WHITE PAPER

SINGLE-SYSTEM MULTISERVICE PROVISIONING PLATFORMS FOR COST-EFFECTIVE SERVICE DELIVERY AT THE CUSTOMER LOCATION

Redundant control-system architecture can provide 99.999-percent system availability. But for many organizations, using single-system, nonredundant common control systems with 99.99-percent availability for service delivery can provide a significantly accelerated return on investment (ROI) without adversely affecting network reliability.

Network availability is more important today than ever before. Users expect and need much more from networks than e-mail and file sharing, which were the primary requirements and applications of yesterday's applications. Today, enterprises maintain a multitude of mission-critical applications on their networks that drive their businesses: videoconferencing with partners, Web-based order entry, payment processing, customer relationship management, etc. Cornerstones to making operations much more efficient, these types of applications are critical to the viability and productivity of an enterprise. Meanwhile, these applications also create greater network complexity and make understanding "true availability" more difficult.

High availability (99.999 percent)—or just a few minutes of downtime a year—has been the traditional aim for service provider networks. The crucial concept is that availability is a factor of the network as a whole. Devices in the core, distribution, and access layers all have various levels of availability. In the core, networks have the fewest devices, the most traffic, and the largest number of customers serviced per device. At the edge, networks have the most devices, the least traffic, and the least number of customers per device. Finally, the overall service reliability for a single customer is the sum of the availability of the entire network that a particular service traverses.

The higher reliability in the core and distribution portions of the network is achieved with common control (for example, timing, cross connect, and synchronization processors) redundancy that permeates both areas in this network. However, for many organizations, using a single-system common control Multiservice Provisioning Platform (MSPP) is acceptable in the service-delivery equipment at the edge because it affects the fewest users and has no impact on the reliability for most users in the network. Optical protection and automatic protection switching (APS) protects the optical facility links with ringed and linear protection schemes.

SYSTEM AVAILABILITY

Several equations describe the basic concepts that define availability:

$$\text{Availability} = 1 - (\text{Total connection outage time})/(\text{Total in-service connection time})$$

or

$$1 - \text{Downtime}/\text{Uptime}$$

The definition of a connection is the successful data transfer from end device A to end device B, involving physical connectivity, link-layer protocol connectivity, and network-layer protocol connectivity. Some organizations choose to add a time factor to further define satisfactory availability. This overall number can be derived primarily from trouble-ticket reports on the network. However, overall availability does not provide much detail. You need to calculate availability for all the devices in your network, the paths, and perhaps the applications to determine the overall service availability.

Availability for devices can be expressed as the following equation for mean time between failure (MTBF) and mean time to repair (MTTR):

$$\text{Availability} = \text{MTBF}/(\text{MTBF} + \text{MTTR})$$

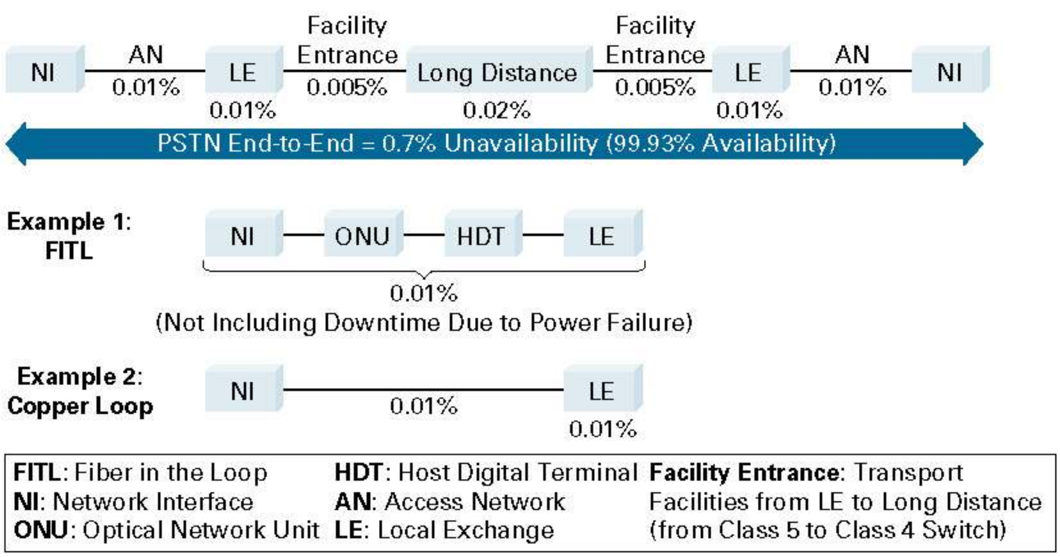
For example, if MTBF = 38,830 hours and MTTR = 6 hours for a type of Internet connection device, device availability would equal 0.999837116, or 99.9837116 percent. Essentially, this equation states that the availability of a device equals the MTBF for that device lessened by the MTTR, whose effect will be slight because the MTTR is quite small compared to the MTBF.

THE RIGHT AVAILABILITY FOR DIFFERENT PARTS OF THE NETWORK

Network design is a rigid hierarchy of core, distribution, and access, with the highest availability and resilience in the core. Redundant common control processors and redundant power inputs can provide device-level resilience—that is where 99.999-percent (or greater) reliability is required to ensure the most uptime for the most customers, across the fewest devices. This 99.99-percent availability on the customer delivery device has almost no significant impact on the availability of a delivered service as it traverses the network.

The classic availability objective for the public switched telephone network (PSTN) is to provide 99.99-percent availability. However, it must be noted here that this is not the end-to-end objective of the PSTN—this objective applies only to the access-network portion of the PSTN system. The access network is the subsystem that provides individual subscriber access to the actual PSTN (that is, connectivity between the subscriber and the local circuit switch).

Figure 1
PSTN Availability Reference Model



The PSTN reference model in Figure 1 indicates that the device(s) delivering services from the network interface (NI) to the local exchange (LE) may provide 99.99-percent availability and be acceptably in line with the comprehensive PSTN model of 99.93-percent availability.

The impact of total availability of a typical circuit being delivered by a redundant customer located MSPP device compared to a single-system, single system/non redundant MSPP is minimal (refer to Table 1).

Table 1. Single System/Non-Redundant MSPP vs Redundant MSPP at the Customer Location

	Single System MSPP	Access ADM	Access ADM	Access ADM	DCS	IOF ADM	IOF ADM	IOF ADM	DCS	Access ADM	Access ADM	Access ADM	Single System MSPP
Availability	99.9977%	99.999%	99.999%	99.999%	99.9999%	99.999%	99.999%	99.999%	99.9999%	99.999%	99.999%	99.999%	99.9977%
“Unavailability”	0.0023%	0.001%	0.001%	0.001%	0.0001%	0.001%	0.001%	0.001%	0.0001%	0.001%	0.001%	0.001%	0.0023%
Total “Unavailability”	0.014%												
Total Availability	99.986%												
Total Hours Per Year	8760												
Total Expected Circuit Hours Downtime	1.2												
	Redundant MSPP	**Access ADM**	**Access ADM**	**Access ADM**	**DCS**	**IOF ADM**	**IOF ADM**	**IOF ADM**	**DCS**	**Access ADM**	**Access ADM**	**Access ADM**	**Redundant MSPP**
Availability	99.999%	99.999%	99.999%	99.999%	99.9999%	99.999%	99.999%	99.999%	99.9999%	99.999%	99.999%	99.999%	99.999%
“Unavailability”	0.001%	0.001%	0.001%	0.001%	0.0001%	0.001%	0.001%	0.001%	0.0001%	0.001%	0.001%	0.001%	0.001%
Total “Unavailability”	0.011%												0.011%
Total Availability	99.989%												
Total Hours Per Year	8760												
Total Expected Circuit Hours Downtime	0.98												
Difference in Hours	*0.23*												
Difference in Minutes	*13.7*												

As indicated in Table 1, when considering the end-to-end availability of the network circuit and inversely the un-availability (the time in which system is not working properly) for multiple Add/Drop Multiplexers (ADMs), interoffice (IOF) ADMs and Digital Crossconnect Systems (DCSs) within the network the utilization of a single system MSPP vs. a redundant MSPP at the customer location can be evaluated.

Using an MTBF calculation of 99.9977 percent which is the *MTBF for the Cisco® ONS 15310-CL SONET MSPP*, the difference is less than 14 minutes in circuit availability if a single system platform is used at the customer location (CL), resulting in minimal effect on the overall end-to-end availability. *It is actually even less with actual end-to-end equipment MTBF with additional significant figures* (for example, 99.9977xxxxxx%, where x-more significant figures). With this minimal effect on overall availability, the service provider or enterprise customer can justify the economics of purchasing the lower-priced device while at the same time maintaining network service availability. This can provide substantial savings for service providers and enterprise customers—enhancing the ROI and extending the range of customer penetration.

SINGLE-SYSTEM MSPPS OPTIMIZED FOR THE CUSTOMER LOCATION

Metropolitan (metro) network architecture is complicated because it must incorporate platforms and interfaces for Ethernet, time-division multiplexing (TDM), and SONET/SDH, to name a few. In many instances, service providers and enterprise customers have built multiple networks for multiple services, a scenario that generally does not scale, is not flexible, and increases both operating and capital expenses. One convergence solution involves deployment of versatile integrated products that can deliver not only Ethernet, but also other protocols onto high-speed optical transmission systems. These multiprotocol or MSPPs aggregate or deliver TDM, Ethernet, and other services and channels them to OC-n/STM-n speeds.

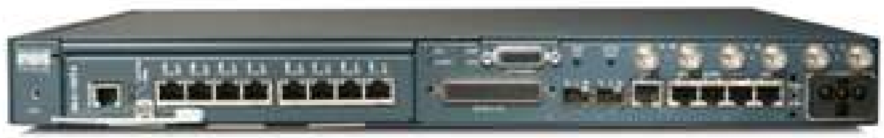
MSPPs are deployed at both the central office or hub location and the customer location. MSPPs deployed at the central office are used for aggregation, and at the customer location they are used for service delivery. Typical network architecture includes TDM and Ethernet delivery to customers connected over fiber to a central-office hub node aggregating the traffic over protected SONET/SDH transport from various customers. MSPPs with single system common control are optimized for the customer location to not only effectively deliver TDM, Ethernet, and other services, but also efficiently use limited space, use less power, and have a much lower price tag than larger redundant MSPPs (thousands of dollars less).

By using single-system MSPPs at the customer location, service providers and enterprise customers can obtain the economics of a single-system platform with 99.99-percent availability and continue to achieve high availability for the overall network.

OPTIMIZED MSPP: CISCO ONS 15310-CL

The Cisco ONS 15310-CL SONET Multiservice Platform (Figure 2) is an economical, 1-rack unit (1RU)-high provisioning platform optimized for use as the last network element, at the customer location, in a service provider's network or for use as an end node in enterprise or campus environments. The Cisco ONS 15310-CL takes advantage of the proven technology pioneered by the Cisco ONS 15454 MSPP, the industry's leading metro optical transport platform.

Figure 2
Cisco ONS 15310-CL SONET Multiservice Platform



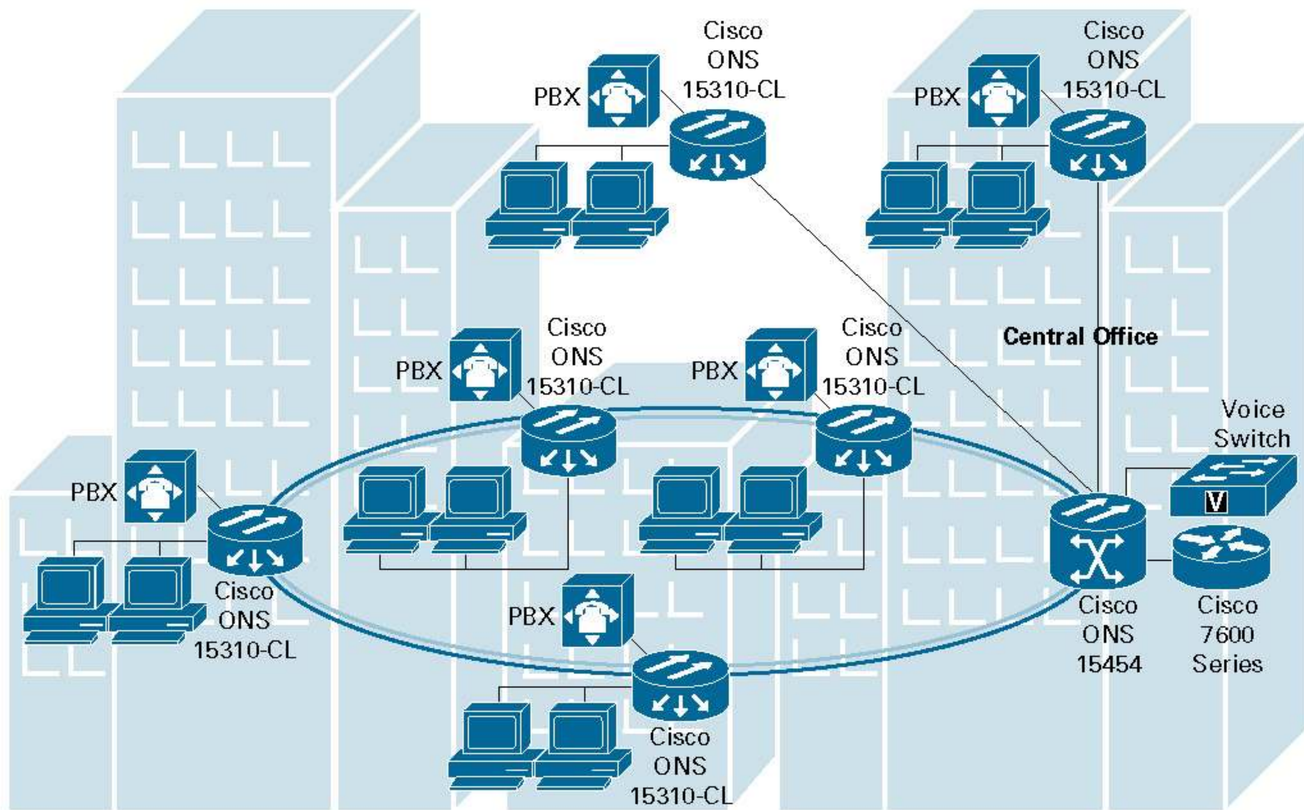
The Cisco ONS 15310-CL efficiently aggregates data, voice, and video services for transport. The platform effectively supports TDM and 10/100 Ethernet, and it provides integrated data-switching and cross-connect functions. Various data streams can be carried separately or together and transported in a one-for-one dedicated bandwidth mode or in a concentrated mode with no limit on the oversubscription ratio.

With the ability to transparently integrate into SONET networks and with an expansion slot providing the modularity to evolve with changing network needs, the Cisco ONS 15310-CL helps transform today's TDM-based transport networks into flexible, data-intensive superhighways.

Although many transport products claim to handle today's data and voice traffic, they lack the ability to provide effective bandwidth management for higher-speed, IP-based data services. Many of these platforms require significant setup time and are difficult to provision. The Cisco ONS 15310-CL offers optimized bandwidth for high-speed, IP-based data services, rapid service provisioning, and multiple optical interfaces through Small Form-factor Pluggables (SFPs) for flexible SONET networking. (Refer to Figure 3.)

Figure 3

The Cisco ONS 15310-CL Delivers Multiservices On Demand to the Customer Location and Metro Edge



For more information about the Cisco ONS 15310-CL, refer to: http://www.cisco.com/en/US/products/hw/optical/index.html.

REFERENCES

The PSTN reference model is derived from separate Telcordia specifications as follows:

- GR-499-CORE O2-16 specifies the subscriber-line availability as 99.99 percent. This specifies the access-network unavailability objective of 0.01 percent. The access-network objective covers up to the service provider's network interface, which is typically the point on the customer side where the network ends and the customer's wiring begins.
- GR-499-CORE O2-3 specifies the interoffice transport availability as 99.98 percent. This specifies the long-distance unavailability objective of 0.02 percent. The long-distance objective is assumed to include the Class 4 switch.
- GR-499-CORE O2-13 specifies an 80-mile DS-3 level facility unavailability as 26 minutes per year. This specifies the facility-entrance unavailability objective of 0.005 percent.
- TR-TSY-000512 sections 12.4.2, 12.4.3, and 12.4.6 specify the unavailability of the switching system as 53 minutes per year. This specifies the local-exchange unavailability objective of 0.01 percent. The local exchange is equivalent to the local Class 5 switch.

Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters
Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: 31 0 20 357 1000
Fax: 31 0 20 357 1100

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

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