CMR
INSTITUTE OF
TECHNOLOGY

USN

Sub:	Digital Switching Systems								Code:	
Date:	/ 05 / 2017	Duration:	ECE	Max Marks:	50	Sem:	8		Branch:	

Marks

1 a) Explain the organizational interfaces of digital switching central office. — 5

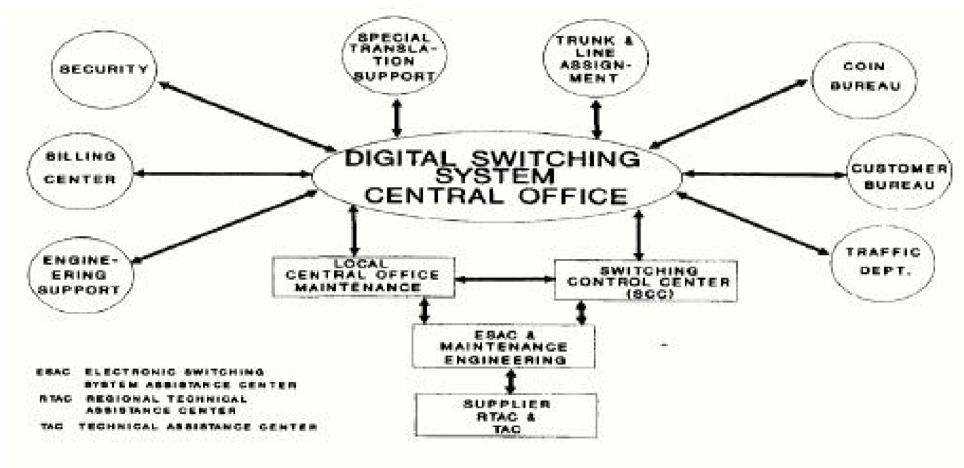

Figure 7.1. Organizational interfaces of a typical CO

Interfaces of a Typical Digital Switching System Central Office

Most of the common interfaces needed for a digital switching system central office are shown in Fig. 7.1. The maintainability of a CO depends on satisfying the needs of all these and other interfaces. A group of COs is usually assigned to a switching control center (SCC), in the Bell Operating Companies environment, but local maintenance personnel are also involved in maintaining COs. The next level of maintenance is assigned to the electronic switching system assistance center (ESAC) in parallel with the maintenance engineers. Maintenance engineers are not involved with daily maintenance but oversee resolution of recurrent maintenance issues. The ESAC organization usually controls generic upgrades, patching, operational trouble reports (OTRs), and interfaces with the supplier's regional technical assistance centers (RTACs) and technical assistance centers (TACs) to solve unusual and difficult maintenance problems. Note that this is only a typical arrangement and will vary with telephone companies and switching system products. But most telephone companies support different levels of digital switch maintenance. These other departments interact with a digital switch:

	- *Engineering support:* This department writes specifications for a new digital switch and engineers' additions to the existing CO. This department also interfaces with the supplier's engineering department, CO plant department, and traffic department with the objective of issuing accurate engineering specifications for a new digital switch installation or addition. - *Billing center:* The billing center is responsible for processing automatic message accounting (AMA) or billing tapes from a CO to produce customer bills. Currently, billing information can also be transmitted directly to the billing center. - *Security:* This department provides security services for the digital switching system to prevent unauthorized entry and fraudulent use of the telephone service. - *Special translation support:* This group provides support in establishing unusual translations for COs that provide special services for large corporations with complete call routings, trunk translations, etc. - *Trunk and line assignment:* This group's main function is to assign lines and trunks to a digital switch's line equipment and trunk equipment, respectively. It also maintains database of line and trunk assignments. - *Coin bureau:* Usually, coin equipment is maintained by a separate department since coin telephones employ	
b)	Explain Impact of software patches on digital switching system maintainability The frequency of generic releases for a large digital switching system is usually limited to a few times a year; however, some digital switching systems are beginning to deploy new releases more often. In between these releases all software corrections are incorporated via patches? Patches are a "quick fix" or program modification without recompilation of the entire generic release. In the case of real-time operational systems, it is usually difficult to install patches since the digital switching system works continuously and patches have to be applied without bringing the system down.	5
2a)	Explain system outage and its impact on digital switching system reliability	5

- *Software deficiencies.*
This includes software "bugs" that cause memory errors or program loops that can be cleared only by major initialization.

- *Hardware failure.*
This relates to simplex and/or duplex hardware failures in the system which result in a system outage.

- *Ineffective recovery.*
This category includes failure to detect trouble until after service has been impaired and failure to properly isolate a faulty unit due to a shortcoming of the software and/or documentation.

- *Procedural error.*
In short, these are "cockpit" or craft errors which have caused loss of service. Examples may include inputting wrong translation data or taking incorrect action during repair, growth, and update procedures. Based on earlier studies of outage performance, an allocation of 3 minutes per year of total system downtime has been made to each of the above categories.

The most important finding in the switching system outage study was that over 40 percent of outages were caused by procedural errors directly related to digital switch maintainability issues. To reduce digital system outage, a concerted effort is required in all four categories mentioned above. However, this chapter focuses on the reduction of system outages by proper digital switch maintenance, since currently this is the highest contributing category. The next few subsections elaborate on areas that need to be studied to improve digital switching system maintainability.

b)

Explain with block diagram the methodology for reporting and correction of field

In the digital switching environment, the internal and external (field) reporting of faults usually follows a similar scheme. A very simplified problem reporting system is shown in Fig. 7.2. Fault reports from various sources such as testing/ first office application failures, operational (CO) failures, and failures observed during the upgrade process are sent to a fault-reporting database. This database can be used to record and assign fault report numbers, fix priorities (e.g., critical/ major, and minor), and track time required to fix. The formal problem report can then be captured by fault report metrics and forwarded to the module owner for correction. Depending on the type of fault, the module owner can decide to fix the problem in the current generic program with patches or to postpone it for compiled correction in the next generic program. The fault reporting metrics can then be used to record correction history. These metrics can also be enhanced to break down the causes of failures and aid in root-cause analysis of faults.

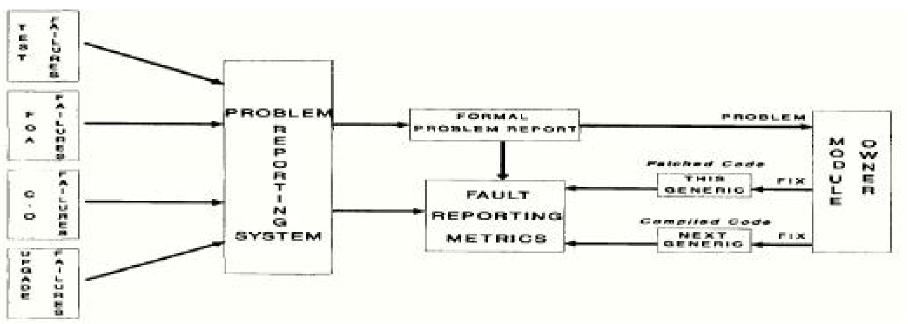

Figure 7.2. A simplified problem-reporting system

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Explain in brief about firmware deployment and firmware software coupling on DSS.

The recent trend toward distributed processing in digital switching systems has resulted in increased use of firmware. The impact of firmware on digital switching system reliability and maintainability can be substantial. Most intelligent subsystems in digital switching systems require resident nonvolatile object code for the purpose of booting or bringing the system on-line after a loss of power or a system failure. These semiconductor memory types are often referred to as firmware devices. The term firmware is often used to include the program code stored in the device.
For telecommunications applications, firmware can be defined as executable code or data which arc stored in semiconductor memory on a quasi-permanent basis and require physical replacement or manual intervention with external equipment for updating .With the trend toward distributed architecture in digital switching systems, the use of microprocessor controllers embedded throughout the system has increased dramatically.
As a result, typical digital switching systems may have 20 to 30 percent of their program code embedded in firmware (some digital cross-connect systems and subscriber carrier systems have 100 percent of their program code embedded in firmware). Most present-day switches incorporate many call processing functions on the line cards, and these line cards can perform many switching functions by themselves. These line cards are capable of detecting line originations, terminations, basic translation, service circuit access control, etc. Most programs which provide these functions are firmware-based. Many vendors choose this arrangement since firmware-based programs require no backup magnetic media and provide local recovery of line service with minimal manual intervention.
While the semi permanent code storage aspect of firmware provides a necessary function, it requires physical replacement or manual intervention with external equipment for updating. The updating process may involve erasing and/or Programming equipment or special commands and actions from a host system for updating electrically erasable/ programmable firmware devices. During the updating process, the switching system controllers may be required to operate in simplex (without redundancy).
The basic notion of "coupling" between firmware and software evolved slowly in the telecommunications industry. Telephone companies became aware of the importance of firmware in digital switches when the companies were required to change a large number of firmware packs upon the release of new software updates. The need to change significant numbers of firmware packs as part of generic updates has created a number of problems, including these:

- Increased simplex times for switches during the firmware update process
- Increased switch downtimes due to system faults while in simplex
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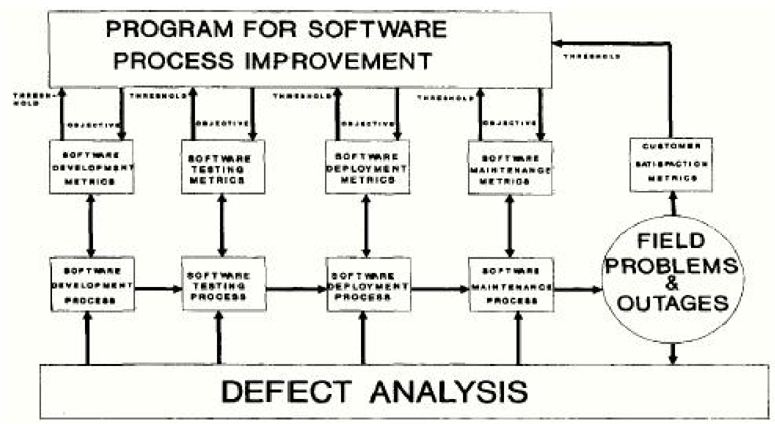
Explain the strategy for improving software quality with a block diagram.


Figure 7-4. A strategy for improving software quality
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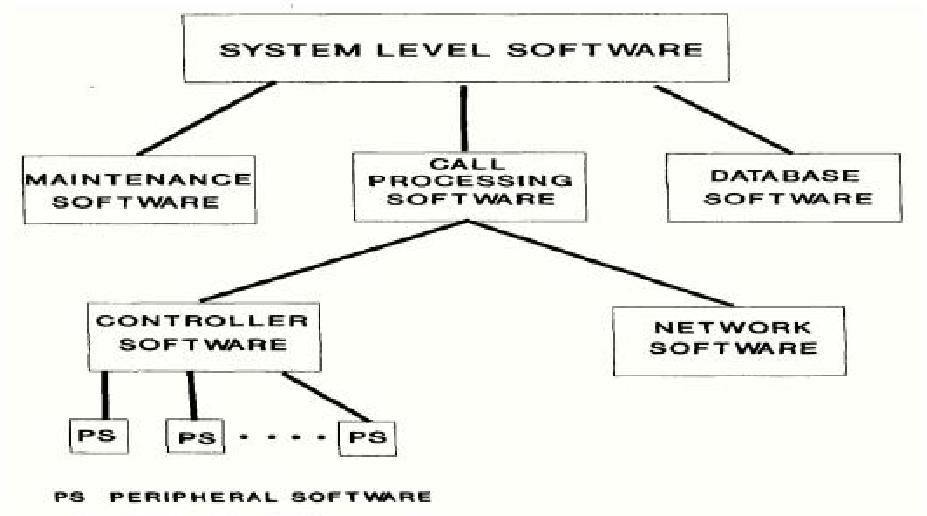
	A strategy for improving digital switching system software quality is shown in Fig. 7.4. It is based on a process metric, defect analysis, and a continuous-improvement program. The importance of a good measurement plan cannot be overemphasized in the arena of software process improvement. A good example of software metrics is Bellcore's In-Process Quality Metrics and the field metric is Bellcore's Reliability and Quality Measurements for Telecommunications Systems [6] . These two measurement systems are used extensively in the United States by the telecommunications industry and are now being implemented in Europe. However, the methodology described here is independent of any measurement system, but depends on measurement systems that control software processes and field failures. Let us consider this methodology in detail. Figure 7.4 shows five distinct processes. We begin at the top. **1. Program for Software Process Improvement** This represents the heart of the system. Software processes for the digital switching system are usually large, complex, and multilocational. These processes must be formalized (i.e., documented) and base lined by putting them under a configuration management system. This will allow tracking of any changes to the process and help the process administrator to better understand the impact. A process change does not always improve a process, but a continuous improvement program (CIP) always does. The CIP strategy can vary greatly for different processes, projects, or products. The suggested strategy in this section assumes that the processes can be instrumented. The inputs to the improvement process are the thresholds established for different metrics. These thresholds are used to observe the impact of changes on all processes. A set of new thresholds is fed to the metric system when the process is changed, enforcing tighter thresholds when required. This feedback process is implemented continuously to improve the quality of the software process.	

5a)	Explain generic switch software architecture	5	C06	L4

	 **Figure 8.2.** A generic switch software architecture			
b)	Explain three level scheme of recovery strategy in digital switch. **Level 1 Initialization (INIT 1)** This is considered the lowest level of initialization for the digital switch. This level of recovery initializes all components that function at level 1 control (see chapter 2). It is controlled and directed by the interface controllers which control line modules, trunk modules, and peripheral modules (PMs). This INIT 1 recovery could be directed specifically to initialize defined line modules, defined trunk modules, and defined peripherals. This recovery strategy selectively initializes lines, trunks, or peripherals based on the severity of the problem. This recovery can be called local recovery, since it can initialize peripherals locally without impacting the operation of the entire digital switching system. **EXAMPLE** After a thunderstorm, a technician in a digital CO found 17 LMs, 5 TMs, and 2 PMs hung up (nonoperational). This was causing a partial outage and other operational difficulties. In this type of situation, it is appropriate for the technician to conduct a direct local recovery of these modules. Manual restoral would take too long. This type of recovery will have minimal impact on the rest of the digital switching system and will bring the digital switching system to normal operation by the low-level initialization of the digital switch.	5	C06	L4
6a)	Write short notes on reliability analysis and network control processor. This section is the most important, and it gives a brief description of the reliability models of the digital switch and includes overall reliability findings covering - **Component failure rates**: Describe the component failure rates for different circuit packs used in the digital switch. - **System reliability**: Describe the results of hardware modeling of various subsystems of the digital switch. - **Software reliability analysis**: Describe the results of the software analysis of the digital switching system software.	5	C06	L4
b)	Describe the common characteristic of digital switching system.	5	C06	L5

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<td>Most commercial digital switching systems in the North American network exhibit some common characteristics. They are described here at a high level and do not pertain to a particular switch. Chapter 10 provides some high level details on some major digital switching systems that are currently deployed in North America.

- Dual capability. Most digital switching systems covered, which are primarily class 5, can also have tandem/toll or class 4 capabilities.
- Termination capability. Most of the large digital switching systems can terminate approximately 100,000 lines or 60,000 trunks.
- Traffic capacity. In a distributed environment, this depends on the digital switch configuration, and it can go as high as 2,000,000 busy hour call attempts (BHCAs).
- Architecture—hardware. Most digital switching systems have a quasi- distributed hardware architecture (see chapter 2 for definitions), since they all maintain control of the switching functions through an intermediate processor. All digital switching systems employ multiple processor subsystems.
- Architecture—software. Most digital switching systems maintain a modular software design, sometimes through layering or through functionalities. They have operating systems under which application systems function. They all support database systems for office records, subscriber records, administration records, etc. They all have maintenance subsystems that support diagnostic and switch maintenance processes. They also support billing systems for subscribers such as the automatic messaging system.
- Switching fabric. Most digital switching systems utilize time-space- time (TST) mode for switching calls.
- Remote operation. Most digital switching systems have remote switching modules (RSMs)</td>
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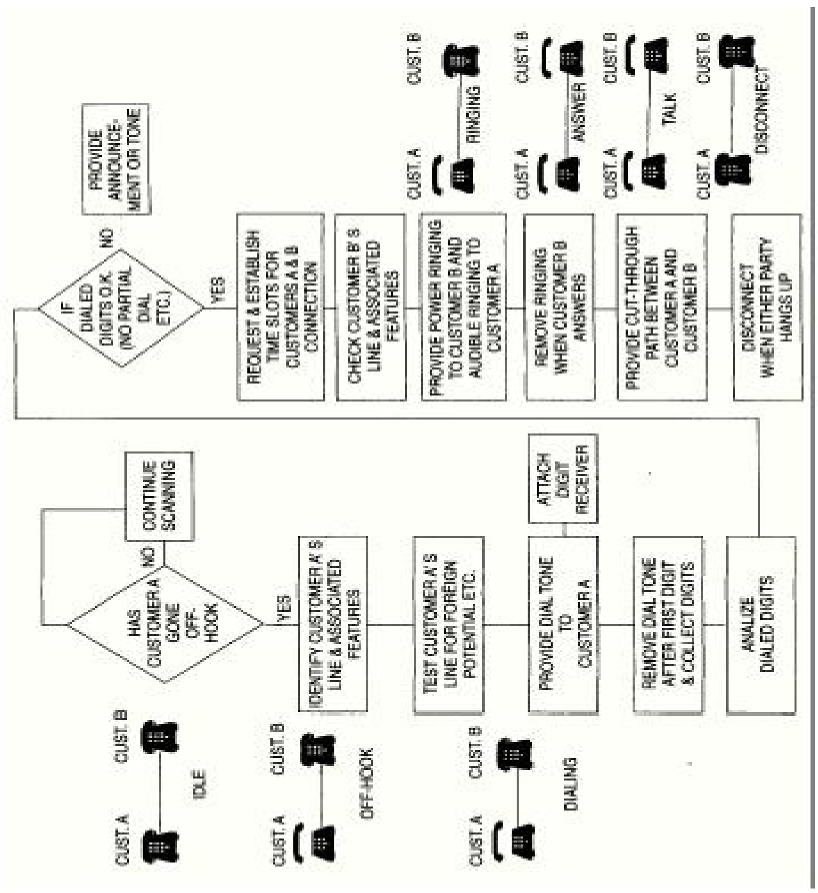
<td>List the basic steps necessary to complete a simple call with flow chart.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	1. Detect off-hook condition. 2. Identify customer's line. 3. Test customer's line. 4. Provide dial tone to customer. 5. Provide digits analysis of dialed number. 6. Establish a path between the calling customer and the called customer. 7. Ring the called customer. 8. Detect answer and establish cut-through path. 9. Supervise both lines for disconnect. 10. Detect on-hook condition and disconnect.				