Agilent Technologies

Operations Support Systems (OSSs)

Definition

The term *operations support systems* (OSSs) generally refers to the systems that perform management, inventory, engineering, planning, and repair functions for telecommunications service networks.

Overview

Originally, OSSs were mainframe-based, stand-alone systems designed to support telephone company staff members in their daily jobs. Essentially, these systems were designed to make the manual processes through which a telephone network was operated more efficient. Today's service providers, however, are required to manage a much more complex set of services and network technologies in order to remain competitive. As a result, new generations of OSSs are being developed—using state-of-the-art information technology—to address enterprise data information management. These systems make a company's information a more accessible and useful resource for managing the business, providing services, and delivering extraordinary customer care.
This tutorial focuses on the current and near-future states of OSS technology and its development to support emerging and hybrid network technologies. Note that the tutorial focuses only on the service-management layer of the telecommunications management network (TMN) model. Refer to the Web ProForum TMN tutorial for a complete discussion of this model.

Topics

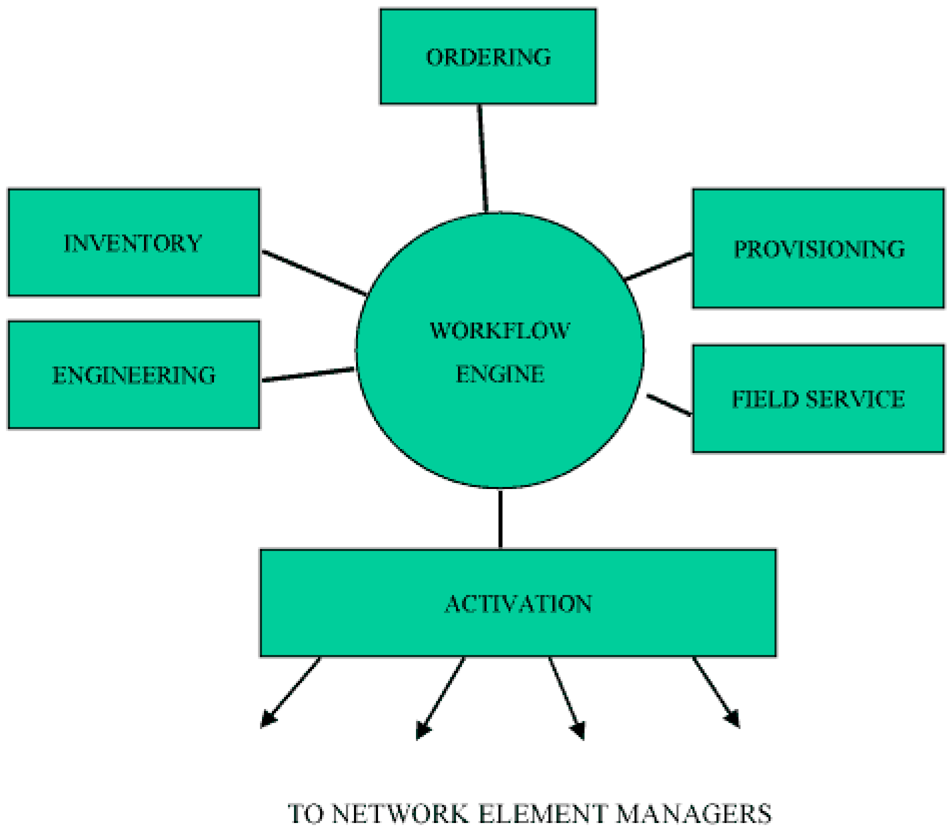
Correct Answers

Glossary

1. The Basics of OSSs

The easiest place to start a discussion of OSSs is with the fundamental systems in the ordering process for any-voice services provider. The process flow from placing an order for service to activating that service on the network leads through workflow, ordering, inventory, circuit design/engineering, provisioning, and activation systems.

Figure 1. Process Flow



Workflow Engine

A workflow engine is generally at the heart of an integrated OSS infrastructure. It can be built in any number of configurations utilizing any number of technologies, but its purpose is generally the same regardless. The workflow engine manages the flow of information from system to system, essentially checking off the tasks associated with any process as it goes. Some OSS vendors package workflow engines with their systems whereas other vendors specialize in workflow. Workflow systems are sometimes telecom specific, but just as often they are general information technology products that can function effectively in any environment from telephony to financial services to manufacturing. The workflow engine's utility, again, is managing and coordinating interactions between integrated systems.

Ordering

The ordering system is where all the information necessary for providing service is entered into a service provider's systems. These services range from basic, residential plain old telephone service (POTS) lines to complex services such as channelized tier 1s (T1s)—high-capacity pipes carrying voice and data traffic, integrated services digital network (ISDN), asynchronous digital subscriber line (ADSL), and more. Modern ordering systems generally utilize a graphical user interface (GUI), which guides order takers or customer-care representatives through the ordering process for any number of services. These systems also incorporate some default data common to each service a provider offers to ease the keystroke burden on those entering orders. Ordering systems also perform a certain amount of error checking to notify users when required data has been omitted or invalid data has been entered in order to maintain overall process integrity and stop faulty or incomplete orders from being passed on.

Once an order is entered, the system generates specific tasks that must be completed to activate service on the network. The ordering system passes these tasks on to other systems, which in turn update the ordering system as they complete each task to provide a current status report for each service order. The workflow engine generally supervises these tasks, ensuring that each system performs its specified function in the proper sequence and within established time parameters.

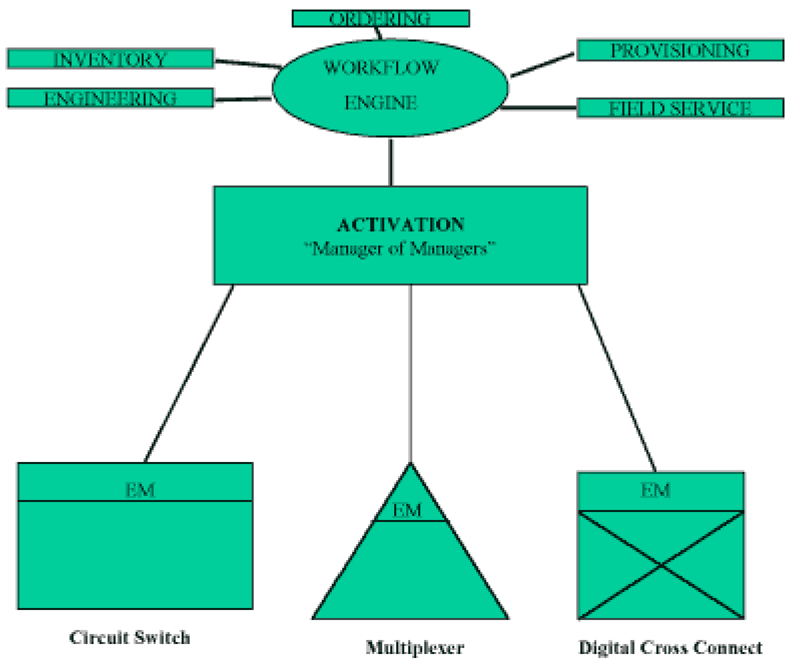
Inventory

In the inventory system, a carrier stores all its information regarding the facilities and equipment available on its network. To process an order, the inventory system must be queried to determine whether or not the requested service can be supplied. Is the proper equipment in place, or must new equipment be installed? Are the proper facility circuits—the high-capacity circuits that provide backbone transport—already assigned, or do they need to be configured?

Circuit Design/Engineering and Provisioning

These systems manage and track the equipment and circuits that physically provide service and that must be assigned for eventual activation. Often referred to as design and assign, they basically involve specifying which pieces of equipment and network routes a given service will utilize. For example, if T1 service is requested, channels, ports, cards, and circuits must be assigned on any combination of M13 multiplexers, digital cross-connect systems, T3 facility circuits, or synchronous optical network (SONET) channels and network routes connecting carrier network locations to the end user. Network locations are identified by a Telcordia Technologies (formerly Bellcore) standard, eight- or eleven-digit common language location identifier (CLLI) codes. For example, a CLLI code of PLANTXXAH01 would indicate a SONET shelf at the "A" designated end office located in Plano, Texas. Similarly, exchange carrier circuit identification (ECCKT) codes identify specific circuits.

Figure 2. CLLI Code



EM: Element Manager

A current trend for design-and-assign systems is to incorporate graphical tools that allow a system user to create services on a network map with point-and-click capability rather than either drawing maps by hand or relying on an abstract set of equipment identifiers displayed in a table.

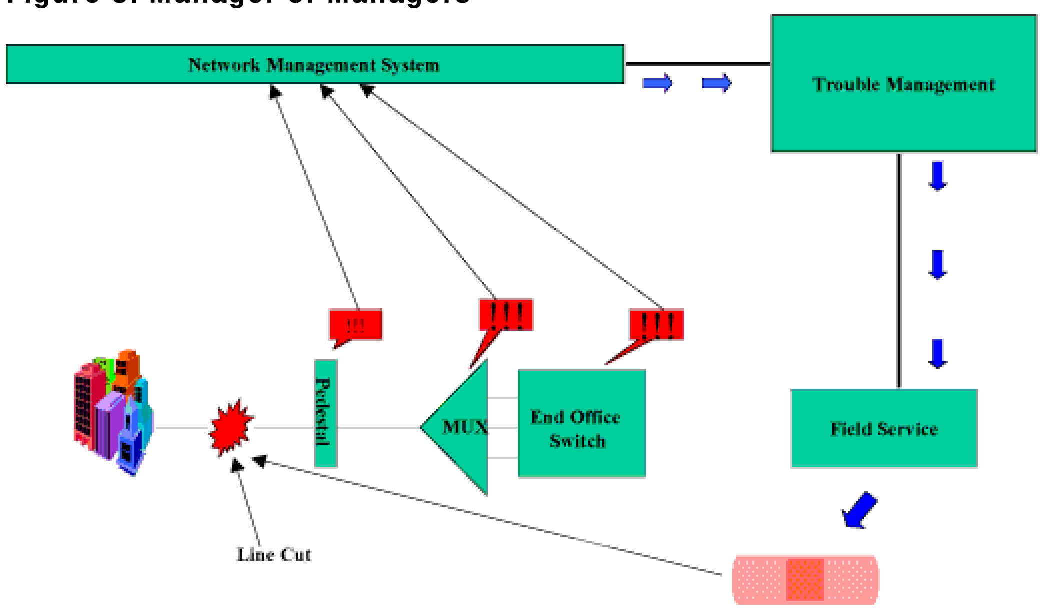
Element Management and Activation and Field Service Management

Once the previous tasks are accomplished, service can be activated on the network. Activation requires several steps. If new equipment or lines must be installed, or if equipment or lines must be configured manually, a field service–management system must be notified so that technicians can be dispatched. Field service systems must not only notify technicians of the service being installed but also of the specific equipment involved and where it is located. For example, services provided to a large office complex must be associated with a building, floor, network, closet, and perhaps a certain equipment rack within that closet.

Some activation can be performed automatically. Today's service providers are working toward enabling flow-through provisioning and activation, combining provisioning and activation systems to allow order and design-and-assign systems to issue commands to an activation system. The activation system then automatically activates service on the proper network elements (any piece of network hardware, such as a switch, multiplexer, or cross-connect system).

Current network elements are generally designed with an intelligent element manager built in that can receive and execute commands sent by activation systems. Element managers also can feed equipment status data back to upstream systems for network- and trouble-management functions. Element managers use protocols such as common management information protocol (CMIP), transaction language 1 (TL1), or simple network management protocol (SNMP) for traditional data equipment to communicate with activation and other systems. An activation system often acts as a manager of managers, overseeing and communicating with a number of various element managers and equipment types.

Figure 3. Manager of Managers



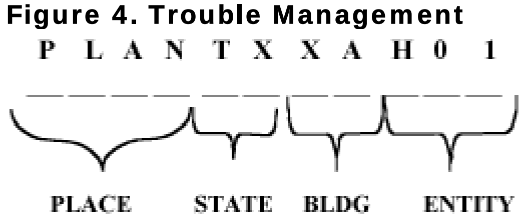
Network and Trouble Management

OSSs certainly go beyond service activation. Two critical elements of any OSS infrastructure are network- and trouble-management systems. Network-management systems are responsible for the overall supervision of a network. They monitor traffic traversing the network and collect statistics regarding performance. They also are responsible for spotting trouble on a network and identifying the cause. Network-management systems are the heart of a network operations center (NOC) and are often known for the graphical network displays projected on large screens on the walls. Network-management systems utilize protocols such as SNMP and CMIP to communicate with network elements.

Network elements are designed to provide varying levels of self-diagnosis. While older elements might simply send an alarm to supervisory systems announcing a problem, newer, more intelligent elements are often designed to provide more precise trouble messages. A problem in a network, such as damage to a fiber-optic line or switch failure, can result in a chain reaction where many network elements along a certain path, or along multiple paths, will produce alarms. Network management systems are generally designed to correlate these alarms to locate the source of a problem.

Once the system identifies trouble, it passes information on to a trouble-management system that logs the problem and issues a trouble ticket to begin the repair process. Some network elements have enough intelligent routing capability built in to automatically reroute network traffic around problem areas. Where this is not the case, trouble spots must be identified to allow human operators to reroute traffic. A trouble-management system in an integrated OSS environment can send commands to the appropriate systems, such as field service management, to dispatch technicians who physically repair equipment.

Figure 4. Trouble Management



2. OSS Interconnection

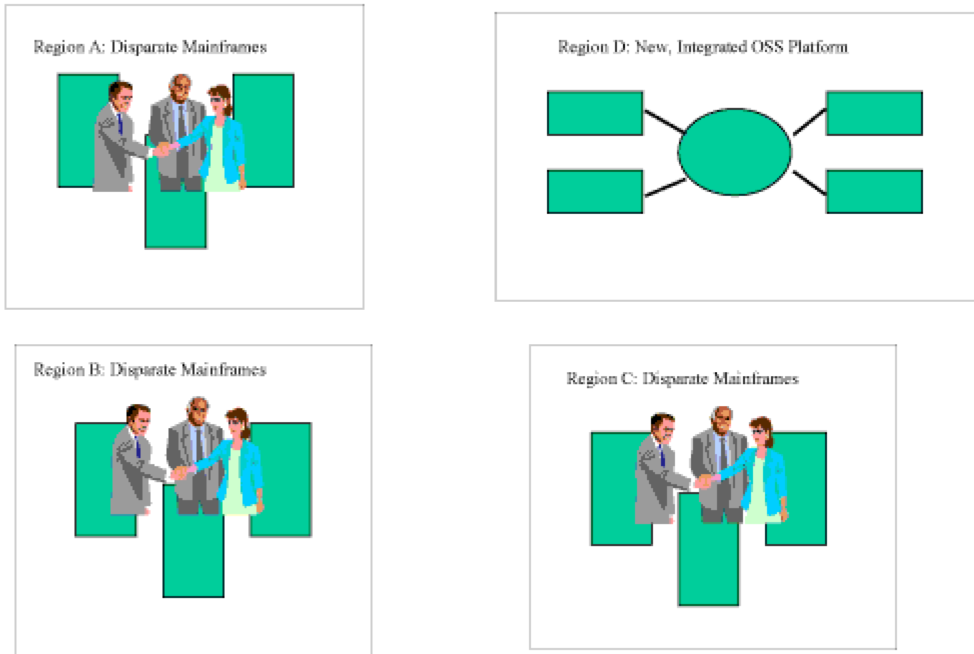
Regulations

A critical portion of the Telecommunications Act of 1996 and its associated orders deals with OSS interconnection. Regulations require the regional Bell operating companies (RBOCs) to allow competitors limited access to their customer databases and various OSS functions, such as preordering, ordering, and provisioning. (Preordering is the process by which a competitive local-exchange carrier [CLEC], with permission from the customer, requests data regarding that customer from an RBOC.) The Federal Communications Commission (FCC) has made it clear that RBOCs will not be permitted to enter the long-distance business until, among other things, they create access mechanisms that both state regulatory commissions and the FCC deem sufficient to enable competition. RBOCs and incumbent local-exchange carriers (ILECs) have built or are building interfaces into which a CLEC can connect its systems. This is an extremely difficult and time-intensive task, one with which the industry has wrestled for several years. In the meantime, carriers often rely on manual means, such as phone calls and faxes, to exchange customer data and service orders. Manual processes are highly error-prone and slow—insufficient for a truly competitive environment.

Interconnection Challenges

The first problem RBOCs face in enabling interconnection is integrating their own OSSs. A large number of RBOC OSSs are stand-alone mainframe systems that were never intended to be integrated or accessed by anyone but the RBOCs. Often referred to as legacy systems, they were designed to assist people in their daily jobs. Most RBOCs are conglomerations of many smaller local phone providers and are still in the process of consolidating, integrating, and eliminating their legacy systems. These systems cannot be easily replaced, however, due to both the cost and time involved in such a large-scale project and the fact that these systems are critical to everyday RBOC business processes. RBOCs are working steadily, though the process is innately slow, to replace their older systems with modern, integrated OSS packages.

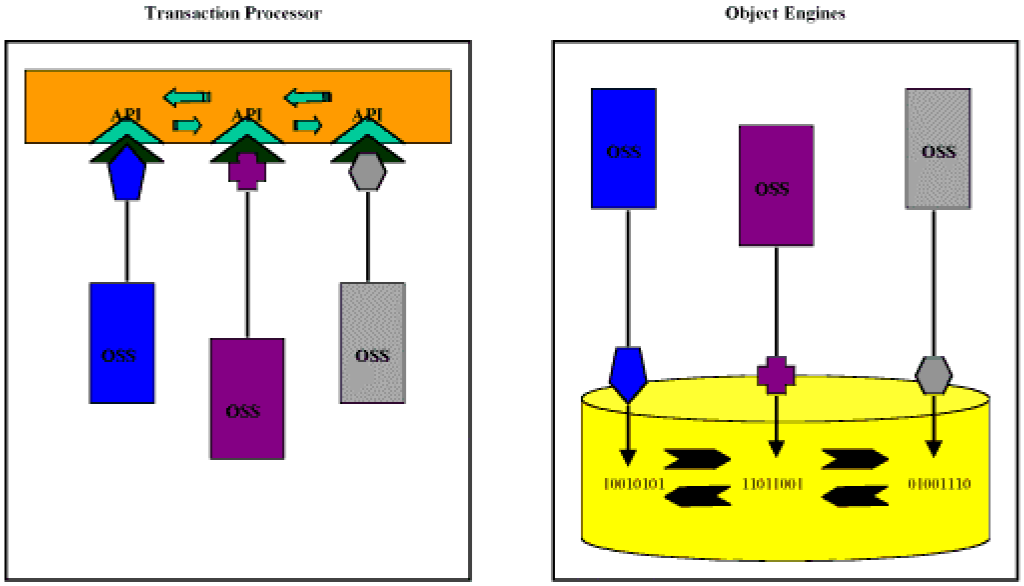
Figure 5. RBOC Legacy Environment



RBOC legacy systems do not have sufficient security mechanisms to partition customer data—in other words, to keep RBOC customer data separate from CLEC customer data. Additionally, external interfaces must be added on to these systems to allow integration with surrounding systems. Without such integration, functions such as flow-through provisioning are impossible to enable. These systems also must be able to respond to commands coming from an interconnection gateway in order to fulfill CLEC data requests.

There are many conceptual and technological approaches to legacy systems integration. These approaches involve technologies such as middleware, transaction processors (TPs), workflow systems, and object engines. *Middleware* is a term commonly applied to any integration technology, and it is often used interchangeably with TP. These technologies present a common application programming interface (API) into which a system can be integrated to manage data translation and exchange among disparate systems. Workflow systems often work hand in hand with TPs, providing multiple, dynamic APIs and managing data flow and task sequencing while the TP handles data conversion. Object engines use technologies such as the Object Management Group's (OMG) common object request broker architecture (CORBA) or Microsoft's distributed component object model (D–COM). Object engines abstract application interfaces into definable, flexible software objects that allow applications to communicate in a uniform manner through the engine itself.

Figure 6. Integration Technology



While RBOCs work to integrate their systems and make them accessible for CLECs, they also must develop their interconnection interfaces and integrate their systems and business processes with them. Because there is no industry standard or consensus about how this should be accomplished, RBOCs often rely on technologies they already utilize for information exchange with large customers and interexchange carriers (IXCs). Once again, these technologies are often older and not necessarily intended for tasks such as CLEC interconnection. They often make the most sense economically for RBOCs, however, because a large amount of code is already in place. The most common protocol being used for interconnection is electronic data interchange (EDI) but in various versions. EDI was originally designed to enable the exchange of business documents and is now being used mainly for ordering and preordering.

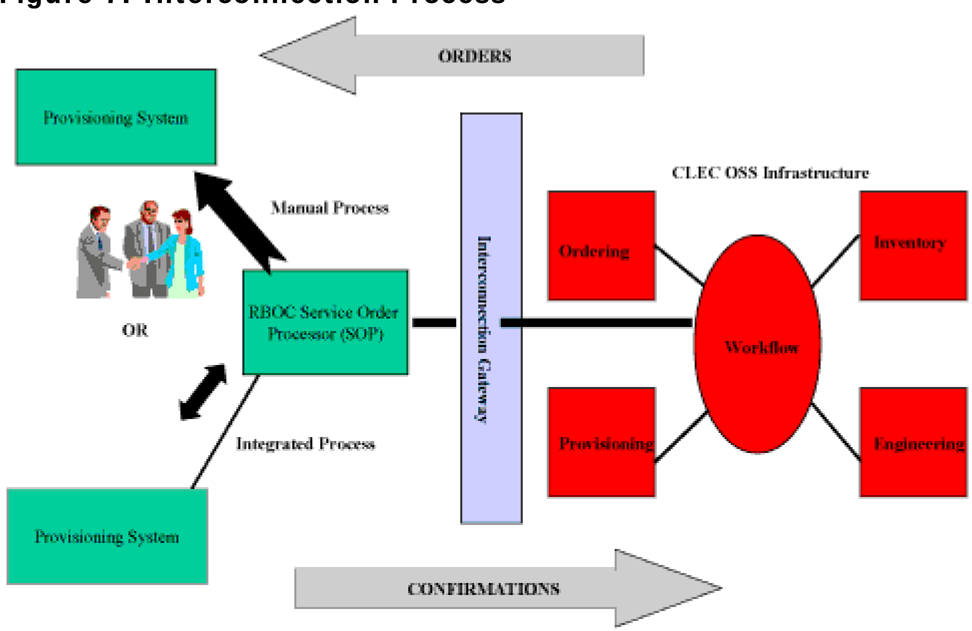
Gateway Functions

Many vendors have brought to market flexible gateway products intended to help CLECs develop the interfaces necessary for interconnection with RBOC OSSs. The TeleManagement Forum, an industry organization devoted to the implementation of telecom standards such as the Telecommunications Management Network (TMN), has led an initiative to develop guidelines for a common interconnection gateway platform (CIGP). The goal of the CIGP is to apply vendor-neutral, industry-common technologies to OSS interconnection in order to assist CLECs in developing interconnection interfaces. Most of the vendors that have developed gateway products have been involved in the CIGP initiative.

A gateway's primary function, as mentioned above, is to manage the interfaces between CLEC and RBOC OSSs. Gateways handle data integrity and security between carriers as critical customer and service data is exchanged. One of the most important aspects of a gateway, however, is to perform error checking on service orders as they are passed across carrier boundaries. With manual processes, a CLEC often sends service orders to an ILEC or RBOC that end up lost in a pile of faxes for several days. When orders are finally attended to, they are rejected if they are incomplete or somehow erroneous—a common occurrence because orders can be rejected for simple typographical errors. They are only then returned to the CLEC for reprocessing. This adds days and even weeks to the ordering process. A gateway can reduce these errors by reviewing all orders before submission to the ILEC, returning any erroneous orders for instant review.

Another critical function of a gateway is to facilitate the preordering process. In this process, the CLEC secures permission from a potential customer to obtain its data from the ILEC. This data consists of a customer profile, outlining all the service provided to the customer. This data is often transferred in the form of universal service order codes (USOC). These codes are cryptic, and there are thousands of them. In a manual process, a CLEC customer representative must flip through a large catalog to determine the services provided and to build sales quotes for similar offerings. Again, this is an extremely time-intensive process. New gateway software can read these codes and match them to a CLEC's product catalog database to automatically generate product offerings and sales quotes, making the CLEC customer-acquisition process far more efficient.

Figure 7. Interconnection Process



3. Operations Support of Data Services

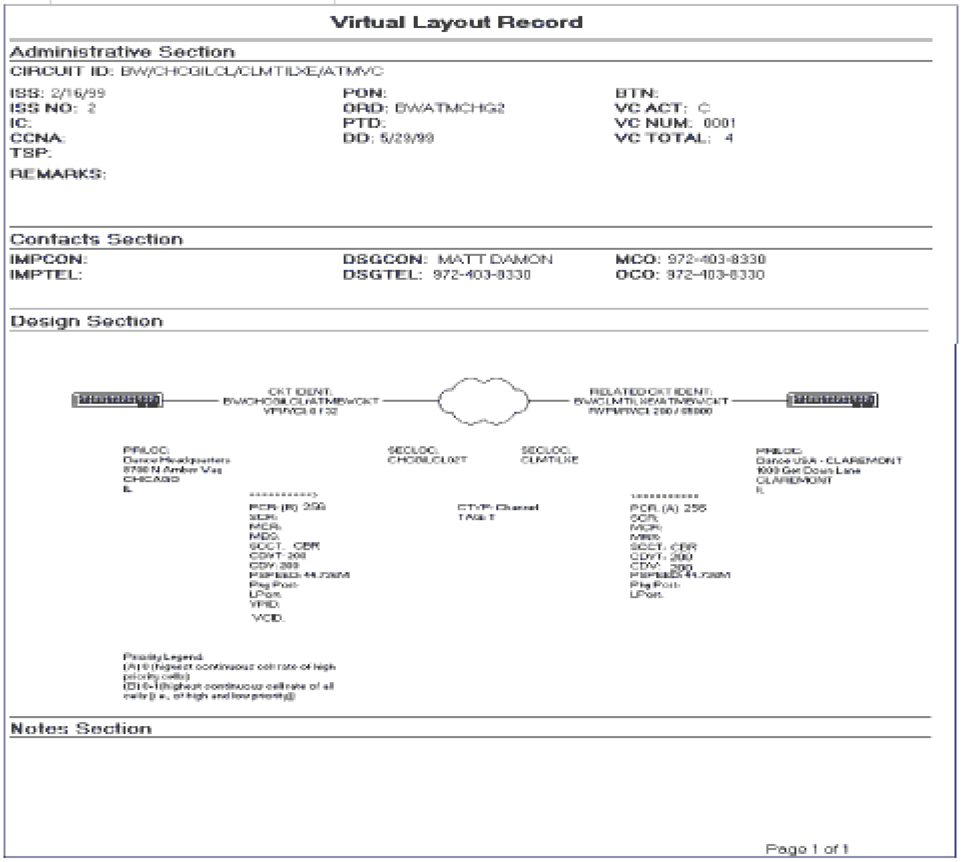
As complex as the OSS infrastructure for a wireline network is today, it will only become more complex as new network technologies are introduced to the carrier environment. Packet technologies, such as Internet protocol (IP), frame relay (FR), and asynchronous transfer mode (ATM), are becoming increasingly prevalent in the public network. While service providers have been managing FR and ATM for several years, the demand for more feature-rich services has necessitated reworking OSSs to support the complexities of service-level-agreement (SLA) management, usage-based billing, and flexible quality-of-service (QoS) parameters.

IP, the technology that drives the Internet, is developing into a carrier-grade technology that will enable a mix of voice and data services to be more advanced and widely available than has ever been possible before. Like ATM and FR, IP services are demanding support to ensure high QoS. Two major hurdles must be overcome to meet that goal. First, service providers must adopt QoS that can map to both connection-oriented and connectionless protocols. They also must address the integration of an IP–address management system.

Data Service Provisioning

Assuming a service-management perspective for offering data services, the service provider defines the bandwidth access circuits for the A and Z locations and the bandwidth for the QoS, service category parameters, or both as they relate to the particular permanent virtual circuit (PVC). After provisioning the equipment, the provider defines a virtual layout for the field to use for the actual mapping of the virtual circuit (VC) to the equipment.

Figure 8. Service-Order Work Request



Virtual Layout Record

Administrative Section

CIRCUIT ID: BW/CHCGILCL/CLMTILXE/ATMVC

ISS: 2/16/99
ISS NO: 2
IC:
CCNA:
TSP:

PON:
ORD: BWATMCHG2
PTD:
DD: 5/29/99

BTN:
VC ACT: C
VC NUM: 0001
VC TOTAL: 4

REMARKS:

Contacts Section

IMPCON:
IMPTEL:

DSGCON: MATT DAMON
DSGTEL: 972-403-8330

MCO: 972-403-8330
OCO: 972-403-8330

Design Section

Notes Section

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Data Service Activation

As end-to-end automation is becoming the norm, the ability to pass the virtual layout to the network-management layer (NML) for activation is necessary. This involves using an NML manager to activate the appropriate equipment. Understanding the service provider's network is key to this process because service providers cannot activate a PVC for an endpoint that is not under their control.

Advent of Broadband Access

Broadband-access technologies also are having a huge impact on a service provider's OSS. Digital subscriber lines (xDSLs) and cable modems are currently the leading data-access technologies most likely to be deployed in the United States.

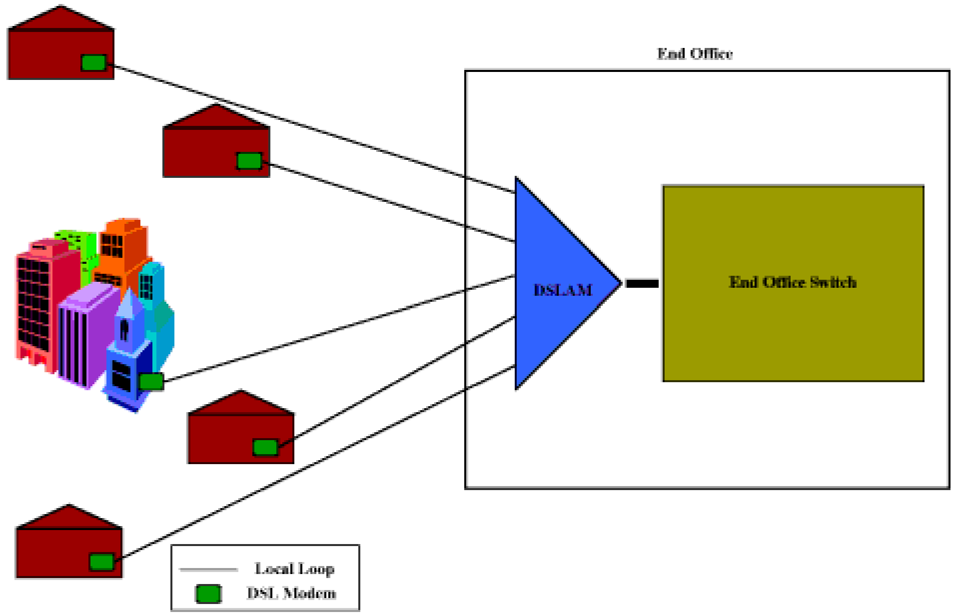
The xDSL technologies that enable existing local loops (the copper wires that connect end users to the public network) to carry higher-capacity data streams than common analog-modem technologies come in several flavors. They also permit simultaneous voice and data streams to travel over the same wire pair. Having accurate records of their copper infrastructure is a major concern for incumbent service providers. Service providers that are Internet service providers (ISPs) or CLECs also have major concerns about getting access to unbundled loops and a clear communication path to the incumbent provider.

A central office (CO) must incorporate two new components to enable xDSL technologies: a splitter and a digital subscriber line access multiplexer (DSLAM). The splitter simply distributes the voice traffic to the POTS network and the data traffic to the DSLAM; it is expected that the splitter will largely become obsolete as the demand for an all-in-one box increases. The DSLAM communicates with the xDSL modems installed at the end-user location and aggregates multiple xDSL streams into a switch for transport on high-capacity circuits using various multiplexing schemes. It is managed and maintained much like other end-office equipment, but most installed OSSs do not yet support the technology. xDSL modules must be added to older OSS systems to enable automatic provisioning and management of xDSL services. The splitter simply distributes the voice traffic to the POTS network and the data traffic to the DSLAM.

The new xDSL technology has several core functions that the existing OSS should support. For example, the DSLAM and splitter, while specific to xDSL technologies, are very similar to a service provider's existing equipment (i.e., routers and switches) in terms of equipment inventory. Supporting customer premises equipment (CPE), on the other hand, may be a new challenge for the service provider. However, providers with a managed service offering may find they also can handle the CPE network aspects.

The more complex scenarios for broadband access involve incorporating VCs along with voice services. OSSs traditionally have not viewed an xDSL as capable of providing this type of service. One approach is to handle the cable pair as a channelized T1 circuit capable of handling both voice and data circuits. The scenarios typically encountered range from only offering xDSL on the cable pair, with no voice service, to offering a small office with multiple users an xDSL solution involving voice channels as well as several VCs that each have differing levels of service (such as an analog phone, a PVC for Internet access, a PVC to corporate headquarters, and an Internet phone connection).

Figure 9. DSLAM



One of the problems with xDSL technologies is that they are susceptible to a number of network pitfalls. For example, local loops that are equipped with special noise filters or load coils will filter out the frequencies at which xDSLs operate, rendering them ineffective. Additionally, some services can create interference on xDSLs. If an xDSL loop rides in the same bundle as a loop delivering one of these services, the xDSL service can be disturbed. Also, some older copper wires, installed years ago, are simply insufficient to support the service. Some RBOC regions lack detailed line records that can inform service providers of potential problems because line records are kept on spreadsheets or even by hand and are not updated accurately. A strong network-inventory system is thus critical to the effective deployment of xDSL services.

4. Business Impact of an OSS solution

Service providers are constantly striving to differentiate their businesses from those of their competitors through superior customer service and rapid time-to-market for new products and services. A powerful OSS solution can help service providers meet these goals while controlling their operating costs.

Quality of Service

In its simplest terms, QoS is a measure of the telephone service quality provided to a subscriber. This measurement can be very subjective, and the ability to define it depends upon the technology being used. For example, ATM and FR technologies were designed with multiple grades of service delivery in mind, but

IP technology was not. IP is, however, the leading technology for enabling next-generation telecommunications services. Unlike the circuit-switching technology that makes up the public voice network, IP networks are connectionless. Circuit networks utilize dedicated, 64 kb connections to support service delivery. This provides high-quality service because only the traffic for a specific session can utilize the dedicated network path, but it also is bandwidth inefficient. If two people on a voice call are not speaking, bandwidth goes unused. In a world where time is measured in milliseconds, even a half-second of dead air is an enormous waste of resources. An IP session can utilize multiple paths to complete its delivery and only uses as much bandwidth as it needs, allowing traffic to mix on network paths in order to maximize bandwidth usage. The downside of IP telephony, however, is that its best-effort delivery model does not guarantee delivery of packets in order, in a timely manner, or at all. Therefore, acceptable quality levels must be maintained in order to successfully deploy real-time applications over IP networks. Solutions include using virtual private networks (VPNs) and IP over ATM.

Data Warehousing

Measuring QoS compliance requires having access to accurate and timely data. While traditional OSSs may be adequate for the service provider's day-to-day operations, they lack the ability to provide these vital performance metrics. New OSSs, on the other hand, can quickly and efficiently access historical data by taking advantage of data warehousing technology. Data warehousing consists of storing information from disparate systems in a central repository or a single database and then carefully managing this data to ensure its integrity. Management can draw upon this wealth of information when access to the latest business intelligence is necessary, not only for QoS analysis but also to analyze market trends and adjust product strategy accordingly.

Operational Efficiencies

In order to be successful, an OSS solution must mirror the service provider's business processes. Most OSS solutions today are considered commercial off-the-shelf (COTS) applications. While these packages do not offer pure off-the-shelf functionality, they are designed to be customized to fit how a company does business. For example, a sophisticated OSS solution will offer work management capabilities that enable users to maintain provisioning plans that manage the flow of work and information within their unique organization.

The Importance of Flexibility

Given today's dynamically changing marketplace, flexibility also is of utmost importance in an OSS solution. A technology-neutral OSS is built upon an architecture that supports both current and new technologies, enabling service providers to respond immediately to business changes, whether these changes stem from marketing decisions, new technologies, or regulatory requirements.

5. Conclusion

Ideally, an OSS's architecture enables work to flow electronically across the organization, providing visibility to the processes and resource utilization. It also should enable the service provider to manage the end-to-end service delivery process that often involves more than one type of order or transaction across the organization, as well as with other service or network providers. Most important, this software should be available in a single solution, eliminating the complexity of dealing with a variety of systems. If a service provider cannot achieve this goal due to complex OSS requirements, the provider should carefully select best-of-breed vendors offering proven, integrated solutions.

Self-Test

1. Which of the following is a function of a workflow engine?

    a. to provide network repair information for field service technicians

    b. to prompt customer-care representatives to sell specific service packages

    c. to facilitate communication and task sequencing among various OSSs

    d. to draw graphical network maps for capacity planning

2. A CLLI code is a Telcordia Technologies (formerly Bellcore) standard code used for _____________.

    a. identifying specific circuit paths

    b. identifying network locations

    c. identifying a customer's long-distance carrier

    d. transmitting fiber-optic signals

3. Which of the following is not a protocol used for communicating with network elements?

    a. CMIP

    b. SNMP

c. TL1

d. TMN

4. All network elements are equipped with built-in intelligence that will reroute network traffic around trouble spots.

   a. true

   b. false

5. Legacy systems are _________.

   a. systems created from parts of other systems

   b. any RBOC OSS

   c. older, stand-alone mainframe systems common to ILECs

   d. systems used to interconnect LEC OSSs

6. OSS interconnection is mandated and a critical factor in determining ILEC entry into long-distance markets.

   a. true

   b. false

7. Interconnection gateways often perform error-checking functions to help speed the ordering process.

   a. true

   b. false

8. Which of the following is not an inhibitor to DSL deployment?

   a. DSLAMs cannot be housed with circuit switches.

   b. Some lines carry load coils and filters that can negate DSLs.

   c. LEC line records are often inaccurate.

   d. Services riding adjacent lines can interfere with DSLs.

9. IP guarantees time and delivery sequence for all packets on a network.

   a. true

b. false

10. Data warehousing provides quick and easy access to performance metrics.

    a. true

    b. false

11. If Mickey is a mouse and Donald is a duck, what is Goofy?

    a. a dog

    b. a dawg

Correct Answers

1. Which of the following is a function of a workflow engine?

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    See Topic 3.

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    b. false

    See Topic 4.

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    See Topic 4.

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Glossary

ADSL
asynchronous digital subscriber line; current technology that enables digital, high-capacity, and simultaneous voice and data transmission over copper local loops; called asynchronous because it utilizes a higher-capacity channel going to the user than coming from the user

analog modem
a device designed to transmit and receive signals over regular telephone lines, most common method for accessing the Internet today

API
application programming interface

ATM
asynchronous transfer mode; a switching technology that packages voice, data, or video traffic in fixed-length cells and incorporates variable QoS parameters

circuit switch
the network equipment that controls all traffic routing in the traditional voice network by establishing point-to-point circuits connecting network locations; a normal voice call is provided a dedicated 64 kbps circuit, which is multiplexed onto a higher-capacity circuit for switching and transmission throughout a circuit-switched, voice network

CLEC
competitive local-exchange carrier; a new class of local voice service providers that compete with the former local carrier monopolies; often called new entrants or emerging carriers

CLLI™
common language location identifier codes; a system devised by Telcordia Technologies (formerly Bellcore) for identifying locations and equipment in a telephone network

CMIP
common management information protocol; an advanced protocol used to send and receive information to and from network elements

CIGP
common interconnection gateway platform; an initiative led by the TeleManagement Forum to develop a technology-neutral standard model for the design of OSS interconnection gateways

CO
central office

CORBA
common object request broker architecture

COTS
commercial off-the-shelf

D–COM
distributed component object model

DSLAM
digital subscriber line access multiplexer; a multiplexing system used to aggregate digital subscriber line traffic before transmission across a network

ECCKT
exchange carrier circuit identification

EDI
electronic data interchange; a data transfer technology originally designed for the automated exchange of business documents; also one of the predominant technologies currently used for automated exchange of service orders between CLECs and ILECs

facility circuit
a high-capacity carrier circuit from which serving circuits are assigned

FCC
Federal Communications Commission

FR
frame relay; a switching technology, mainly used for data transmission, that uses variable length frames to package and send information

GUI
graphical user interface

ILEC
incumbent local-exchange carrier; the former monopoly local service provider in a given region; all RBOCs are ILECs, but not all ILECs are RBOCs

IP
Internet protocol; a best-effort routing technology that uses packets to package and send voice, video, or data traffic; the underlying transmission technology that enables the Internet

ISDN
integrated services digital network; a 1970s digital subscriber line system, still in relatively wide use today, that enables digital, high-capacity, simultaneous voice and data transmission over copper local loops

ISP
Internet service provider

IXC
interexchange carrier; commonly known as a long-distance carrier

legacy systems
common term for the older vintage systems often employed in carrier back offices

M13 multiplexer
a type of network equipment that multiplexes multiple T1 circuits onto a T3

multiplexing
the general practice of aggregating and combining lower-capacity traffic streams onto higher-capacity carrier circuits

NML
network-management layer

NOC
network operations center

OMG
Object Management Group

OSS
operations support system; system that directly supports the operations of the telecommunications infrastructure

POTS
plain old telephone service

PVC
permanent virtual circuit

QoS
quality of service

RBOC
regional Bell operating company; also known as the baby Bells; the once seven, now five, companies that were divided out of the old Bell system and until recently held local telephone monopolies in most of the United States (Bell Atlantic, BellSouth, Southwestern Bell, U S West, and Ameritech)

SLA
service-level agreement

SNMP
simple network-management protocol; the protocol most commonly used for data network element management

SONET
synchronous optical network; a North American standard for fiber-optic voice transmission technology, equipment, and network architecture

T1
a digital transmission link with a capacity of 1.544 Mbps (1,544,000 bits per second)

TL1
transaction language 1; a predominant control protocol, in use for many years, for issuing commands to voice network elements

TMN
telecommunications management network; a set of standards, originally presented by the International Telecommunications Union (ITU) and further developed by the TeleManagement Forum, that provides architectures, protocols, and interfaces for building standardized OSS applications and infrastructures

TP
transaction processor

USOC
universal service order code; the codes used to identify specific services offered on the voice network; critical to the preordering process; thousands of such codes exist, and they are rarely uniform from region to region

VPN
virtual private network