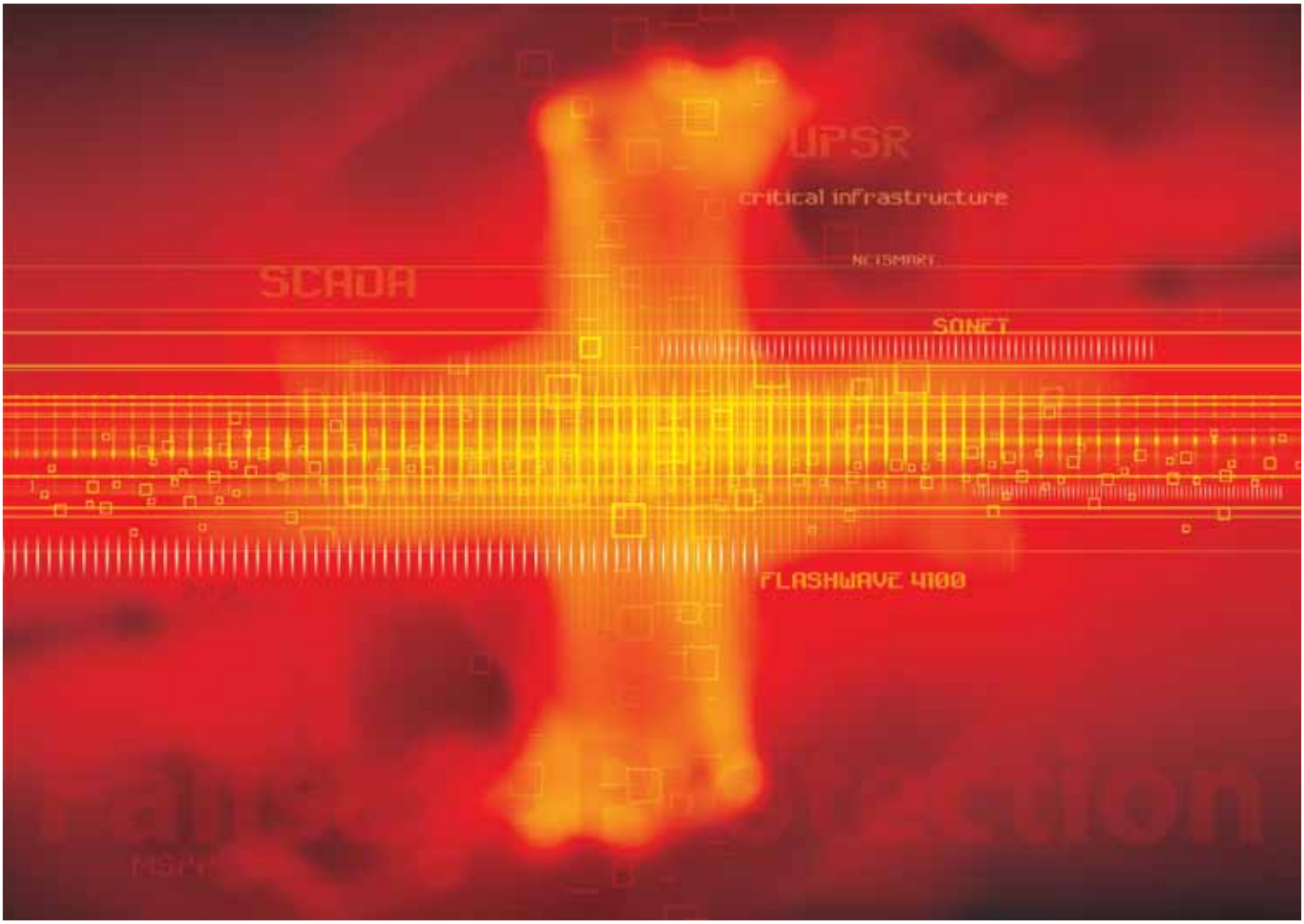
FUJITSU

Failsafe Protection for Utility Critical Infrastructure



Introduction

PUCs maintain a crucial part of the nation's CI that provide essential services to the public, business and government. Reliable CI communication networks are essential to safeguard not only transmission and distribution equipment but also utility company personnel.

Utility-specific applications such as SCADA, current differential, transfer trip, phase comparison and telemetering are an important layer of CI communications and must be part of a modern, reliable and self-healing network.

Substation automation using modern computerized devices to reduce intervention by personnel has caused a leap in the demand for bandwidth to substations. In addition, pressure to provide security has added urgency to the drive for ways to replace aging analog communications systems and reduce circuit leasing costs. Utility companies have begun the migration to reliable, high-capacity fiber optic systems based on the SONET standard.

According to *Transmission & Distribution World* magazine, "In the final analysis, ring-protected, SONET-based relay systems offer significant advantages, whether working in normal or protected mode. Compared to traditional PLC systems, SONET and fiber optics deliver the survivability and the performance needed to overcome concerns of multiplexed network relays and switching reliability—and put fears of failure to rest." [1]

Utility Critical Infrastructure Communications

Status and control circuits that connect SCADA RTUs to the MTU and transport communication links for transfer trip, current differential and phase comparison applications are critical elements to protect equipment, service and personnel.

These CI circuits are typically redundant and travel diverse routes (i.e., the primary circuit must be provisioned on a separate path from the secondary or back-up circuit). Some SONET vendors have marketed special provisioning features that allow utility companies to send identical copies of a DS1 signal over diverse routes simultaneously to ensure the continuity of SCADA and other critical data. All Fujitsu SONET products are able to support these "locked path" applications, however many newer types of data communication equipment require transport that cannot be efficiently supported in legacy SONET products.

The FLASHWAVE® 4100 MSPP and FLASHWAVE 4500 MSPP/MSSP systems address not only the needs of large telephone companies and enterprise customers, but also the unique needs of utility companies.

MultiService Provisioning Platforms

Many utility company applications are migrating from TDM-based circuits (e.g., DS1, DS3, and OC-n) to Ethernet protocols. Third-generation SONET systems that support both TDM and Ethernet transport, as well as associated services, are known as MSPPs. These MSPPs have the flexibility and feature content to address not only traditional applications essential to utilities such as teleprotection, SCADA and voice transport, but must accommodate new application demand such as Internet and Intranet access, SAN transport and video applications.

The Fujitsu FLASHWAVE 4000 family serves all of these requirements, including critical circuit protection needs unique to utilities. This system provides a number of protection schemes, including very fast path switching and path locking, that can be used for CI data while the network simultaneously transports other types of data using provisioning schemes that make the most efficient use of bandwidth for the data format.

Fujitsu FLASHWAVE 4000 Failsafe CI Data Protection Options

The Fujitsu FLASHWAVE 4000 family of MSPPs provides a portfolio of options that compliment SONET protection standards, thus giving the user the added flexibility to provision protection features unique to utility CI communication networks. The three high-protection diverse routing options recommended for CI TDM are:

- Non-revertive, UPSR-protected
- Revertive, UPSR-protected
- Unprotected, route-diverse with dual locked paths

These options offer the flexibility to provide for the unique design requirements associated with CI TDM circuits that have specific redundancy, diversity and delay requirements.

UPSR Networks

SONET UPSR networks offer an elegant and effective way to protect data being transported across any network where diverse routing is available, desirable and affordable. In this scheme, the input signal is split at the site where it is added to the transport network. One copy is sent clockwise around the ring, and the other copy is sent counter-clockwise. At the tail end, when that particular signal is dropped, two complete real-time copies of the information are compared. While one direction is provisioned as the working direction, both signals are constantly monitored for quality. If the working signal's quality drops below an acceptable level as provisioned by the network owner, the MSPP instantly switches to the hot-standby protected signal.

Unlike other diverse routing schemes, UPSR switching is based completely on the quality of the received signal. There is no delay because each channel is switched independently at the point where it is dropped from the main network. Switching is not based on signaling between NEs. Once the switch is enabled, the NE generates appropriate alarms to the network, but these alarms are not the basis of the switch.

Figure 1 shows a simplified UPSR application. The signal shown could be a DS1, DS3, or even an Ethernet circuit that is mapped into any SONET channel.

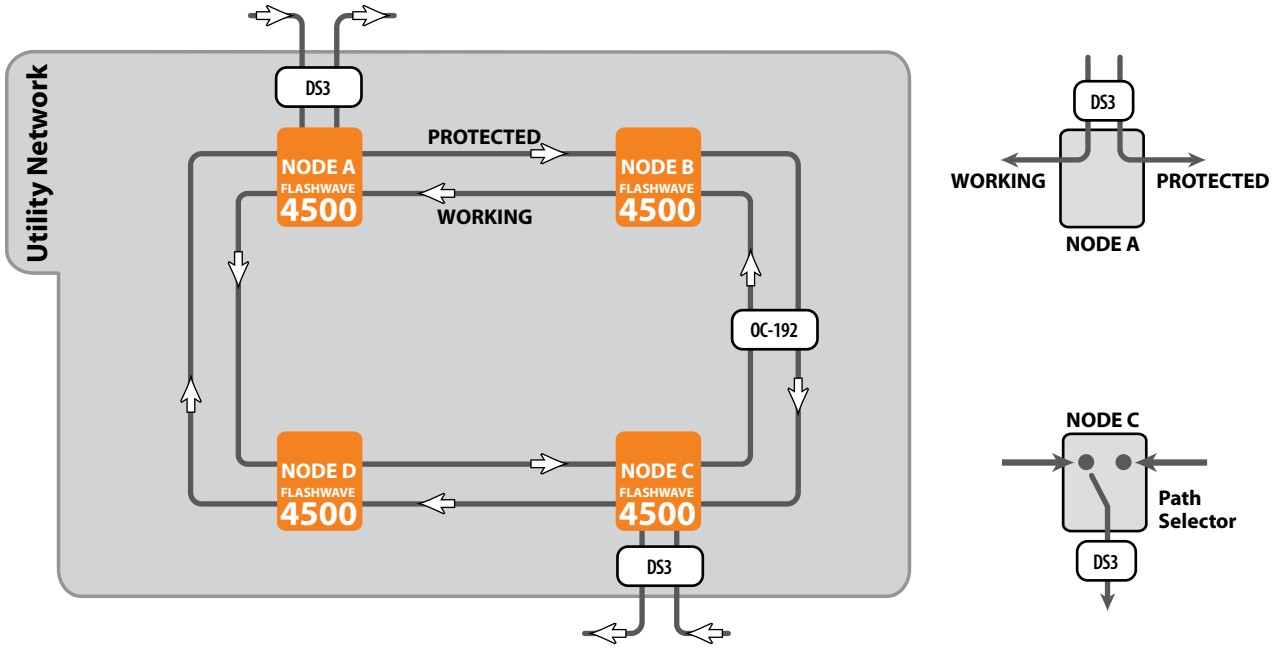


Figure 1: UPSR Traffic Protection

Under normal conditions, the primary and secondary CI circuits would be routed in separate and diverse paths as shown in Figure 1. In the event of a path failure or service degradation, the MSPP controlling the tail end of the circuit would detect a failure and switch to the diverse protection path within 1 ms.

With non-revertive protection switching, the primary circuit remains on the new path once the failure or degradation is repaired. Non-revertive protection switching eliminates any potential effect of a "return to normal" path switch. However, this type of protection can create a problem for utility personnel because upgrade or maintenance work might require technicians to be aware of which circuit is designated as "working." Using this scheme, each channel could potentially have a different working direction.

With revertive protection switching, the primary circuit will revert back to its original path after the failed or degraded path is repaired.

Locked Path Option

For some applications, neither of the two integrated path switching options may be desirable. For example, if the current system uses an external path selection switch that is an integral part of the SCADA system, external protection is not desirable.

The locked path protection feature of FLASHWAVE 4000 MSPPs allows primary and secondary circuits to be permanently locked onto separate and diverse paths under all conditions. The signal is split (duplicated) externally and each copy of the signal is fed into a separate interface. At the tail end, both channels are provisioned as "unprotected" and coupled to an external path selection device. This option locks out the previously described SONET protection switching on both the primary and secondary DS1 channels.

In the event of circuit failure or signal degradation, once the problem is repaired the primary circuit is restored to its original path.

Ethernet Protection

As additional CI applications migrate to Ethernet-based interfaces, redundancy and path protection become critical on these interfaces as well. Fujitsu FLASHWAVE 4000 MSPPs offer RPR over SONET capabilities. RPR provides the protection characteristics of SONET as well as the ability to classify Ethernet services into three distinct QoS classifications in order to maximize the bandwidth of the SONET system.

Unified OAM&P

The Fujitsu FLASHWAVE product family is managed by the NETSMART® 1500 NMS, a standards-based network management system that employs a simple GUI. The NETSMART 1500 NMS provides for point-and-click provisioning of traditional TDM services as well as broadcast and multipoint Ethernet-based services. The NETSMART 1500 NMS works with the auto-discovery features of the FLASHWAVE product family to make TDM circuits, RPR rings and SONET sub rings easy to manage.

Summary

Utility companies have unique requirements for their CI communications network. Fujitsu FLASHWAVE 4000 MSPPs provide a wide range of options and features that address these applications, including UPSR and locked path protection features for CI circuit and RPR protection in support of emerging Ethernet-based applications.

References

[1] Gardner, Terry N., "Power Networking," *Transmission and Distribution World*, February 1, 1998.

Acronym	Descriptor
CI	Critical Infrastructure
GUI	Graphical User Interface
ms	millisecond
MSPP	MultiService Provisioning Platform
MSSP	MultiService Switching Platform
MTU	Master Terminal Unit
NE	Network Element
NMS	Network Management System
OAM&P	Operations, Administration, Maintenance and Provisioning
PLC	Programmable Logic Controller
PUC	Public Utility Company
QoS	Quality of Service
RPR	Resilient Packet Ring
RTU	Remote Terminal Unit
SAN	Storage Area Network
SCADA	Supervisory Control And Data Acquisition
SONET	Synchronous Optical Networking
TDM	Time Division Multiplexing
UPSR	Unidirectional Path Switched Ring

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