window must be an integral part of effective broadband power system design. Power systems with a narrow input voltage window switch to batteries more frequently, reducing the life of both the power system and the battery. A wide input voltage window translates directly into longer battery and system life, especially in areas experiencing frequent reduced voltage brownout conditions.

Unlike other power applications, broadband systems are subject to unusually high peak demands. Appropriate power systems are designed to operate effectively up to 150 percent of normal demand, creating greater efficiency in system design and stable operation in short, peak demand conditions. A broad efficiency range ensures the lowest possible operating costs—even during these high-load conditions. This capability not only helps ensure reliable operation in extreme conditions, but also reduces capital costs by eliminating the need to "over power" a system to protect against outage in peak demand situations.

Summary

Broadband power requirements are unique. In light of recent and on-going industry developments, clean, quality power is needed with more reliability than ever before. Where analog technology once tolerated momentary power service interruptions, the complex, vulnerable digital stream is much more susceptible to power interruptions of any length. Knowing the demanding characteristics of these delivery networks is essential to properly evaluating proposed powering solutions.