

◆ Using Remanufactured Switching Equipment to Reduce Restoration Time in Case of a Disaster

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Product demand as a result of a single, large unforecasted event, like a disaster, is difficult to meet. This paper reviews the highly developed remanufacturing process of the 5ESS® switch. The ability to remanufacture existing surplus or pre-owned product assemblies allows for rapid response for network restoration initiatives because the main components exist in a pre-built configuration. © 2004 Lucent Technologies Inc.

Introduction

In 1996, the Special Customer Operations (SCO) business at Lucent Technologies entered into the 5ESS® switch used-equipment market primarily through the sale of circuit packs. During the latter part of 1997, the SCO remanufacturing scope expanded to include the remanufacturing and resale of 5ESS® wired equipment such as shelf units and cabinet assemblies. Today, the remanufacturing capability has the inventory and infrastructure to provide nearly all of the 5ESS® equipment required for full switch deployments. This capability includes hardware remanufacture only. Software and services are not part of the remanufacture model.

Remanufacturing is generally referred to as *recycling* by manufacturing *good-as-new* products from used products. *Remanufacturing* has become the standard term for the process of restoring used durable products to a “like new” condition [6]. Remanufacturing is the preferable recycling process as it conserves the added value that has been put into the product through its design and manufacture. Studies have shown that time criteria can be used to determine if a product should be remanufactured as opposed to reprocessed

in an effort to recover the natural resources. These same studies suggest that as long as the product lifetime (or wear-out life) exceeds the product life cycle (technology cycle), it is a good candidate for remanufacture [4, 6]. The 5ESS® switch meets this criterion. Customers are still operating 20-year-old 5ESS® switches in their networks with a significant step in the technology evolution of the hardware occurring approximately every five years. A study was done using the end-of-life design advisor modeling tool to determine whether reprocessing or remanufacturing would be the right strategy for the recycling of used 5ESS® equipment. This tool also suggests that remanufacture is the appropriate strategy to pursue [4]. As a result, if a several-year-old piece of 5ESS® equipment were acquired, it would have some value. It could be remanufactured and resold, and it could continue to operate in a customer’s network for many years.

The SCO organization commissioned an outside analyst in 1998 to conduct a study of the reseller market. This study concluded that the market size for used telecommunications equipment is in excess of \$1 billion and that one of the main drivers for the industry

is rapid delivery, which is generally unavailable through the original equipment manufacturer [3]. When equipment is requested in an emergency, generally it is “like for like.” Customers want equipment that is as close as possible to what they already have or what was lost and not necessarily the current vintage being manufactured. In addition, manufactured discontinued equipment is commonly requested and customers want the replacement product as quickly as possible. Natural and man-made disasters can devastate a business, and this underscores the importance of disaster recovery planning. Some in the industry advocate that an effective disaster recovery plan should provide for alternate sources of supplies. Businesses should not rely on a single supplier but rather establish alternate sources of supplies [5]. The SCO remanufactured 5ESS® equipment is considered by customers as an alternative source to new for 5ESS® equipment. Although not specifically designed for disaster recovery, the 5ESS® remanufacturing business model does fit this use. The support of disaster recovery initiatives on behalf of customers’ networks has become a side benefit to homeland security in the business model.

A study commissioned by the Alliance for Downtown New York, the Real Estate Board of New York, the New York Building Congress, and the Association for a Better New York stated, “Many of the 34,000 customers who lost telephone and Internet capability on September 11 didn’t realize how reliant they were on Verizon Communications Inc., which operates the largest telephone and data system in the city” [1]. Many equipment suppliers prioritized aid to Verizon and other customers in restoring their networks as quickly as possible. The SCO 5ESS® switch remanufacturing organization was heavily involved in the disaster recovery support of affected service providers. Out of all line items on orders shipped by the company for this disaster recovery effort, 1,274 line items, or 60% of the total, were supplied by the SCO business. Of these, 1,274 line items that were shipped, 1,216 line items, or 95.4%, were remanufactured 5ESS® product. The SCO 5ESS® switch remanufacturing organization shipped more line items for this disaster recovery than any other company

Panel 1. Abbreviations, Acronyms, and Terms

BC&DP—business continuity and disaster preparedness
CDO—Customer Delivery Organization
ESS—electronic switching system
FST—functional system test
SCN—Supply Chain Network
SCO—Special Customer Operations
WEEE—waste electrical and electronic equipment

operation. The 5ESS® remanufactured equipment support included 334 line items of equipment for one service provider and 938 line items for another. This support included circuit packs and wired equipment such as cabinet assemblies. In addition, the SCO operation has responded to other urgent requests for product as well. This includes inquiries for switching, transmission, and wireless equipment due to disasters caused by floods, earthquakes, and wildfires, and to outages due to lightening strikes.

In the days and weeks that followed the disaster on September 11, 2001, the company employed a modified version of its process used to respond to an outage in support of network restoration. Installation and sales teams worked with the customers to identify requirements needed for restoration. This information was fed to the supply chain that staffed the order desk around the clock and worked to procure the required product. Single points of contact, set up representing the various organizations within the company, were on call 24 hours a day, 7 days a week. All orders for equipment were expedited. Much of the order process was done on a “batch mode” (overnight). Orders were handled manually and the paperwork was done after shipment. This was outside the normal operational process. The customer’s requirements dictated whether the request was fulfilled by SCO or another source. The types of requirements fulfilled immediately after the disaster by the SCO 5ESS® remanufacturing group were largely for older technology within the customer’s vintage networks and for the redirection of product that was already in the process of being remanufactured. Most products were shipped the same day as the request was received.

The ability to remanufacture complex wired equipment products is the most substantial value-added advantage of the SCO 5ESS® switch remanufacturing capability. It is difficult for a reseller to fully duplicate these capabilities because the expertise exists within the original equipment manufacturer. The SCO remanufacturing organization has acquired trained resources and has transferred technology from the factory that produces new product for the single purpose of remanufacturing 5ESS® switching equipment, which allows the operation to work concurrently with regular operations when supplying products. The equipment is remanufactured to the latest factory specifications, functionally tested, packed, shipped, and warranted the same as new equipment.

Remanufacturing Model

The modular architecture of the 5ESS® switch differentiates it from all other competitors' switches and allows customers to protect their initial investment by growing their switch around existing equipment. This modular architecture consists of the basic building blocks of circuit packs, shelf units, and cabinet assemblies. The used equipment is generally acquired at the system level—i.e., the equipment acquired consists of fully configured cabinets complete with their complement of circuit packs within shelf units. The equipment is sent to the warehouse where it is sorted. Products are dispositioned upon comparison to a database that is populated with desired stocking levels. Products that have reached their desired stocking level are not received into inventory, but rather junked. Circuit packs are removed from each cabinet assembly and dispositioned per the sorting database. The basic building blocks of circuit packs are placed in inventory individually and made ready for sale. Depending on the type of product request, individual circuit packs can be shipped to fulfill a customer request. This can be done within the same day of receiving an order.

The wired equipment (cabinets with installed shelf units) is also sorted using the database. The wired equipment is further reviewed to establish its vintage. Experience has shown that there is little demand for older vintage cabinet assemblies equipped with shelf units. Therefore, these are generally broken down,

with the shelf units placed into inventory and the framing placed in inventory separately or discarded. A modest number of older vintage cabinet assemblies are placed into inventory in case of an emergency. Older vintage shelf units are also stocked individually and made ready for sale. The newer vintage cabinet assemblies (the ones for which recent history has shown a demand) are left in tact and placed into inventory in their wired condition. These pre-wired cabinet assembly configurations are entered into a database that allows viewing of the cabinet/unit layout. If a configured cabinet assembly is required, a kit of circuit packs is picked from inventory, paired with a pre-wired cabinet assembly, and sent into the remanufacturing shop to be configured per a specification from an engineering region. Assembly of a cabinet for shipping can be done in as little as one day.

Figure 1 is a process flow chart for ordering of 5ESS® remanufactured equipment from SCO. The flow chart starts at the upper left with an inquiry coming into the SCO 5ESS® remanufactured product planning team from a (sales) customer team or Customer Delivery Organization (CDO) manager within the Supply Chain Network (SCN) organization. The SCO product planning team reviews the used-equipment inventory per the request. If remanufactured equipment cannot be supplied, then the alternative is to offer new equipment built by the contract manufacturer. If remanufactured equipment can be applied, then the configuration is reviewed in detail at the network systems engineering practice level. If required, a business case is generated that incorporates the lower cost of the used product to calculate the improved profitability to the company. If, for some reason, remanufactured product will not be used, then the whole order will be sourced through the contract manufacturer if the product is rated generally available and not manufactured discontinued. If remanufactured equipment is to be used as part of the solution, then Engineering Services within the professional services organization generates the required specification and passes this information to the SCO product planning team. This information is then incorporated into a work order instruction intranet-based Web tool that passes the information to SCN. SCN's

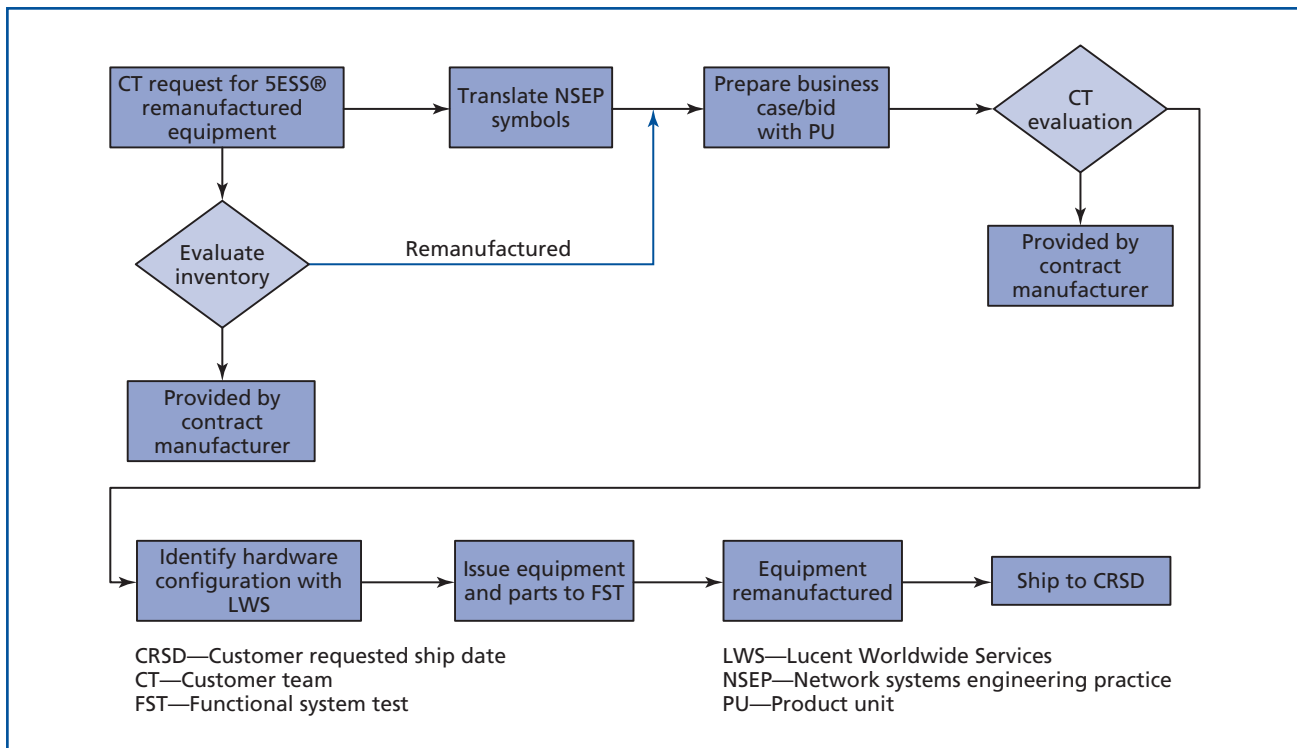


Figure 1.
5ESS® remanufactured equipment order process.

responsibilities include drawing the required equipment from inventory, reconfiguring it to match the current requirement in a functional system test (FST) shop, and shipping per the customer's requested ship date. The software is generated from the specification by the Network Software Center, just as it is for new equipment. Installation Services within the professional services organization does the installation of the remanufactured products at the customer site.

The above process and the flow chart in Figure 1 are in support of the standard ordering/quote process. In support of Homeland Security initiatives, the process in Figure 1 is streamlined. As a direct result of the attacks on the World Trade Center in New York and the Pentagon in Washington, D.C., each telecommunications equipment provider has to develop a business continuity and disaster preparedness (BC&DP) plan that includes actions to be taken during a service disruption. The company has responded by developing an internal disaster recovery team to assist each customer in network restoration in times of crisis. Each disaster recovery team consists of representatives from

sales, program management, engineering, installation, order fulfillment, customer technical support, and SCN. The SCO business is fully integrated into the SCN portion of this team. In addition, SCO is integrated into the SCN portion of the business continuity plan should a Lucent facility be affected by a disaster. In case of a disaster affecting a customer's network, Technical Support Services within the professional services organization works with the customer to identify the equipment hardware needed for network restoration. The professional services organization offers service providers a BC&DP capability in the form of a service to support their planning to protect their organization in the event that all or part of their network, operations, and/or computer services is rendered unusable. Once the service provider's needs are determined, the CDO/SCN organization supports the initiative by determining where the equipment should be sourced. The SCO used-equipment inventory is viewed by the SCN organization as an alternative source new equipment. In some cases, e.g., in the support of a network still equipped with vintage hardware, SCO inventory is

viewed as the only source. The order process shown in Figure 1 is streamlined. Any actions regarding business case preparation and customer team evaluation are skipped. The rapid delivery of product is paramount, and emphasis is placed on delivering the equipment under existing business agreements.

The equipment that SCO uses in its remanufacturing process is primarily on hand, which results in a short advertised delivery interval of 10 days for a circuit pack, shelf unit, or cabinet assembly. In cases of emergency, SCO has shipped circuit packs and shelf units from inventory the same day. This is in contrast to when a new solution is required. New equipment relies on accurate forecasting to a contract manufacturer. The contract manufacturer will build “just in time” to meet forecasted orders and, generally, will have minimal component inventory on hand to build more. The unforecasted demand for 5ESS® product is routinely fulfilled by SCO with remanufactured equipment. In the case of unforecasted demand due to an emergency like a disaster, only new material on hand to build an existing order is available to ship. In addition, in many cases the customer requires the replacement equipment in as short an interval as possible. Experience has shown that “like for like” is what is most desirable for integration in existing networks. This may include manufactured discontinued product no longer available from the contract manufacturer. In some cases, the customer is only looking for a workable solution. The equipment match to what the customer had may not be exact, but the used product from SCO may be close enough.

Business Integration

The SCO 5ESS® remanufacturing group currently has approximately 250,000 items in inventory. This remanufacturing business accounted for 13% of global 5ESS® switch hardware sales in fiscal year 2003. A dedicated staff of product planners with a technical background in 5ESS® switch technology supports the business. The product planners interface with all aspects of the order process, including sales, engineering, installation, and production and customer service. All product planners possess the expertise to field an inquiry from SCN, the professional services organization, or the sales team for a product

configuration, and they are able to respond if a suitable used product match is in inventory.

The used product inventory and reconfiguration work is done at the Custom Manufacturing Center in Charlotte, North Carolina. Remanufacturing is done in a dedicated 10,000 sq. ft. FST shop established specifically for the remanufacturing of 5ESS® switching equipment. This FST shop is run by the SCN organization for SCO. The FST shop contains four 5ESS® switches set up as test hosts. In fiscal year 2003, over 700 cabinet assemblies, 4,000 shelf units, and 70,000 circuit packs were processed through the facility. Doing the remanufacturing in a manufacturing center has the advantage of ensuring that the process will not be under the control of a contract manufacturer who might have other priorities or might be located overseas. This enables a quicker response time to domestic emergencies regardless of the nature.

In order to make remanufactured 5ESS® equipment available for sale, the SCO business must acquire it first. The mission of the 5ESS® remanufacturing group is in part to capture surplus equipment, thereby allowing the company to maintain brand quality, avoid price erosion, and minimize inventory assets. To fulfill this part of the mission, buyback opportunities that are considered strategic are identified. Strategic opportunities are defined as situations where customers have idle 5ESS® switching equipment that SCO believes has resale value and could be sold by the customer to another customer, thus competing with a new 5ESS® switch sale. The remanufacturing business works with all of the sales teams to identify such equipment before it is liquidated into the open market. Used equipment is defined as the equipment that was sold (where the title has transferred to the buyer) regardless of whether it was ever installed or carried traffic. SCO acquires equipment and circuit packs that currently are being manufactured (or that are manufactured discontinued) enabling an inventory to be maintained that can be drawn upon to fulfill customer orders. In addition to purchasing equipment outside of the company, the SCO business works very closely with the SCN organization to identify surplus equipment within the supply chain that can be used in the remanufacturing operation and with other internal

Table I. Lucent Technologies remanufactured product portfolio.

Circuit switching	Packet switching	Wireless	Transmission	Other
5ESS [®] switch 4ESS [™] toll switch 1A ESS [™] switch CNI XTSI	GX550 [™] multiservice WAN switch PacketStar [®] PSAX CBX500 [®] multiservice WAN switch B-STDX-9000 [™] WAN switch	Autoplex [®] series II Macrocell, series II M, series II MM, PCS CDMA minicell, and TDMA minicell, Flexent [®] modcell and CDMA distributed baystation	DDM-1000 DDM-2000 FT-2000 OLS DACS II DACS III-2000 DACS IV-2000 bandwidth manager [®] SLC [®] 96 SLC [®] series 5 SLC [®] -2000 AnyMedia [®]	CPE DIF datakit Stinger [®] DSL access concentrator power

CDMA—Code division multiple access

CNI—Common network interface

CPE—Customer premises equipment

DACS—Digital access and cross-connect system

DDM—Dual digital multiplexer line

DIF—Digital interface frame

DSL—Digital subscriber line

ESS—Electronic switching system

FT—Fiber transmission

MM—Micro-mini

OLS—Optical line system

PCS—Personnel communications services

PSAX—Packet Star[®] access

SLC—Subscriber loop carrier

TDMA—Time division multiple access

WAN—Wide area network

XTSI—Expanded time slot interchange

organizations to identify stagnant assets like retired lab gear.

In fiscal year 2003, about 40 of the company's customers purchased remanufactured 5ESS[®] equipment through SCO. These customers include major incumbent local exchange carriers, wireless service providers, and interexchange carriers. In addition to purchasing remanufactured 5ESS[®] equipment, many service providers purchase other product types of remanufactured equipment from SCO. These products include remanufactured wireless and transmission equipment. **Table I** shows the broad range of product lines and the large number of products for which SCO has a remanufactured product offering. Some of the product lines shown may be manufactured discontinued and others may be still in production. In addition, the level of product offerings varies from product line to product line, from just circuit pack support to full systems.

Conclusions

Lucent's SCO organization has developed a very successful 5ESS[®] switch remanufactured equipment capability. The SCO 5ESS[®] remanufacturing business has products in inventory at the modular

building-block level of circuit packs, shelf units, and cabinet assemblies. This building-block approach has demonstrated its value in being able to support major service provider needs for network restoration in catastrophic disasters. This was evident in the support after the September 11 disaster with a shortened delivery interval for generally available and manufactured discontinued equipment.

Homeland Security priorities demand that service providers across the country develop comprehensive BC&DP plans. These providers include public network equipment suppliers, network operators, and service providers. This SCO capability is aligned with the SCN organization both in the company's plan to continue operations if one of its facilities is impacted and in the support of the many customers whose networks may need to be restored.

In addition to disaster support, the 5ESS[®] remanufacturing group establishes a method to exert some control over what 5ESS[®] product is available on the reseller market. To accomplish this, the SCO organization works with the sales teams to acquire products for resale before a customer liquidates the asset on the open market.

Some in the industry believe that remanufacturing is the wave of the future. The proper disposal of waste electrical and electronic equipment (WEEE) directive [2] was initiated around 1998 by the European Union member countries as well as Norway and Switzerland. It states that when telecommunications equipment is displaced, the company that is displacing a competitor's equipment or its own equipment must take back the equipment and properly dispose of it within the WEEE guidelines. The SCO business has been involved in this initiative since early 2000. When a product is displaced, the SCO organization is engaged to decide whether it can be remanufactured and sold or whether it needs to be reprocessed. This is the model for the future.

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