

# ARE 11- SPC local exchange system

LM Ericsson SPC telephone switching systems.

The ARE 11 local exchange has been designed to fit easily into any telephone network and to be an efficient tool for all telephone administrations.

It uses a recently developed data processing control system optimized for telephone switching applications.

Its complexity is only a fraction of that of contemporary systems and its capacity is outstanding.

The data processing system is easy for switching engineers to understand and maintain — even without thorough training in SPC techniques.

ARE 11 has a transit exchange counterpart — ARE 13. The flexibility and wide range of applications of these two systems make it possible to introduce SPC facilities everywhere in a nationwide network.

# Main advantages

## Optimum cost/performance ratio

ARE 11 is designed to meet today's wide range of requirements and to provide the optimum cost/performance ratio through uncomplicated minimum-size software and hardware modules.

It is engineered to meet the introduction on demand of new services for administrations and subscribers, new technologies and new capacity ranges.

## Easy introduction into existing networks

ARE 11 software is simple. It has a new elegant structure. Distributed call processing reduces the number of functions handled by each processor. Standardized program interfaces provide flexibility through functional modularity.

The hardware matches the software in simplicity.

ARE 11 employs a number of identical small, fast processors in a multiprocessor system instead of a single large, very complex processor with fixed traffic handling capacity.

## Cost-effective from 1000 to 80 000 subscribers

With most SPC systems, it's not possible to adapt the traffic handling capacity to the requirements of exchanges of different sizes.

This problem is solved in ARE 11 by distributed call processing and the multiprocessor data processing system.

The number of processors varies to meet the needs of local exchanges serving from about 1000 to 80,000 subscribers.

This makes ARE 11 a practical cost-effective SPC solution for both densely populated metropolitan centres and less populated suburban areas.

Uniform subscriber services and standardized operation and maintenance methods make network administration simple.

# Exceptionally high traffic handling capacity

The unusually high traffic handling capacity of ARE 11 is the result of careful design, excellent extension modularity and large ultimate exchange size.

Subscriber line scanning is eliminated.

Speech path selection and switch operation are handled by peripheral devices.

Internal job administration is streamlined to a minimum.

Operation and maintenance procedures are separated from call handling.

A variable number of processors provide traffic handling capacity as required.

## System reliability

The inherent reliability of ARE 11 processors is very high.

In the event of any processor failing, its devices are handled by a common spare processor of the group.

This makes total system breakdown extremely unlikely.

## The best solution for introducing SPC in Crossbar networks

ARE 11 is an excellent local SPC exchange on its own merits.

In addition, it offers unusual opportunities for administrations already operating or manufacturing ARF local exchanges.

ARF exchanges can be modified to ARE 11 standards as and when convenient, and without interrupting the traffic flow.

This means the whole telephone network can be transformed to Stored Program Control in the most economical and practical way.

## Subscriber and administration services

In addition to all the facilities of crossbar exchanges, system ARE provides a number of subscriber and administration services such as

- abbreviated dialling
- hot line service
- priority
- wide choice of subscriber categories
- remote control of routing, categories etc.
- large analysis capacity
- ordinary call meters or data store call metering
- extensive automatic supervision

# System principles

# Frequency versus complexity for telephone exchange functions

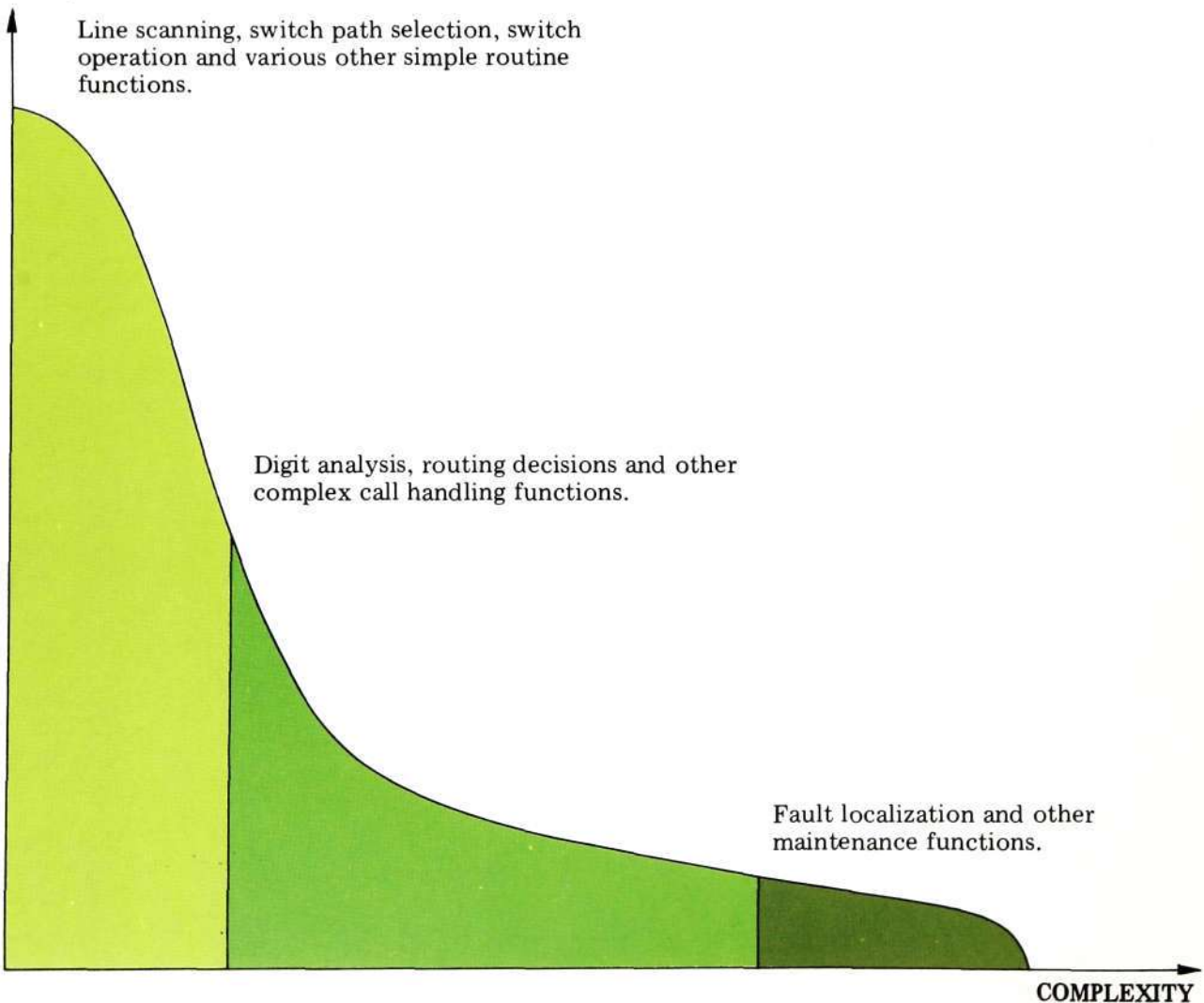
Telephone exchanges perform many different functions. Some of these are simple routine functions unlikely to change during the life of the exchange but, as they occur frequently, they represent a considerable part of the control system load.

Other functions are complex and likely to be modified quite often. Fortunately they occur less frequently, perhaps only once per call.

Fault localization and other maintenance functions are generally the least frequent but also the most complex tasks in a telephone exchange.

If an SPC control system is to be optimized for switching applications, many different factors must be taken into account. The correlation between the frequency and the complexity of the switching functions is one of the most important of these factors.

**FREQUENCY**



# Separation of switching functions increases control system capacity

The control system of ARE 11 is designed to take full advantage of the correlation between frequency and complexity for local exchange functions.

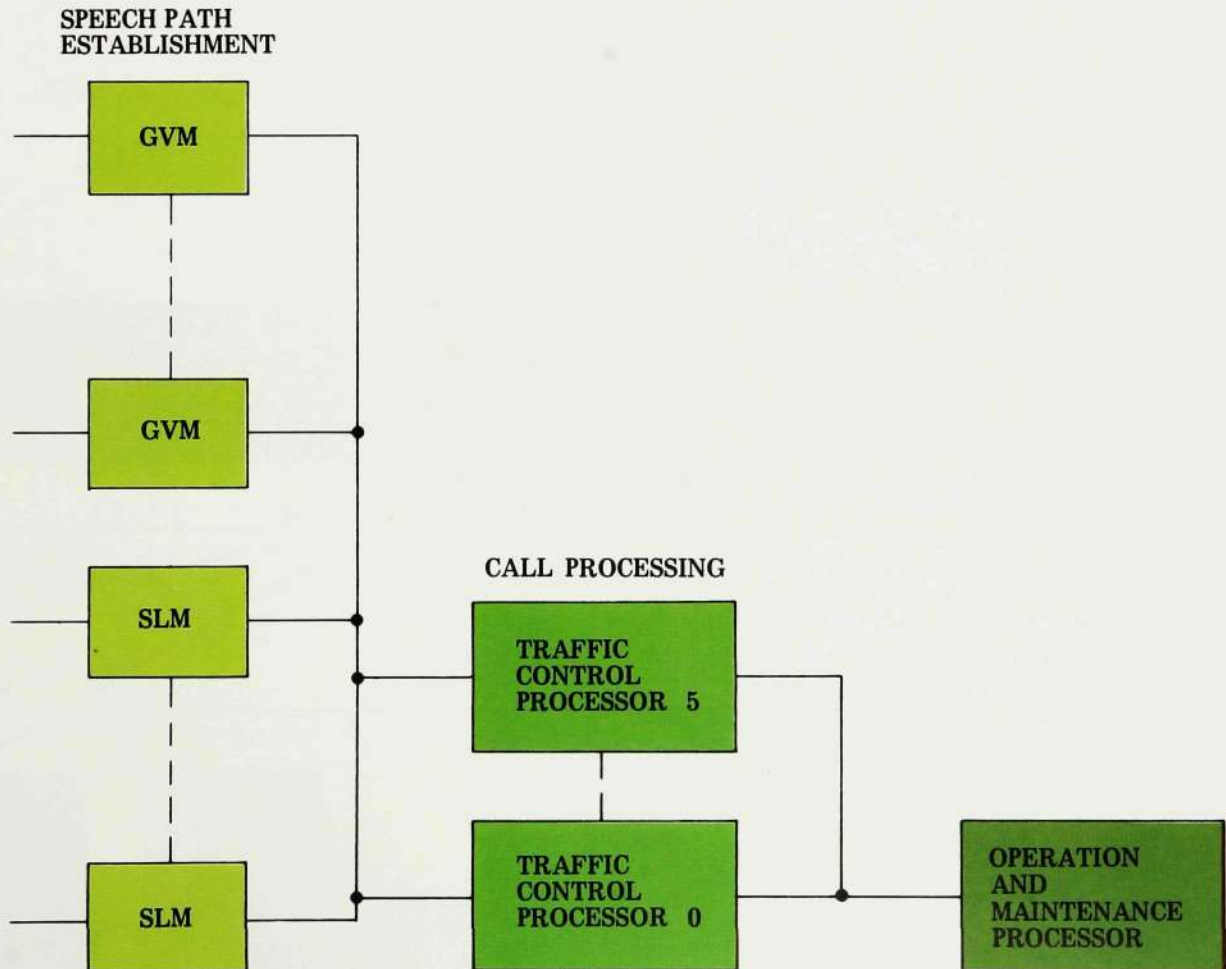
The establishment of speech paths through the switching stages is a permanent, unintelligent routine function. As little can be gained by processor control of this function, it is handled by peripheral, wired logic devices, SLM and GVM. Call detection is another routine activity that is handled autonomously by SLM to remove the load of subscriber line scanning from the central data processing system.

Intelligent traffic handling functions, on the other hand, are controlled by traffic control processors TCP. Operation and maintenance functions and input/output devices are controlled by an operation and maintenance processor OMP. The two processors are identical but use different software.

Six TCP and one OMP form a processor group. Four such groups may work together in one exchange to provide an unusual call handling capacity - 500,000 calls per hour.

The minimum control system configuration consists of two TCP and one OMP, which is suitable for small local exchanges with a few thousand subscribers.

Thanks to the optimized structure of the control system, ARE 11 has a wider range of applications than hitherto thought possible for local SPC exchanges.



# The working mode of ARE 11 saves processing power and simplifies internal job administration

A fundamental problem for the SPC exchange designer is how to organize the internal work of the data processing system to cope with the traffic load. Many hundred calls in different stages of completion must be handled simultaneously. Each one of these involves components and devices in different parts of the exchange, which must be linked together without ambiguity. Timing of different activities is critical and the system must always be ready to accept new calls on demand.

This means that the data processing system must jump from one call to another and from one activity to another, keeping track of all devices belonging to every call and determining the exact time between all activities. The data processing system must use a considerable part of its processing power to arrange all jobs in a suitable sequence. This is one of the major reasons for the complexity and low traffic handling capacity of many SPC exchange systems.

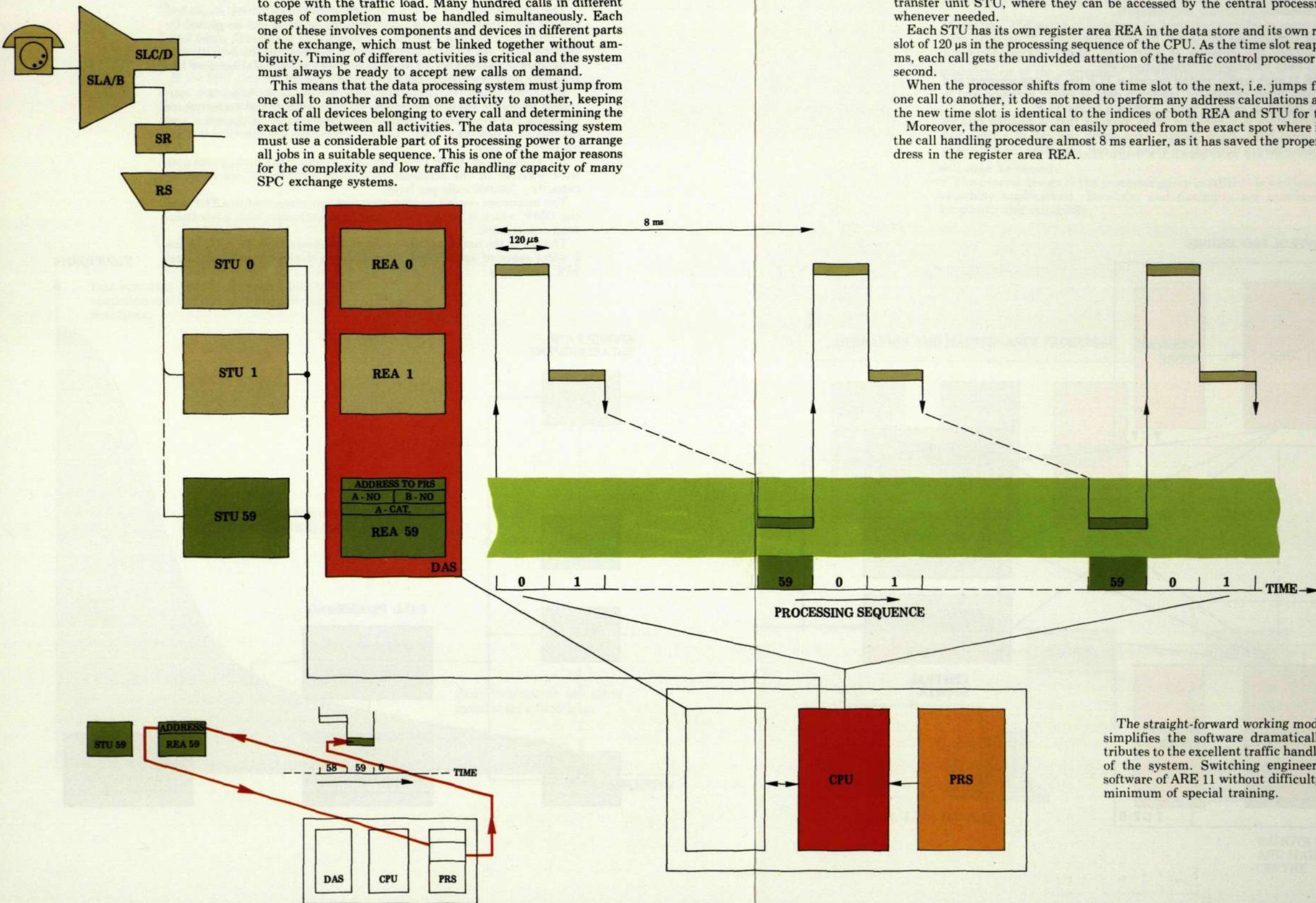
ARE 11 solves this problem by a simple and elegant method.

For every new call, peripheral devices connect the speech wires to an idle signalling transfer unit STU, where they can be accessed by the central processing unit CPU whenever needed.

Each STU has its own register area REA in the data store and its own recurring time slot of 120  $\mu$ s in the processing sequence of the CPU. As the time slot reappears every 8 ms, each call gets the undivided attention of the traffic control processor 125 times per second.

When the processor shifts from one time slot to the next, i.e. jumps from handling one call to another, it does not need to perform any address calculations as the index of the new time slot is identical to the indices of both REA and STU for the new call.

Moreover, the processor can easily proceed from the exact spot where it interrupted the call handling procedure almost 8 ms earlier, as it has saved the proper program address in the register area REA.



The straight-forward working mode of ARE 11 simplifies the software dramatically and contributes to the excellent traffic handling capacity of the system. Switching engineers grasp the software of ARE 11 without difficulty and with a minimum of special training.

# An optimized store organization provides economy, reliability and remote control

The hardware structure of the multiprocessor data processing system of ARE 11 matches the simplicity and elegance of the software structure. The organization of program and data stores is carefully designed to suit telephone switching requirements.

Three types of information must be available in a true SPC system: 1) programs that control the traffic handling functions, 2) variable data that describes the progress of every call, and 3) semi-permanent reference data for analyses, translations etc.

In ARE 11 each traffic control processor TCP has its own program and data stores. Semi-permanent reference data is rarely accessed and is therefore stored in central stores, common to six TCP.

The data store is a dynamic MOS memory that is divided into 60 register areas REA. Each register area serves one call at a time and stores all temporary information about the call, including the address to

the program that is to be executed during the next time slot. As the number of time slots is limited, the traffic control processor can never be overloaded. Momentary loss of all information in the data store affects only those calls that are being handled at that moment.

The program store is a programmable read only memory — PROM — and the contents of this can never be lost or mutilated.

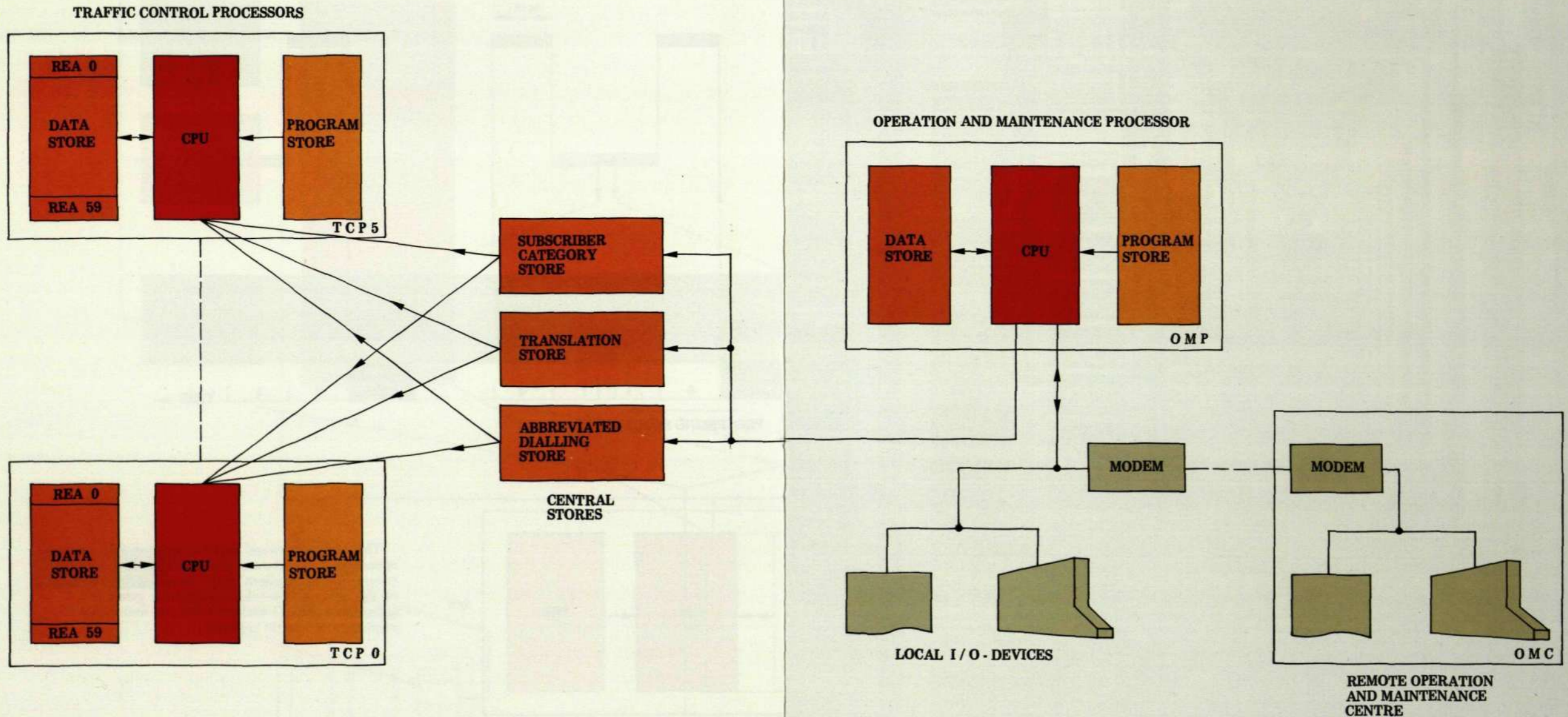
The programs define general functions, which are rarely changed, while the contents of the central stores give these functions the special significance that separates one exchange from another.

Everyday work like temporary disconnection of non-paying subscribers or changes of the routing pattern are readily performed at the exchange or from a remote operation and maintenance centre OMC by modification of the contents of the central stores.

If the functions themselves are to be changed, for example if a new signalling system is to be added, a new program board is simply added to the program store. Standard interfaces provide functional modularity.

Software faults are not easily spread by the CPU, as it normally writes only in the data store where a software fault has little effect and will soon be erased.

The general design of the processor group in ARE 11 is well adapted to switching applications. Economy and flexibility are combined with simplicity and reliability.



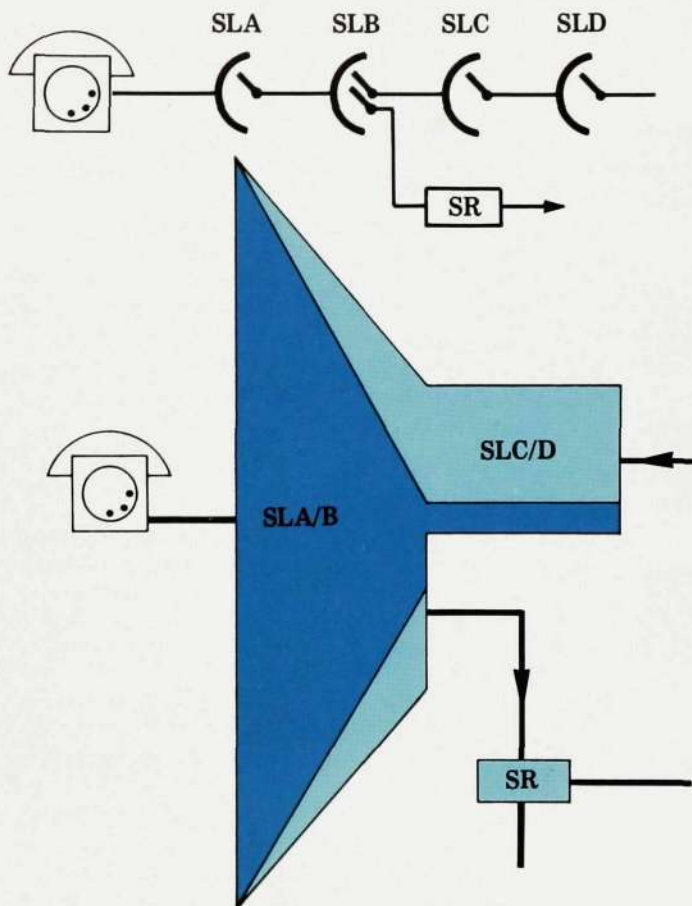


# Practical design

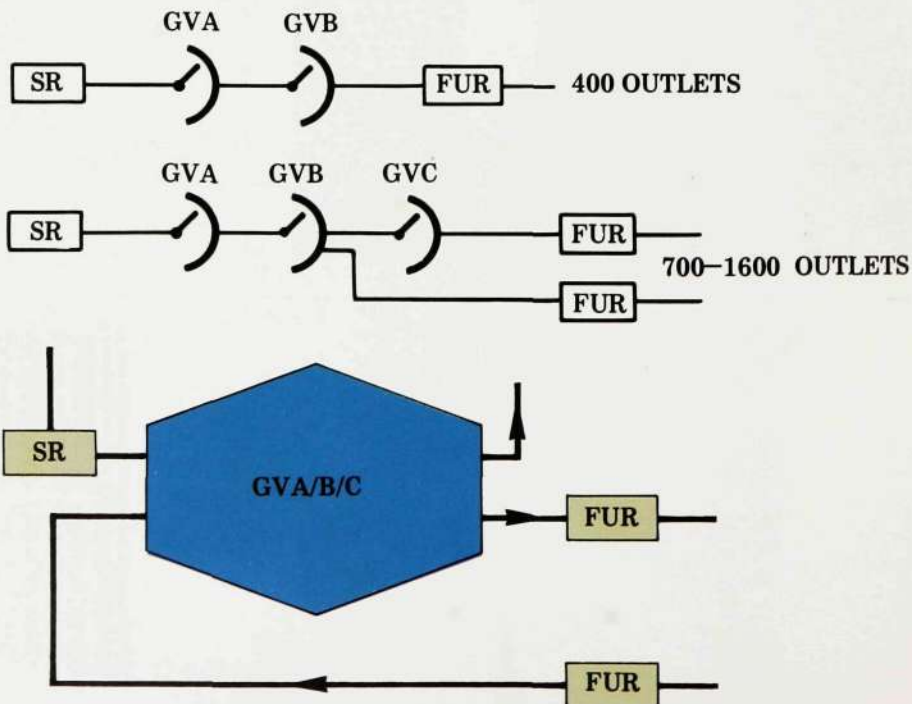


# Switching network

The switching network consists of a subscriber stage SL and one or more group selector stages GV. Both stages use rugged, reliable LME Crossbar switches proven under difficult conditions all over the world.



The SL-stage consists of a number of SL-groups, each for 1000 subscriber lines. The SL-group is subdivided into extension units of 200 subscriber lines. The SL-stage exists in 9 variants with different degrees of concentration to suit any practical combination of originating and terminating traffic.



The group selector stage consists of a number of basic units with 80 inlets and 400 outlets. Each unit has two partial stages GVA and GVB. A third partial stage GVC may be added, offering 700, 1000, 1300 or 1600 outlets as required.

A particular exchange may use one or two GV-stages depending on the size of the exchange. These GV-stages are built up from two-stage or three-stage group selector units according to the traffic and routing requirements.

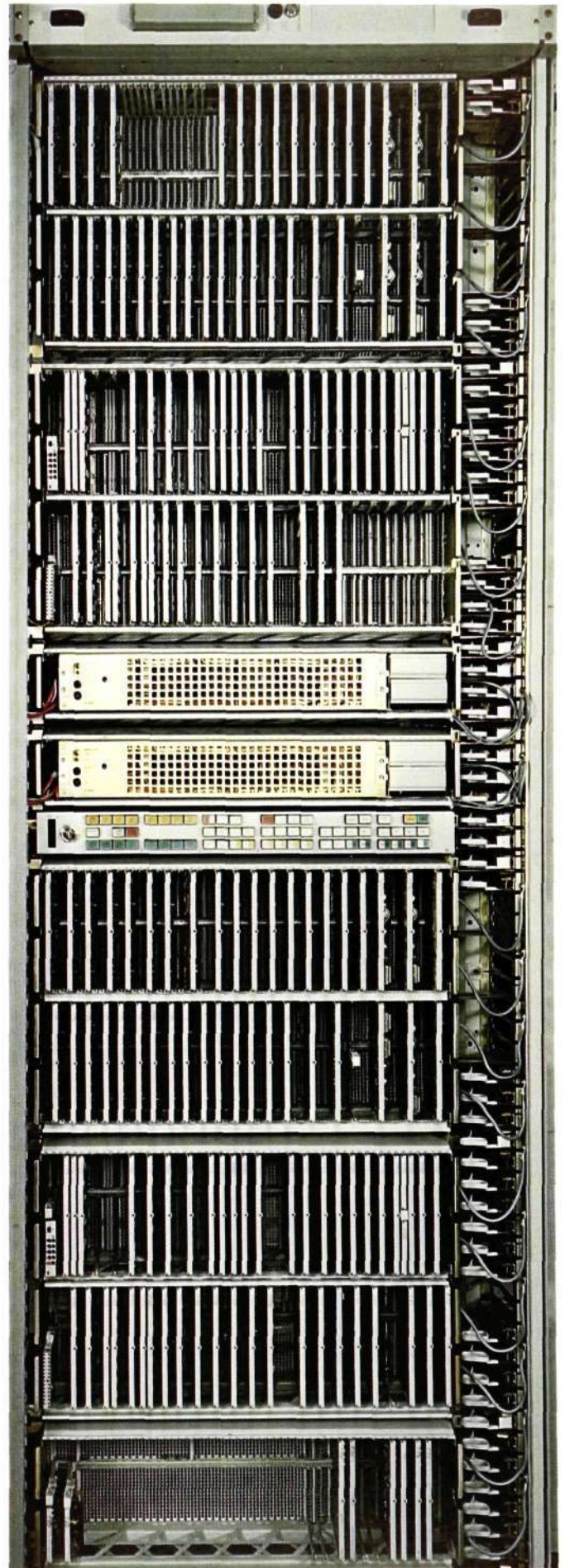
# Hardware design of the ARE 11 processor

The picture shows the ARE 11 processor rack with a traffic control processor TCP in the upper half and an operation and maintenance processor OMP in the lower half of the rack. The only visible difference between these is the I/O terminal interface at the bottom of the rack. The memory contents are, of course, also different.

The central processing unit is a modern micro-programmed machine utilizing fast TTL logic throughout, and it occupies only one two-level shelf. 5 V power units for the central processing units are housed in the middle of the rack together with a control panel for direct access to the processors.

The two-level shelf above the central processing unit contains the program and data stores. The data store is a fast dynamic random access MOS memory, while the program store is a programmable read only memory with the information permanently burnt into PROM chips. The program memory contents can never be lost or mutilated. They can nonetheless be easily changed or extended whenever necessary.

ARE 11 fulfils all the requirements of a modern SPC local exchange with a very moderate program volume of 25,000 instructions. The software efficiency has been achieved by a highly successful combination of instruction list, data structure and operating system.



# Modernization of local networks with ARE 11

Due to the modular structure of the data processing control system, ARE 11 covers a remarkable range - from about 1000 up to 80,000 subscribers. And it is suitable in all local exchange applications.

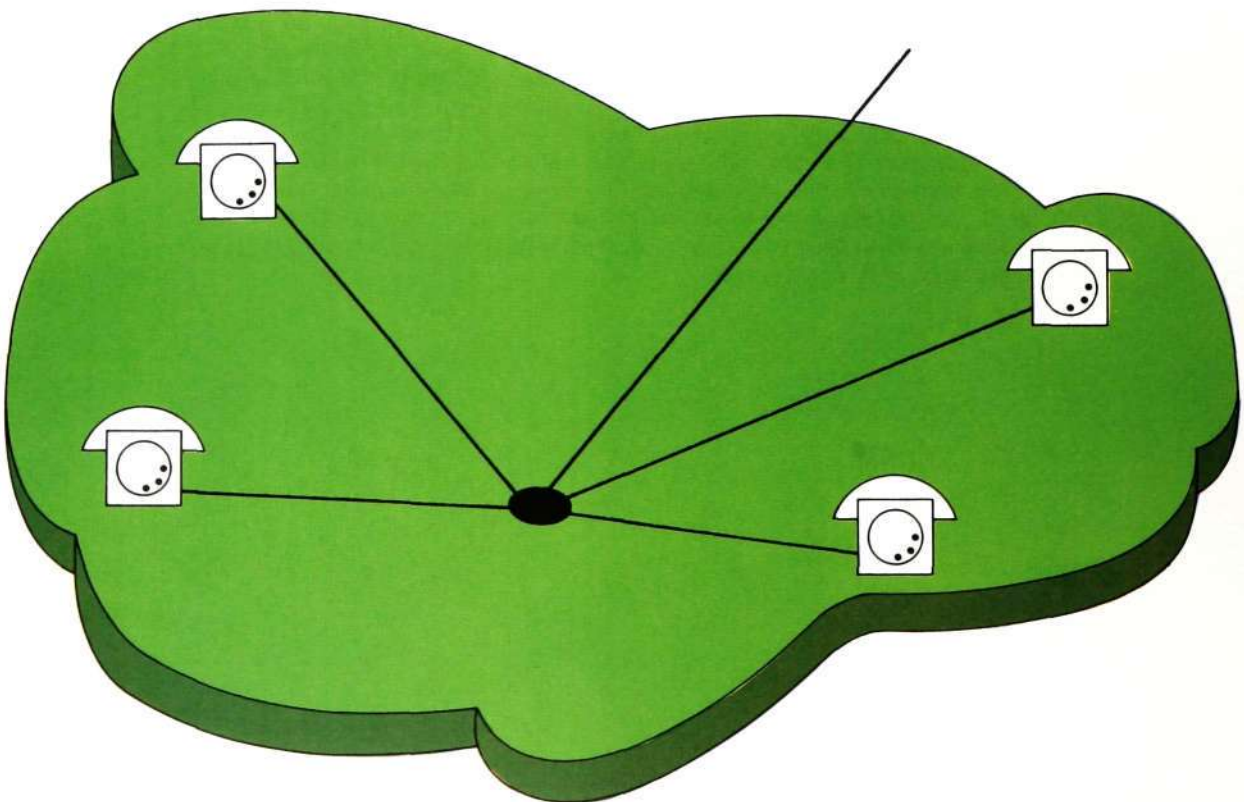
ARE 11 provides a practical and sensible solution to the modernization of any local telephone network. Additional, substantial advantages are gained if the network contains ARF local exchanges.

In this case the administration can choose between keeping the existing exchanges intact, extending them with ARF or ARE 11 equipment, or converting them to ARE 11 exchanges. It has full freedom to choose the most convenient rate of introduction and penetration of new equipment and new services.

# Single-exchange networks

Introduction of SPC exchanges in small or medium-sized, fairly isolated networks is usually not considered economically favourable today. An adequate amount of spare parts should be available at each exchange, as well as expert maintenance staff. The initial exchange size is typically below the optimal size of many SPC exchange systems and the exchange may be out of service for comparatively long periods when support by system specialists is indispensable.

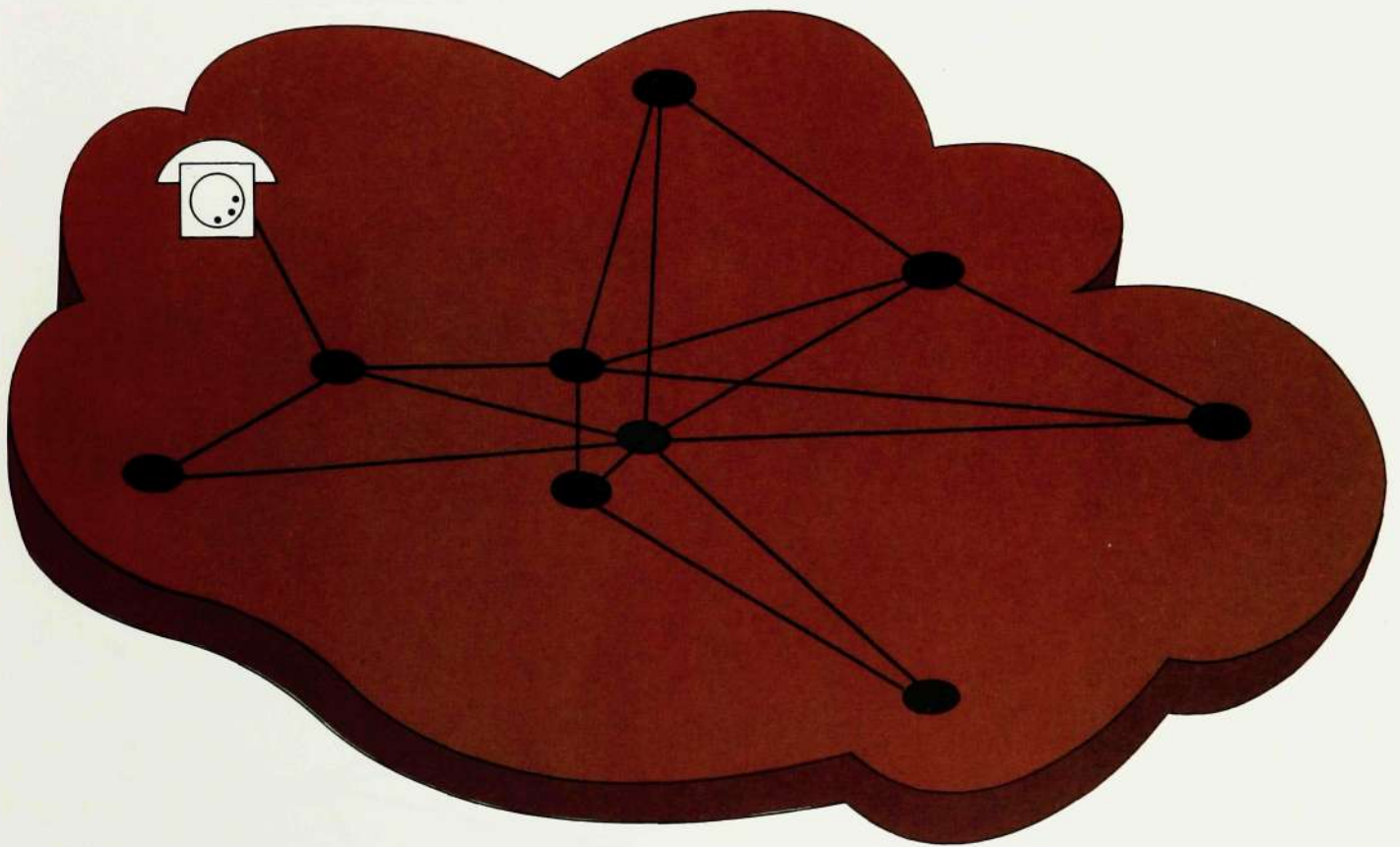
The economy and reliability of ARE 11 changes this picture, however. The effect of a processor failure in ARE 11 is limited to a slight and precalculated reduction of traffic handling capacity without depriving any subscribers of their service. The modularity and simple extension of ARE 11 offer economy for small exchange units and take care of unforeseen developments.



# Multi-exchange networks

The broad range of ARE 11 is of special importance in multi-exchange networks. ARE 11 provides a universal solution that is applicable for very large exchanges in the centre of the city as well as for small exchanges in the outer edges.

System standardization has a decisive influence on the economy of a telephone network. This is valid for the planning of the network and the installation of exchanges but even more, later on, for the long-term operation, maintenance and general administration of the network.



# Modernization of ARF local networks

When SPC exchanges are introduced into an existing network, subscriber services and operation and maintenance methods will differ considerably in the new and the existing parts of the network.

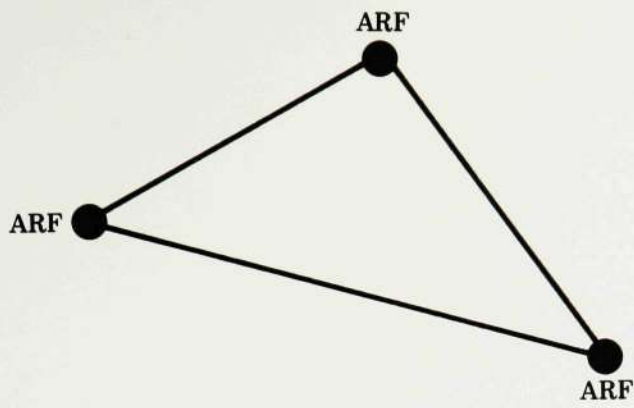
Where the original, homogenous network had only one traffic case, the introduction of SPC creates four traffic cases, which depend on the types and facilities of the originating and terminating exchanges.

The ultimate aim is, of course, to introduce SPC all over the network. But until then, segregated subscriber services can cause confusion. The pricing and the limited availability of the new services may give rise to problems.

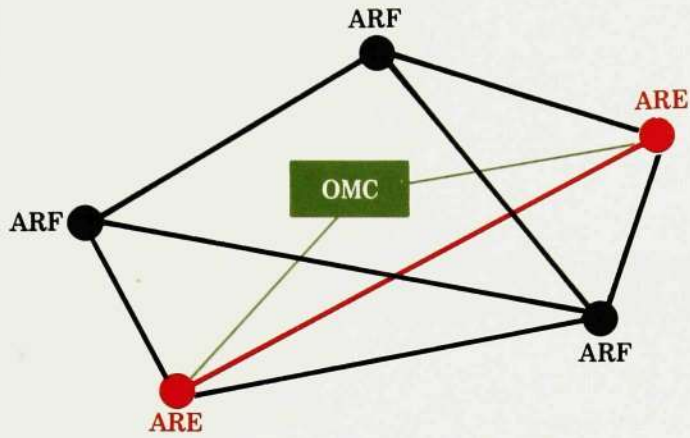
If the existing network employs ARF exchanges, however, the transitional period may be shortened considerably. In this case the existing exchanges may be converted to ARE 11 standards one by one or several at a time.

A minimum investment provides the existing exchanges with the same services as the new ones. Remote control from an operation and maintenance centre OMC lowers the cost for the administration of the network.

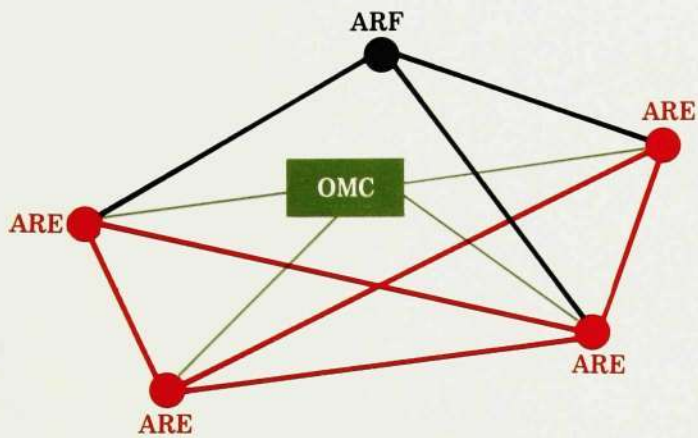
**No other solution will lead to a modern, homogenous local network at a comparable expenditure of time, cost and effort.**



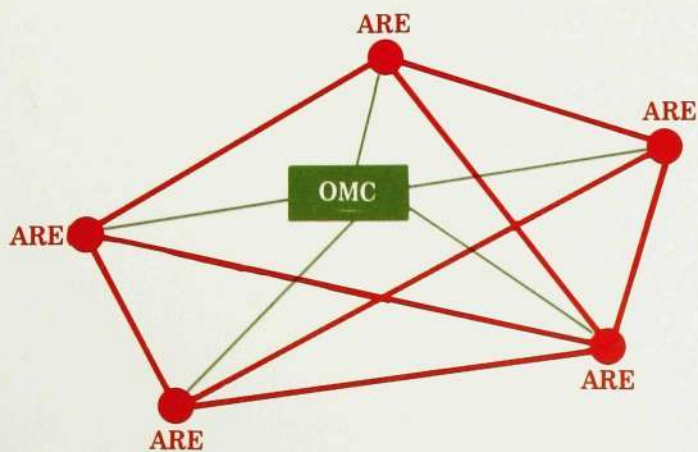
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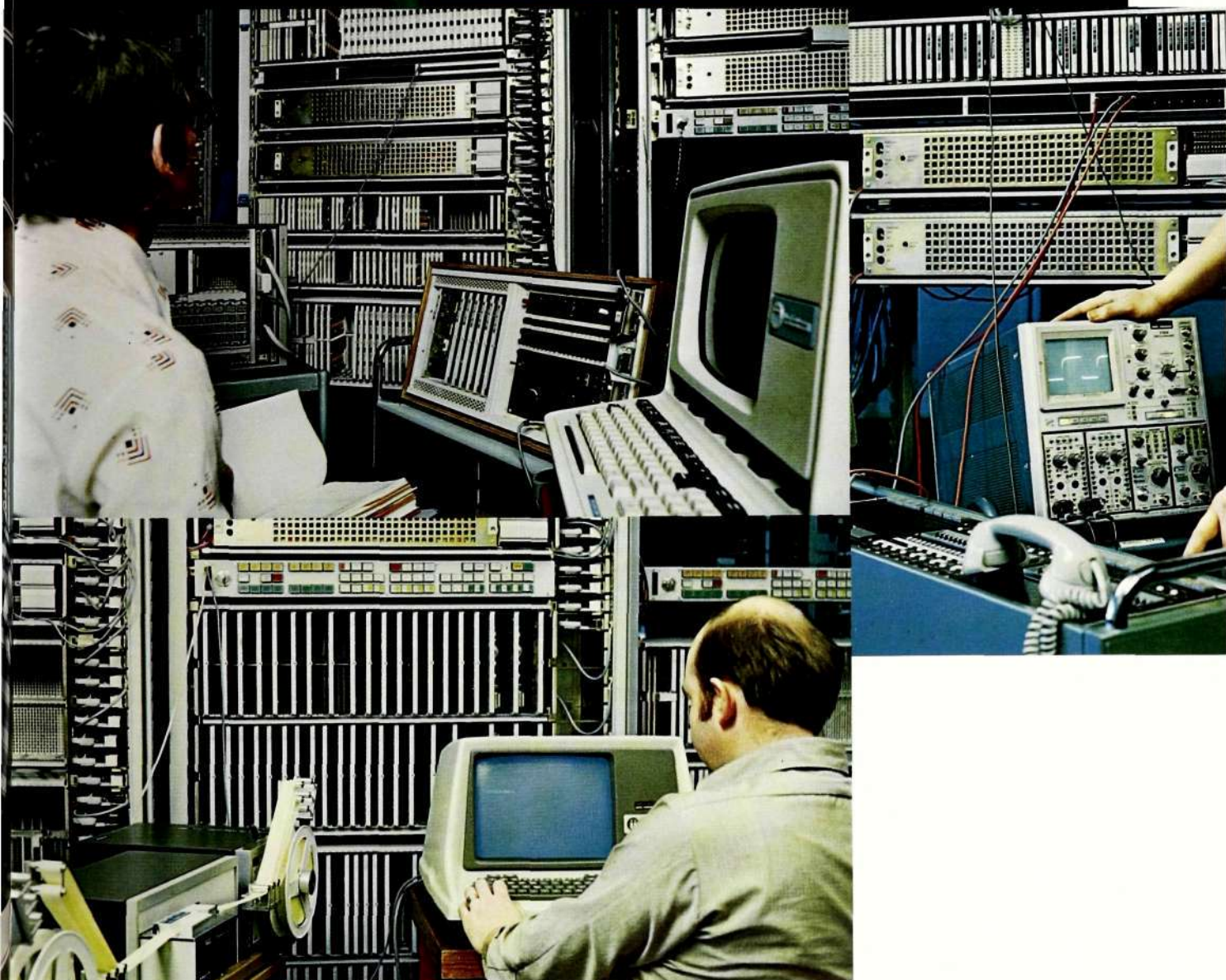
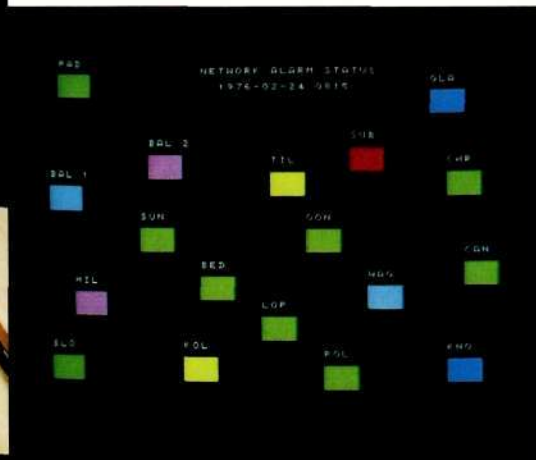
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# Installations





# Technical data

# Technical data for ARE 11

## Traffic handling properties

Max. no. of subscribers	80,000
Extension module	200 subs.
No. of subscriber stage variants	9
Traffic per subscriber	Up to 0.23 erl
Call handling capacity at 80,000 subs. PBX-groups may be distributed over 10,000 multiple positions	500,000 calls/hour
Group selector stage with 2 or 3 partial stages and 400 – 1600 outlets	
Alternative routing	Unlimited
Max. no. of line signalling systems	Unlimited
Max. no. of simultaneous register signalling systems for outgoing traffic	4
Common channel signalling	
Digit analysis	
No. of destinations	256
B-number store capacity	16 digits
Charging	
Conventional electromechanical meters	
Electronic for national and inter- national charging in ARE 11	
Max. no. of tariffs	127
Max. no. of tariff classes	127
Charge pulse intervals	0.5 – 1,000 s

## Subscriber facilities

Push-button set	
Hot line	
Abbreviated dialling	
Priority	
Future facilities	
Add-on conference	
Call waiting	
Hold for enquiry	
A-categories	Virtually unlimited
B-categories	64

## Operation and maintenance properties

Supervision of blocking, seizure and fault ratio for individual devices and device groups, processors, central devices, subscriber lines, etc.

Remote control from Operation and Maintenance Centre (OMC) for

- modification of subscriber category
- modification of traffic routing data
- supervision
- fault indication
- statistics
- disturbance recording of live traffic
- traffic recording of device groups and routes

## Data processing system

Primary interval	8 ms
Max. program store volume	32 K 16
Max. data store volume	32 K 8
Number of instructions	63
Average instruction time	2 $\mu$ s
Microinstruction time	250 ns
Multiprocessor system with roving spare equipment	
Max. no. of Traffic Control Processors	4 $\times$ 6
Max. no. of Operation and Maintenance Processors	4 $\times$ 1
Working mode	Time division with fixed time slots

*The contents of this book are subject to revision without notice, due to continued progress in design and manufacture.*





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