University of Diyala

Telecom Switching Systems

Lecture 14

4th Stage

Communication department / Engineering collage

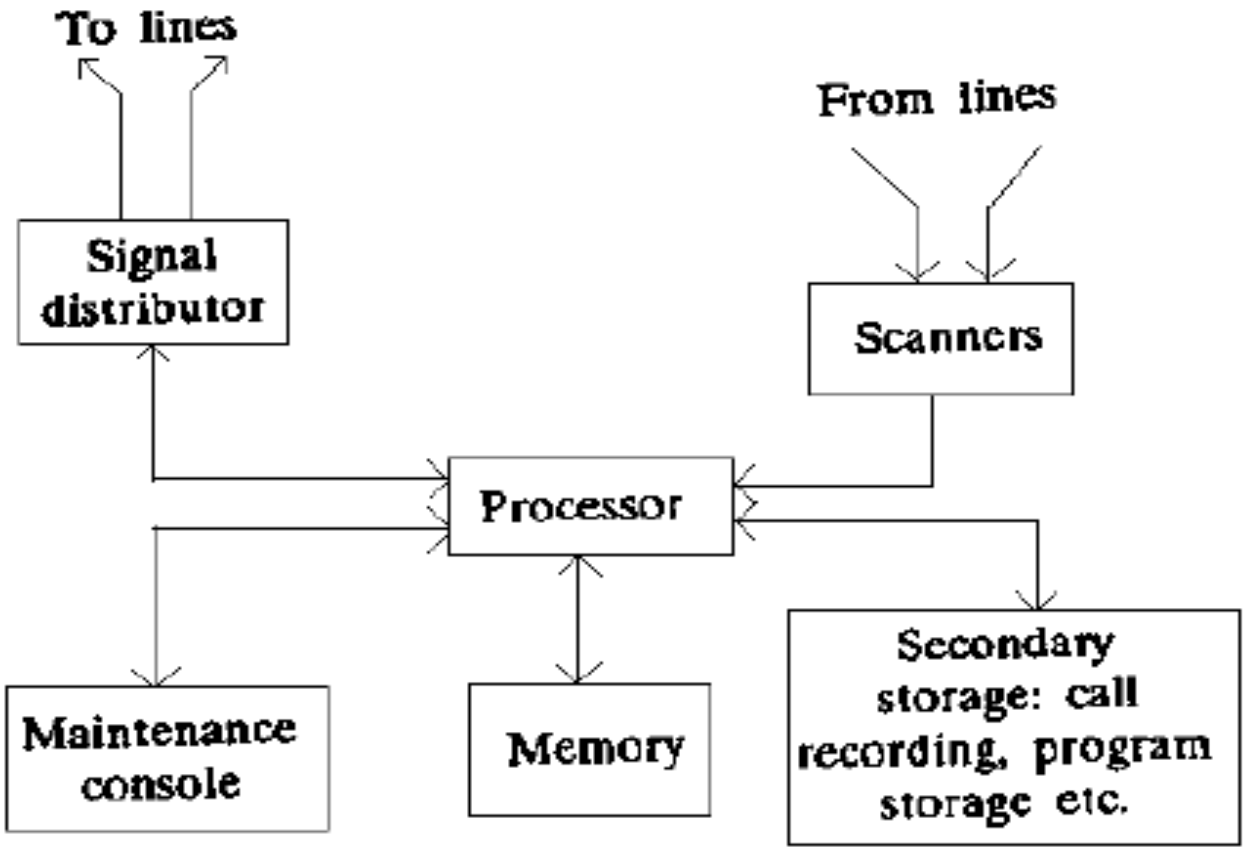
Lecturer Marwa Mohammed

How to organise stored program control (SPC)

There are two approaches to organizing stored program control (SPC):

- Centralized: In this control, all the control equipment is replaced by a single processor which must be quite powerful.
- Distributed: In this control, the control functions are shared by many processors within the exchange itself.

Typically Centralized SPC Organization



Centralized SPC

- Early electronic switching systems are centralized SPC exchanges and used a single processor to perform the exchange functions.

- Presently centralized exchanges uses dual processor for high reliability. All the control equipments are replaced by the processors.

Centralized SPC cont.

A dual processor architecture may be configured to operate in different modes such:

- Standby mode: In this mode, one processor is active and the other is on standby, both hardware and software wise. The standby processor brought online when active processor fails.

- Synchronous duplex mode: In this mode, hardware coupling is provided between the two processors which execute the same set of instructions and compare the results continuously. If a mismatch occurs, the faculty processor is identified and taken out of service immediately.

- Load sharing mode: In load sharing operation, an incoming call is assigned randomly or in a predetermined order to one of the processors which then handles the call right through completion. Thus both the processors are active simultaneously and share the load and the resources dynamically.

Availability

Single processor. Availability $A = \dfrac{MTBF}{MTBF + MTTR}$

where MTBF = Mean time between failures

MTTR = Mean time to repair

Unavailability = 1 – A

$$U = 1 - \frac{MTBF}{MTBF + MTTR} \; ; U = \frac{MTTR}{MTBF + MTTR}$$

If MTBF >> MTTR, $U = \dfrac{MTTR}{MTBF}$

Dual Processor. A dual processor system is said to have failed only when both processor fails and the total system is unavailable. The MTBF of dual processor is given by

$$(\text{MTBF})_D = \frac{(\text{MTBF})^2}{2\text{MTTR}}$$

where $(\text{MTBF})_D$ = MTBF of dual processor

MTBF = MTBF single processor

Availability $$A_D = \frac{(\text{MTBF})_D}{\text{MTTR} + (\text{MTBF})_D}$$

Substituting $(\text{MTBF})_D$ in the above equation, we have

$$A_D = \frac{(\text{MTBF})^2 / 2\text{MTTR}}{\text{MTTR} + \frac{(\text{MTBF})^2}{2\text{MTTR}}}$$

$$A_D = \frac{(\text{MTBF})^2}{(\text{MTBF})^2 + 2(\text{MTTR})^2}$$

Unavailability $$U = 1 - A_D = 1 - \frac{(MTBF)^2}{(MTBF)^2 + 2(MTTR)^2}$$

$$= \frac{2(MTTR)^2}{(MTBF)^2 + 2(MTTR)^2}$$

If MTBF >> MTTR, $$U_D = \frac{2(MTTR)^2}{(MTBF)^2}$$

Ex: Given that MTBF = 2000 hrs and MTTR = 4 hrs. Calculate the unavailability for single and dual processor systems for 10 years and 30 years.

Sol. Given : MTBF = 2000 hrs

MTTR = 4 hrs.

Unavailability of single processor

$$U = \frac{MTTR}{MTBF} = \frac{4}{2000} = 2 \times 10^{-3}$$

for 10 years, $U = 24 \text{ hrs} \times 365 \text{ days} \times 10 \text{ years} \times 2 \times 10^{-3}$

$U = 175.2$ hrs.

for 30 years, $U = 24 \text{ hrs} \times 365 \text{ days} \times 30 \text{ yrs} \times 2 \times 10^{-3} = 525.6$ hrs.

Unavailiability of dual processors

$$U_D = \frac{2(MTTR)^2}{(MTBF)^2} = \frac{2(4)^2}{2000^2} = 8 \times 10^{-6}$$

for 10 years, $U = 24 \times 365 \times 10 \times 8 \times 10^{-6} = 0.7008 \text{ hrs} = 4.2 \text{ minutes}$

for 30 years $U = 2.1$ hrs.

Distributed SPC

The introduction of distributed SPC enabled customers to be provided with a wider range of services than those available with a centralized and electromechanical switching system. Instead of all processing being performed by a one or two processor in centralized switching, functions are delegated to separate small processors. But central processors are still required to direct the regional processors and to perform more complex tasks. The distributed SPC offers better availability and reliability than the centralised SPC.

- Vertical decomposition, the exchange environment is divided into several blocks and each block is assigned to a processor that performs all control functions related to that block of equipment's.

- Horizontal decomposition, each processor performs one or some of the exchange control functions.

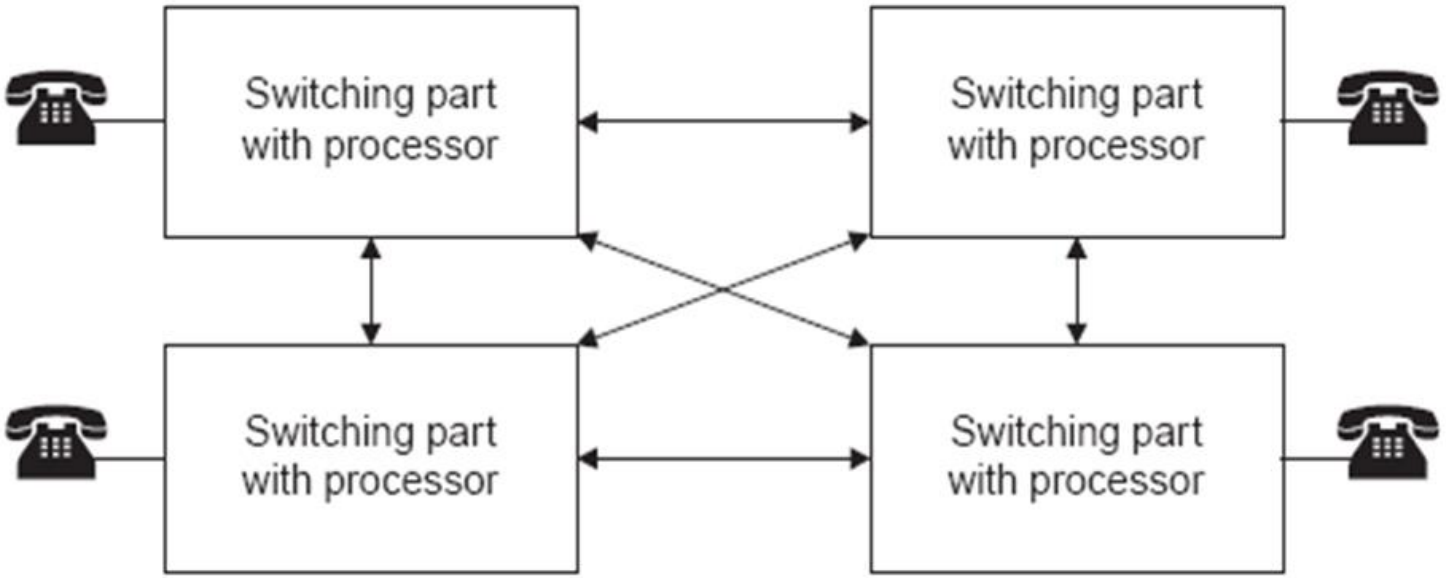


Fig. Distributed SPC.

Switching Networks

The basic function of an exchange is making a connection between calling subscriber and called subscriber.

Based on inlet and outlets switching networks can be classified as:

1. Single stage network
2. Two stage network
3. Three stage Network
4. Four Stage network