ERICSSON Review

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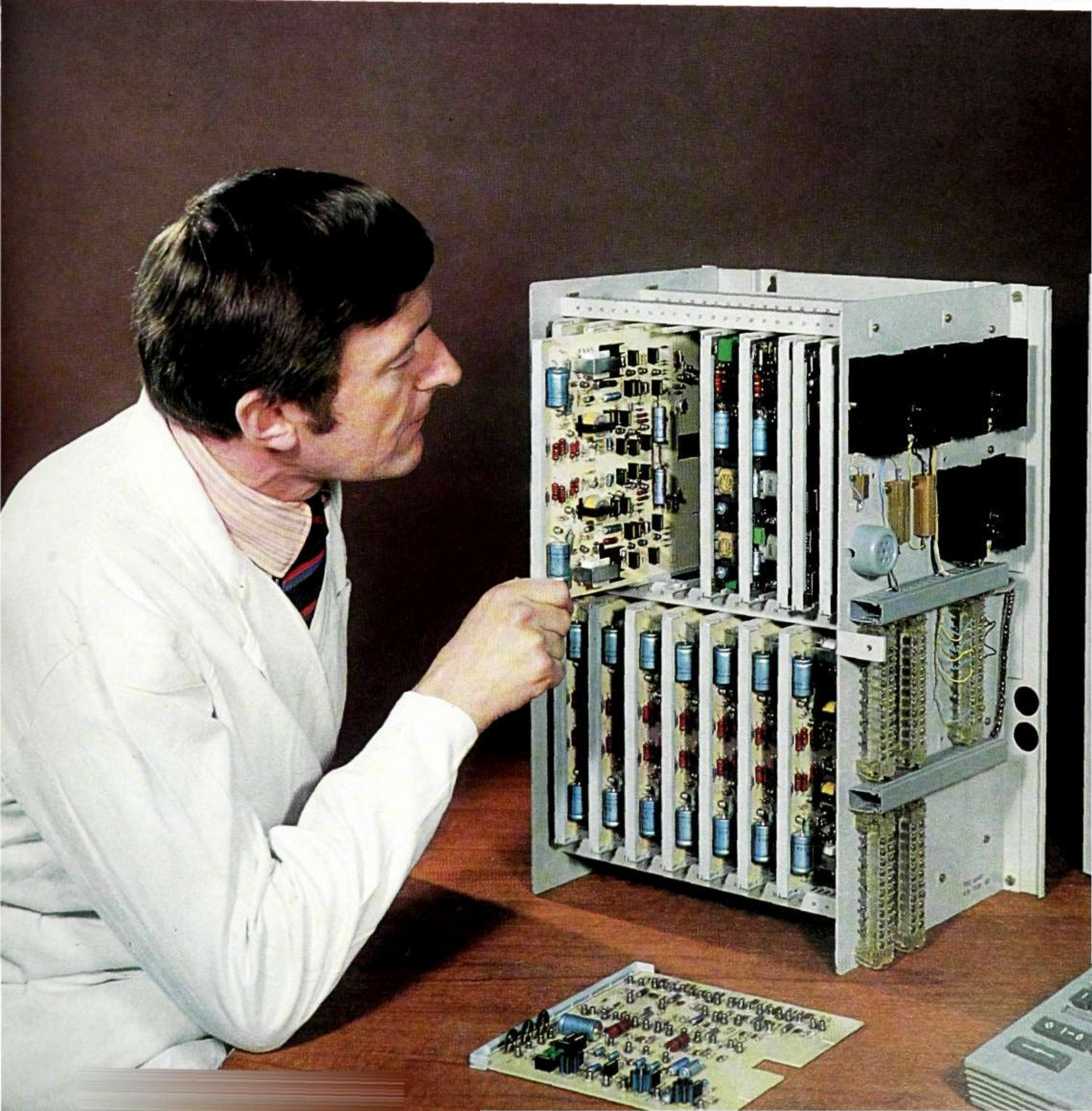
1971



ERICSSON REVIEW

Vol. 48 No. 2 1971

RESPONSIBLE PUBLISHER: CHR. JACOBÆUS, DR. TECHN.

EDITOR: SIGVARD EKLUND, DHS

EDITOR'S OFFICE: S-126 11 STOCKHOLM 32

SUBSCRIPTIONS: ONE YEAR $1.80; ONE COPY $0.60

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On cover: Fully solide state TDM (Time Division Multiplex) Intercom Exchange ASE 432 for 20 extensions from L M Ericsson Telemateriel AB

Jutland Telephone Company's Experience of L M Ericsson Rural Exchanges ARK 522

G. PETERSEN, CHR. NEERGÅRD-PETERSEN & K. VESTERGÅRD, JUTLAND TELEPHONE CO. AARHUS

UDC 621.395.722(489)
LME 8354

The Jutland Telephone Company (JTAS) has a large telephone network with several hundred rural exchanges. Rural automatic exchanges in Jutland were earlier to a large extent of LM Ericsson type ARK 521. A new type, ARK 522, which is superior to ARK 521 especially from the points of view of installation and extension, was however introduced in the network in 1968. This article presents the Administration's experience of ARK 522 from different points of view.

Operating Area, Subscriber Distribution, and Growth of Automatization

The operating area of the Jutland Telephone Company comprises Jutland with surrounding islands as far south as the Kolding, Grindsted and Ribe zones.

The total extent of the area is 25,550 km² and the population 1.95 million. On December 31, 1970, the number of subscribers was 391,000, distributed over the following exchanges:

146,000 subs. connected to	30 exchanges of type *ARF10+ARM 20*
2,300 ,, ,, ,,	1 exchange ,, ,, *ARF 10+ARM 50*
56,000 ,, ,, ,,	10 exchanges ,, ,, *ARF 10*
10,100 ,, ,, ,,	13 exchanges ,, ,, *ARK 521+ARM 50*
2,500 ,, ,, ,,	3 exchanges ,, ,, *ARK 522+ARM 50*
29,700 ,, ,, ,,	96 exchanges ,, ,, *ARK 521*
51,400 ,, ,, ,,	177 exchanges ,, ,, *ARK 522*
21,500 ,, ,, ,,	27 exchanges with registers, other makes, crossbar
27,100 ,, ,, ,,	113 exchanges without registers, other makes, crossbar
44,400 ,, ,, ,,	221 manual rural exchanges

It is expected that the 221 manual rural exchanges will be replaced by 171 automatic rural exchanges type *ARK 522* before the middle of 1974. There will thus be a total of 348 exchanges *ARK 522* serving about 120,000 subscribers by the middle of 1974.

With few exceptions all exchanges were manually served before the automatization of the Aarhus area in 1953. Rural automatization based on *ARK 521* started with the opening of the Øster Hurup exchange in December 1962, and in September 1968 the Administration went over to *ARK 522*.

By the time of the completion of the automatization in 1974 the Administration will have crossbar exchanges throughout the network.

Network Structure

The Jutland network is built up around four district centres, under which there are a number of zone centres.

The zone centres contain registers for a number of terminal exchanges. According to the network planning principle adopted hitherto they have in many cases served also as transit point for one or more group centres.

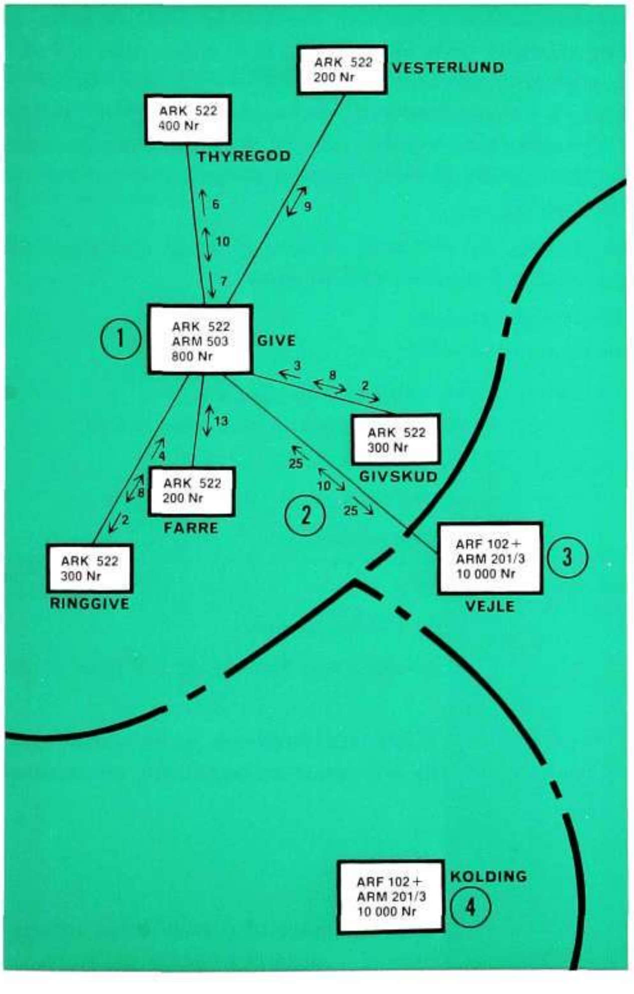
One function of the group centre is, on traffic engineering grounds, to serve as transit point for a number of terminal exchanges. Another function, from the line engineering aspect, is to serve as register point for a number of remote terminal exchanges where the maximum loop resistance of the rural circuits (2000 ohms combined with 20 I.P.S. dial) would not suffice for connection to a zone centre without the use of unreasonably large conductors (> 0.9 mm).

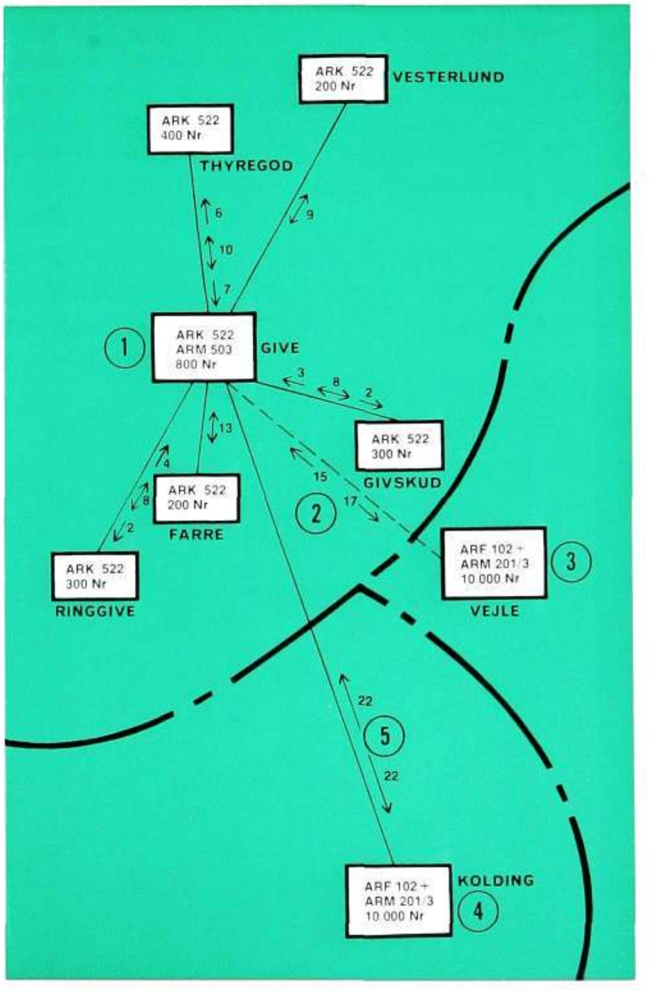
Especially owing to the rapid development of carrier technique this network structure is being changed. Group centres which, on traffic engineering grounds, are warranted as transit points are being successively connected direct to a district centre and thus become zone centres. Group centres which, on the other hand, were only warranted on account of the high loop resistance become terminal exchanges, which, with other terminal exchanges in the area, are connected on carrier direct to a zone centre.

Fig. 1 shows the Give group area with the Give group centre connected to the Vejle zone centre before the conversion of the Give exchange from group to zone centre. Fig. 2 shows the conditions after the conversion, with a main route between Give and Kolding and a direct (high-usage) route between Give and Vejle.

Fig. 1 (left)
Prior to the conversion of the Give exchange to Zone centre
① Group centre
② Carrier
③ Zone centre
④ District centre

Fig. 2 (right)
After the conversion of the Give exchange to Zone centre
① Zone centre
② Carrier
③ Zone centre
④ District centre
⑤ Carrier
--- Direct route (high usage route)





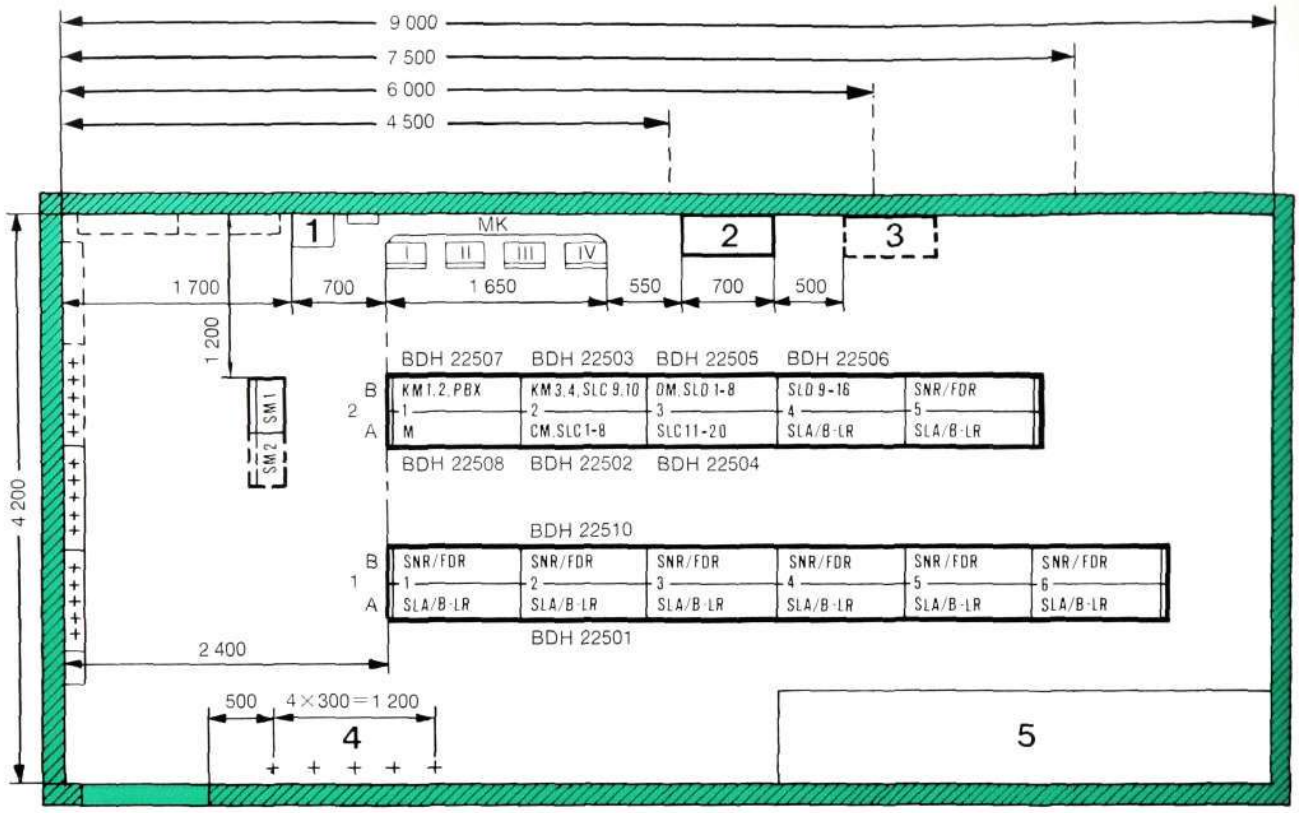


Fig. 3

Small type of exchange building

Rack height: 2700 mm
Rack width: 961 mm
Ceiling heigh: 3350 mm
1 Metering equipment
2 *Coin-box equipment*
3 Coin-box equipment
4 Carrier equipment
5 Power

Extension Policy and Rules for Switch Calculation

Since the start of automatization it has been the Administration's policy to extend the capacity in as small steps as possible. This means that the Administration does not work with optimum economy if one considers solely the operating and first costs of existing automatic exchanges. The capital released through adoption of this principle, however, can be used for automatization of manual exchanges, which in the present situation outweighs the aforementioned economic disadvantages.

For calculating the number of switching devices in rural exchanges the following rules are employed in more than 95% of cases:

- Exchanges < 800 lines: single markers
  Exchanges ≥ 800 lines: double markers
- Exchanges < 400 lines and without direct circuits: single *KM*
  Exchanges ≥ 400 lines and/or with direct circuit: min. 2, max. 3 *KM*
- Exchanges < 500 lines: no local registers
  Exchanges ≥ 500 lines: min. 2 local registers
- Number of $SNR = 2 + \dfrac{\text{number of subscribers}}{50}$
- Extensions are made in steps of entire 100-line groups
- The number of repeaters and the grouping are decided on the basis of the measured traffic.

These rules mean that continuous traffic measurements in individual rural exchanges are superfluous and that only occasional measurements are required at lengthy intervals.

Buildings and Savings

The rural exchanges are housed in buildings made of prefabricated concrete units on a cast foundation.

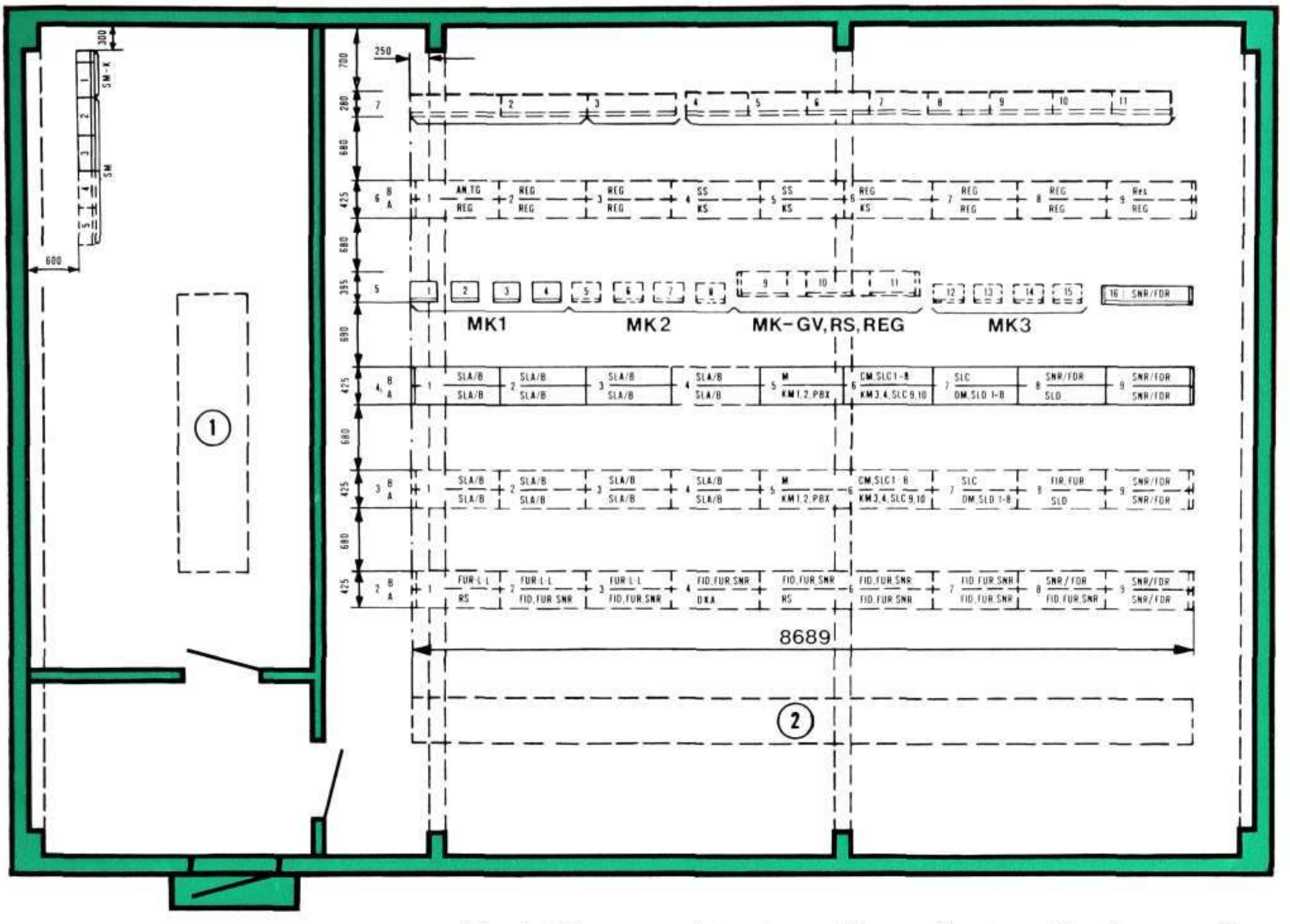


Fig. 4
Large type of exchange building
Rack height: 2700 mm
Ceiling height: 3420 mm
Ceiling height under beam: 3000 mm
① Main distribution
② Carrier equipment

The buildings are of two types. The smaller type (fig. 3) ranges from 4.2×4.5 to 4.2×9.0 m and is used for exchanges which, within the foreseeable future, are not expected to have a capacity greater than 1600 subscribers. The larger type ranges from 9.25×13.75 m to 9.25×18.25 m and is used for larger rural exchanges (twin exchanges) and for rural exchanges which are expected to be combined with transit exchanges. Fig. 4 shows a building with twin exchanges, the dimensions being 9.25×13.75 m.

The Administration regards the design of *ARK 522* with 100% plug-and-jack connection as an important rationalization measure — both for the installation of new exchanges and especially for the extension of existing exchanges.

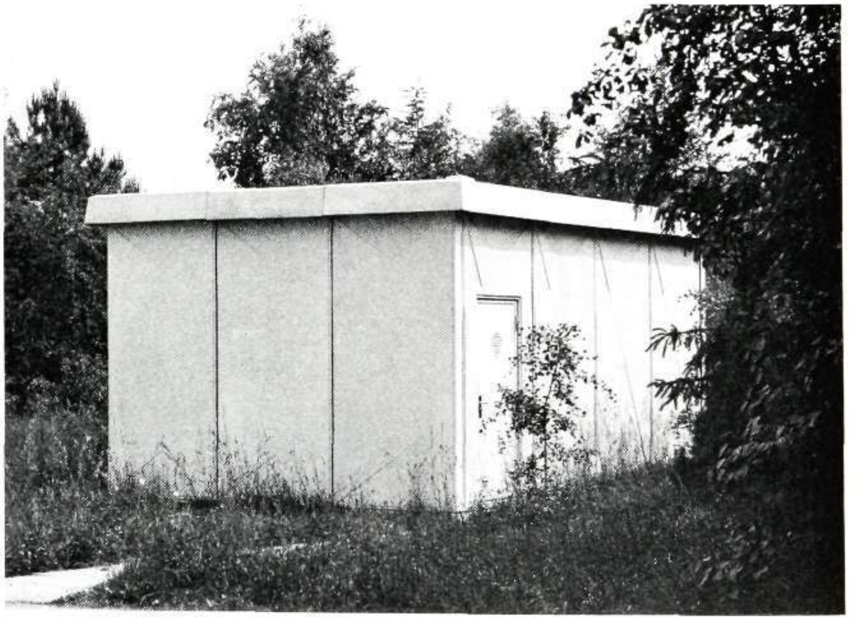


Fig. 5
Rural exchange building 4.2×6.0 m

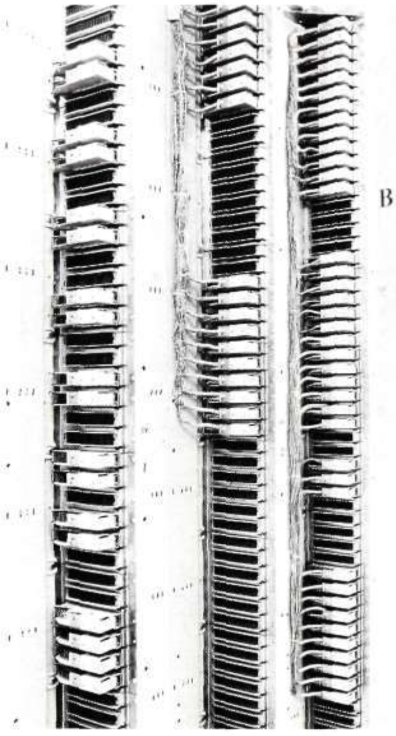


Fig. 6
I.D.F. with plug-and-jack connection

It is a great advantage in particular that the I.D.F. is based on plug-and-jack connections (fig. 6). Earlier an alteration of the grouping had to be done by soldering, often at a very rapid pace during an entire night or even an entire week-end. With *ARK 522*, on the other hand, the entire rewiring of the *BDH* intermediate distribution frame is done in a very short time.

The standardized grading patterns and plug-in, factory-made grading cables of the *ARK 522* exchanges fit the Administration's extension and switch calculation policy like a glove. It is the Administration's experience that the time spent on extension and alteration work, both in the drawing office and in the field, is usually 25% less for *ARK 522* than for *ARK 521* with its fixed cabling. This is most marked in conjunction with the introduction of a *D*-stage, when the saving of time exceeds 45%.

In economic analyses it should also be noted that up to 25% of the installation and testing work can be done in a central workshop, so that fairly considerable savings are made compared with decentralized exchange installation.

Fault Rate

The fault statistics for 111 exchanges *ARK 522* with a total of 51,800 subscribers show for the first six months of 1970 an average fault rate of 15 per 1000 subscribers and year. The exchanges are, however, new and experience shows that the fault rate diminishes after a certain run-in period.

Present Maintenance Method

The present maintenance method is based chiefly on subscribers' complaints and routine tests.

Of the number of faults repaired 36% have derived from subscribers' complaints, 45% from routine tests, 7% from fault alarms, 7% from test calls from a superior zone centre, and 5% from fault reports from other exchanges.

Supervision by Traffic Route Tester (TRT)

JTAS' nationwide test traffic programme includes also tests of incoming traffic to *ARK 522* rural exchanges. The tests are carried out with *TRT* from a zone centre to an answer tone generator in the *ARK 522* rural exchanges.

These traffic route testers have been modified to comply with JTAS' principle of automatic shifting between the *B* groups instead of using push-buttons, so that calls from 10 *A*-numbers can be automatically obtained to max. 200 *B*-numbers.

Routine Tests in the Exchange

Test of Metering

The metering is tested as often as once a quarter by manual means, as JTAS considers that even if the probability of metering faults is very small, a fault is all the more serious when it occurs.

Every link circuit is tested for local rate based on Karlsson metering and every repeater is tested for the rate on direct routes and the rate from the superior exchange.

As aid to the repairman the subscriber's meter of the test number has been connected in parallel with a bell which tinkles every time a metering pulse is received. By means of a stop-watch the repairman can check the time between each two bell signals, i.e. can check the rate.

The test is carried out during normal working hours when the exchanges are carrying traffic and — for an exchange with 500 subscribers, 12 cord circuits, 7 *FUR* and 10 *FDR* — takes about 5 hours. Adding 1 hour for travel, the tests take a total of 24 hours per year.

The rate determination at the zone centre is tested in the zone centre with the automatic rate tester, so that at the rural exchange it is necessary merely to check that the meter pulse transmission was correct.

Test of Traffic Routes

The outgoing traffic from the Administration's rural exchanges has been kept continuously under observation by means of regular visits to the exchanges and through a systematic, nationwide test call procedure. The travelling inspectors carry out the tests with ordinary telephone sets.

Calls are made to the zone centre in the home area, followed by calls to zone centres in others areas. Each rural exchange is visited twice during an 18-weeks period and the results constitute a part of the maintenance reports issued by the Telephone Administration in Denmark every 14th day and every 18th week.

Fault Alarms

Certain fault alarms from the exchanges are today transmitted to a superior exchange. Only two categories of alarm are issued, major and minor alarm.

Planned Maintenance Method

The present method, with lengthy periodical tests and subscribers' complaints as the basis for fault repair, is expensive. Measures for changing this procedure must therefore be taken.

The *ARK 522* system has been designed with a view to the adoption of controlled corrective maintenance. This, in conjunction with certain alterations in the present maintenance method, will mean that the Administration can reduce routine tests and can detect and repair faults before they are reported by subscribers.

The organization of the planned new method is outlined below.

Centralized Supervision

Test of Metering

The Administration plans in most cases to connect a line from the rural exchange to the traffic route tester at its zone centre on a separate pair of wires. When the length of circuit makes this uneconomical, or when there is no circuit available for the purpose, it is the Administration's intention instead to connect a so-called satellite equipment at the rural exchange, adapted for interworking with the *TRT*.

If a separate pair of wires is used, the metering pulses are transferred to a special discriminating selector in the *TRT* at the zone centre, which processes the pulses and reports the result in the normal way.

Using satellite equipment, the metering pulses can instead be transmitted by voice frequency on a set-up test connection.

With these two methods considerable savings can be made, since the manual metering test procedure can be avoided.

Testing of Incoming and Outgoing Traffic

If a line in a rural exchange *ARK 522* has been connected as test number in the *TRT* of the associated zone centre, there is nothing to prevent automatic testing from it of outgoing and incoming traffic at the rural exchange.

This can be done even if a satellite equipment is provided instead at the rural exchange. This equipment is called from *TRT* by dialling of the test number. The satellite equipment closes a loop to an *A* test number in *ARK 522* and dial tone is sent from there via the satellite equipment to *TRT*. *TRT* then transmits the desired number, at voice frequency, which is converted in the satellite equipment into dial pulses.

In this way it is possible automatically to test all outgoing routes from *ARK 522*, and also internal traffic.

Incoming traffic is tested in the normal way.

Built-in Supervisory Equipment

Service Alarm System

JTAS will also make use of the service alarm equipment. The service alarm unit *DLNR* is standard equipment in the rural exchanges. This equipment is designed for continuous supervision of the quality of operation. It consists in principle of a store (zeroable counters and relay chairs), which counts the number of failed connections in relation to the total number of attempted connections. If the fault rate exceeds a predetermined level, an alarm is issued to the superior exchange. Both major and minor alarms can be issued. The equipment is zeroed when a predetermined number of connections have been recorded.

Equipment for Fault Tracing

Analysis Counters

ARK 522 has ten non-zeroable analysis counters placed on the M.D.F.

The first seven counters provide a rough picture of various fault conditions, while counters 8 and 9 provide information for evaluation, for example, of subscribers' complaints concerning the absence of dial tone owing to a shortage of circuits. Counter 9 is used also for counting the number of occupations of local registers. The tenth counter shows that a fuse relay has operated.

The use of a "counter box" permits a more exact analysis, as up to 40 points in the exchange can then be supervised.

By means of special arrangements this counter box in a large exchange with two markers can be so connected that on one occasion it checks one half of the exchange and on the other the other half.

Unit for Directing Calls (DKS)

In order to be able to test a specific device during fault tracing, a unit for directing calls can be used for selecting a given switching path through the selector stages.

Summary

The *ARK 522* rural exchange is flexible from the network planning aspect, is simple as regards switch calculations, can be extended in small steps, can be installed and extended by rational centralized methods with a great saving of costs, can be quickly graded and the grading pattern can be quickly altered, has a low fault rate, and offers the means of controlled corrective maintenance. The latter involves great savings, as all manual testing of rural exchanges is then unnecessary. Visits to rural exchanges need be made only when the built-in supervisory equipment or the test traffic indicate that a fault exists.

All-Electronic Intercom Exchange ASE 432 — a New Step in the Development of Intercom Telephony

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The article briefly describes a recently developed intercom exchange. The exchange is based on the time-division multiplex principle and is all-electronic. The properties of the intercom system and the principles of time-division multiplex are described.

Some important switching processes are presented, as well as the mechanical structure of the exchange.

Fundamental innovations have been introduced in the course of the years within the field of loudspeaking intercom systems. A typical example is the voice-controlled two-way amplifier or, as it is often called, the duplex amplifier. Natural voice control has eliminated the need for manual switching of the direction of speech, which many considered troublesome.

The exchange is one of the series of modern exchanges making up the *AVF 404* system. The intercom stations for this system are available in a number of types for different needs and can be used with all exchanges. This means that already installed stations can be retained when changing to a larger exchange.

Apart from minor modifications the centralized two-way amplifier is identical to the well-known *AVF 404* amplifier.

The popularity of the intercom is based chiefly on the following characteristics:

- Quick contact — direct access is obtained by pushing one or a couple of buttons
- Connection is normally obtained directly without any action being required by the called party. This means that conversation can be conducted at a fairly large distance from the intercom instrument
- The called party can prevent direct access by pushing a special button — privacy condition
- Quick, simple communication — results in short conversations and quick messages — rational work. Average conversation time less than 30 seconds
- Low operating cost — high reliability.

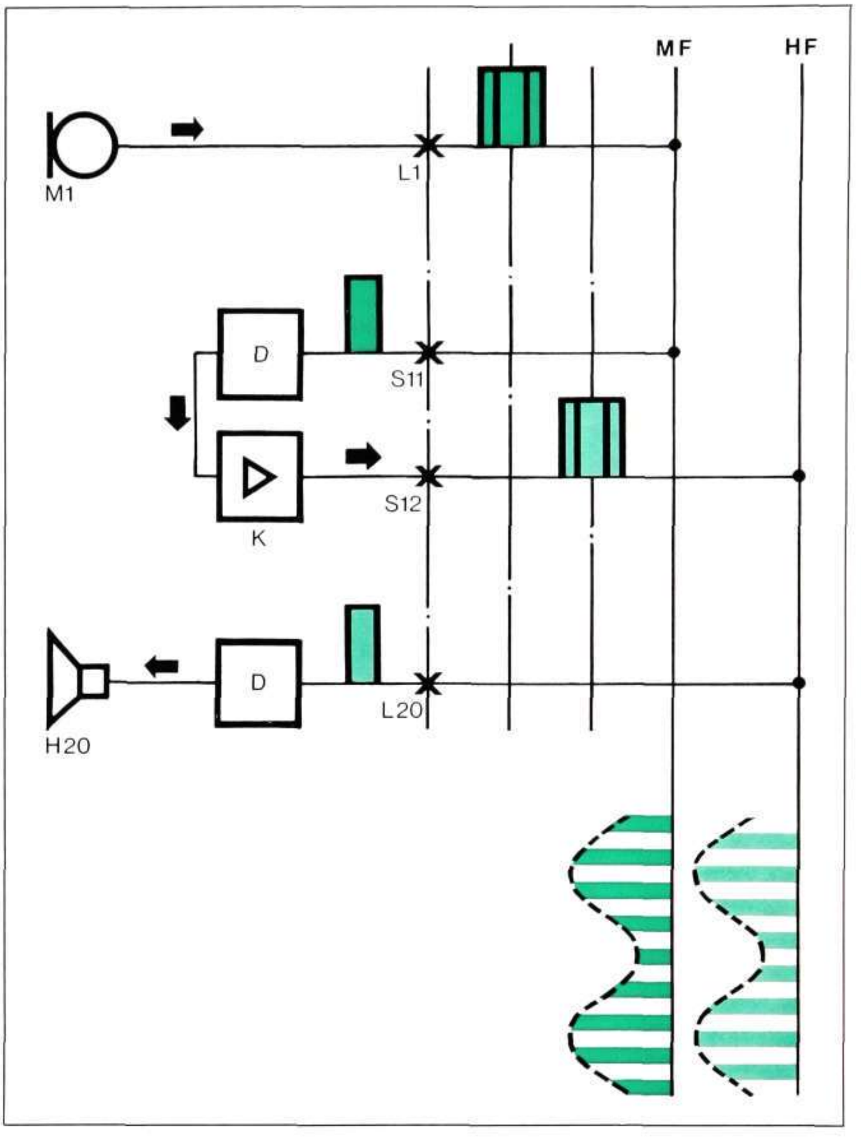
The electronic exchange *ASE 432* offers additional advantages:

- Silent operation permits installation of the exchange in ordinary office rooms
- Small dimensions
- Low weight
- Low installation cost — one-man job

Fig. 1

One-way connection

M	**Microphone**
H	**Loudspeaker**
D	**Demodulator**
K	**Amplifier**
MF, HF	**Microphone and loudspeaker highways**
X	**Electronic switches—L for lines, S for connecting circuits—actuated in time positions marked by colours**
➡	**Natural speech**
	Pulsed speech on MF and HF in different time positions



- Use of plug-in printed circuit boards provides great flexibility and permits simple extension of the system by plugging-in of additional boards
- Quick service through change of printed circuit boards and centralized repair of faulty boards.

Principle of Time-Division, Multiplex and Transmission of Speech

The intercom stations are connected on four wires to the exchange, with one pair for the microphone and one pair for the loudspeaker. The speech switching network can therefore be built up on a four-wire basis with one-way connections.

Every extension line can be connected via individual electronic line switches to two common circuits known as highways. The microphone circuits are connected to one highway — the microphone highway — and the loudspeaker circuits to the other highway — the loudspeaker highway.

The inputs and outputs to and from the channels of the two-way amplifiers are also connected to microphone highway and loudspeaker highway via individual connecting circuit switches.

The connection from a microphone (e.g. *M1*, fig. 1) to a loudspeaker (*H20*, fig. 1) is established by periodical closure of the respective line switches *L1*, *L20* and connecting circuit switches (*S11*, *S12*) during very short intervals of time. Brief samples of the incoming natural speech (black arrow) are thus transmitted in the form of amplitude-modulated pulses (green broad pulse) to the microphone highway *MF*. The pulses are then taken to a demodulator via the connecting circuit switch *S11*, which closes for a shorter time than the width of the pulse. The function of the demodulator is to fill out the gaps between the pulses so that natural speech is again obtained (black arrow). The demodulation to natural speech permits the use of the normal duplex amplifier. The signal is taken to the input of an amplifier. On the amplifier output the natural speech is again modulated by connecting circuit switch *S12* and the resulting pulses are taken to the loudspeaker highway *HF*. This modulation takes place in a different time position than that for contacts *L1* and *S11*. The output pulses are therefore indicated in a different time position (light green broad pulse).

Both on modulation and transition an amplitude-modulated pulse is subjected to different influences which may give rise to time errors or disturbances. The switch through which the pulse is transmitted to the demodulator is therefore closed for a shorter time than the width of the pulse, so that imperfections at the start and end of the pulse can be eliminated. The amplitude-modulated pulses in the loudspeaker highway are connected via the individual switch *L20* of the loudspeaker circuit to the demodulator. After demodulation natural speech is extended to the loudspeaker.

Fig. 2 shows the principle of the two directions of conversation with time positions for a two-way connection. The common highways *MF* and *HF* are utilized on the time sharing principle, the basic period containing 16 consecutive time positions, each corresponding to a one-way circuit. Eight two-way connections can be carried simultaneously on the highways.

Each time position has a pulse width of 4 μs. The sampling interval is thus 64 μs and the sampling frequency close to 16 kHz, which can be simply filtered out from the natural speech.

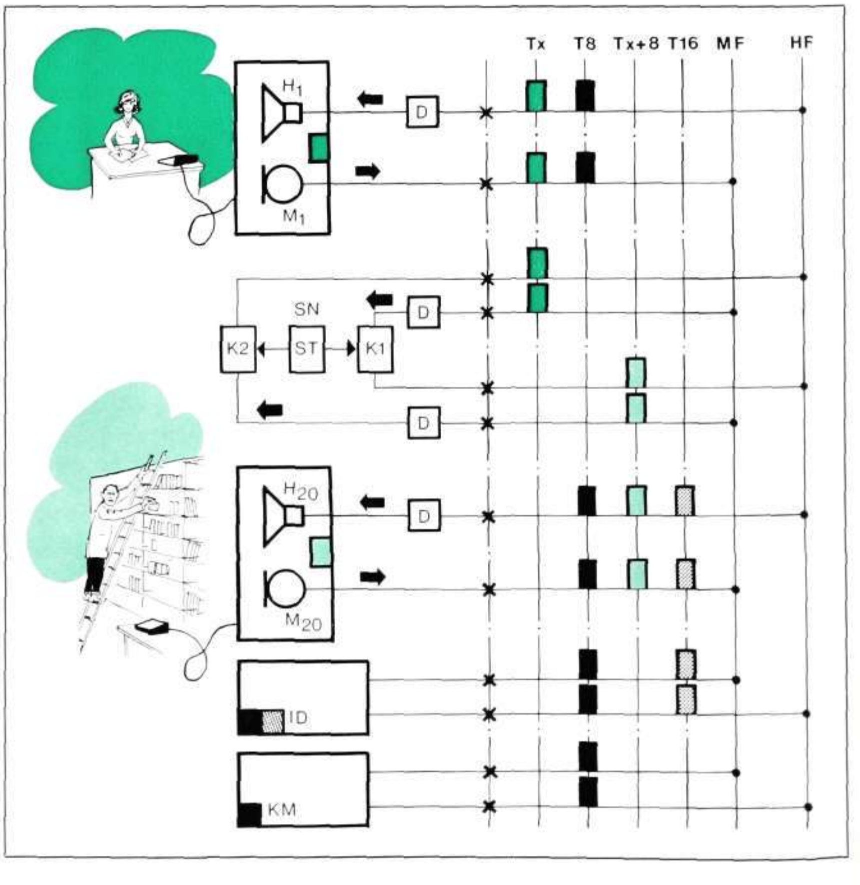


Fig. 2

Two-way connection

Notations as in fig. 1, and in addition:

T Time position
ID Identifiers in T8 and T16
KM Number code receiver in T8
ST Voice control devices which regulate the duplex amplifier K1, K2 according to the direction of speech

The diagram shows how line and *ID* switches are actuated in different time positions.

The process can be followed by means of the pulses marked by colours:

- during conversation (Tx and Tx + 8)
- for line scanning and reception of number code (T8) and for test condition of called extension line (*T16*)

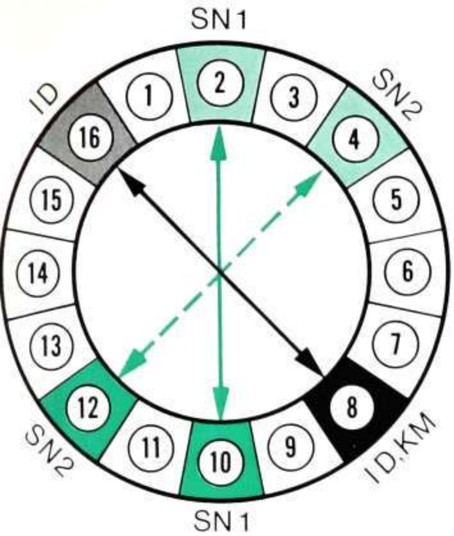


Fig. 3

Utilization of time positions in ASE 432

1—16 Consecutive time positions
SN Connecting circuit with voice-controlled duplex amplifier which is connected to the
- caller in Tx (x = 1—7)
- called party in Tx + 8

ID Identifier—connected in T8 and T16
KM Number code receiver—connected in T8

In larger exchanges a larger number of connecting circuits are connected in free time positions.

SN, ID and KM have fixed time positions and the extension line switches are allotted some of them. Cf. fig. 2.

In the time positions of the connecting circuits ID scans the information in the memory.

Exchange *ASE 432* has equipment for 20 extensions and 2 connecting circuits, each connecting circuit having two time positions (fig. 3). A further two positions are required for the central control devices — the identifier *ID* and the number code receiver *KM*. The remaining 10 times positions are intended for larger exchanges with a larger number of connecting circuits. The exchange also has a central memory equipment *REG*.

The switches to be actuated in the various time positions are tested cyclically. Every time a time position *T8* is passed, *ID* and one of the extensions are connected to the highways so that a call can be detected.

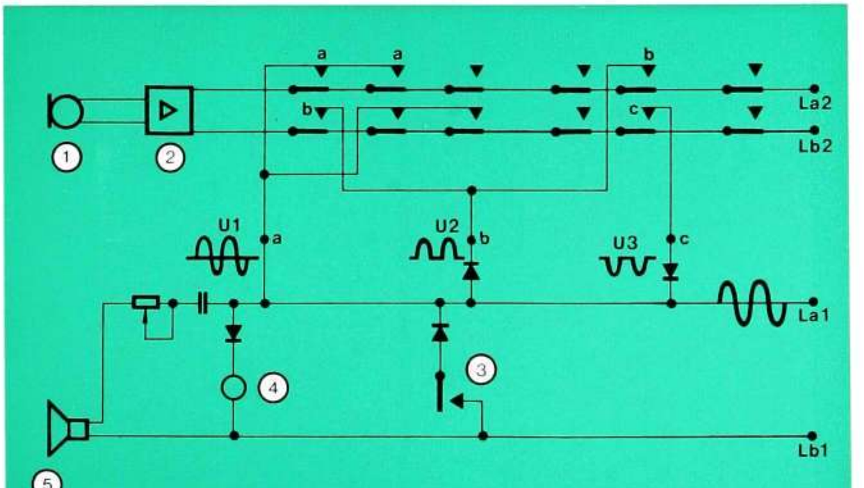
Keying Procedure

A call is made by keying the number of the wanted extension. Both the calling and called extension lines are thereby normally seized. Loudspeaker circuit *La1* has +30 V and is connected by means of diodes to the two microphone circuits in 12 combinations (see fig. 4 with table) for numbers 1—9, 0 and two buttons for special facilities. The combinations are so chosen that there is always +30 V on the microphone circuit, which indicates a call.

When, in time position *T8* (fig. 2), *ID* encounters a call, the line scanning stops. *KM* is connected in parallel with *ID* and a voice frequency is superimposed on *La1*. *KM* detects the number code. At the same time *ID* in *T16* tests the condition of the wanted extension line. A free connecting circuit *SN* is seized and data for both extensions are registered in the memory *REG*, which thereafter controls the connection of the line switches of the two extensions in both time positions of *SN*. Including test of called line condition, a connection takes about 20 ms (0.02 s) to set up.

Switching Procedure

Called extension free. The first call tone is sent to both loudspeakers from *ID*, after which *ID* and *KM* are released for new calls. With the *privacy button* in normal position *SN* transmits call tones until the called party presses the talk button and the call is put through. If the privacy button is up, a diode is connected across the loudspeaker circuit and connection is established automatically without action by the called party. The called party can thus answer the call without being in the immediate vicinity of the instrument.



Comb. No.	1	2	3	4	5	6	7	8	9	0	11	12
La2	a	a	-	c	c	-	a	a	b	b	b	b
Lb2	-	b	b	b	a	a	a	c	c	-	a	b

Fig. 4

Extension station

The diagram shows microphone and pre-amplifier, loudspeaker, call lamp and privacy button, and the principle for initiation of call and number code marking.

The code combinations transmitted via the microphone circuits La2 and Lb2 on pressing of a number button will be seen from the table:

— no tone
a full-wave tone
b positive half-wave tone
c negative half-wave tone

Signal a or b is always issued on one of the microphone circuits. Indicates a call.

Digits 1—9, 0 are transmitted when the corresponding button is pressed.

If the call is initiated by combination 12, it goes to extension numbers 11—19, 10. Combination 11 is used for special facilities.

① Microphone
② Amplifier
③ Privacy button
④ Call lamp
⑤ Loudspeaker

Fig. 5

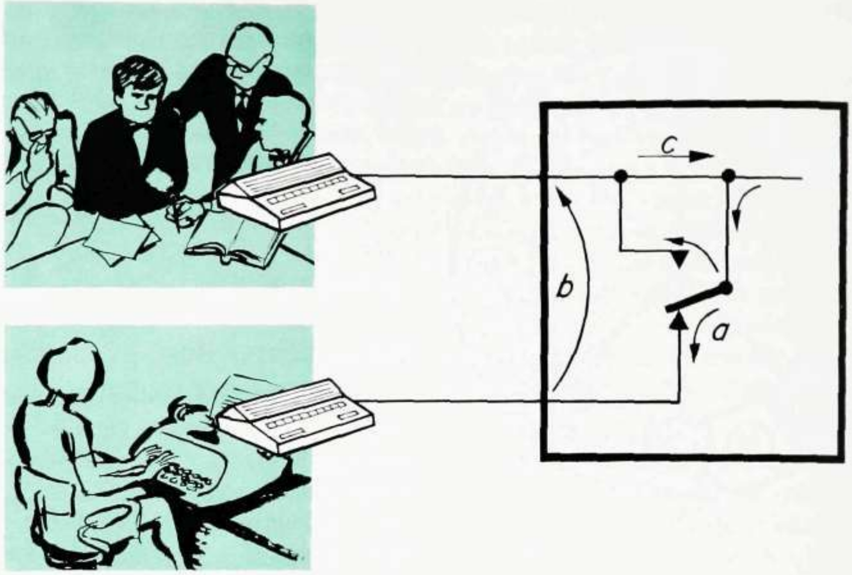
Secretary connection

a When a fingertip switch on the executive's station is actuated, incoming calls are automatically put through to the secretary.

b Only the secretary can override the privacy and call the executive under such conditions.

c Outgoing calls can still be made from the executive's station.

No special cable is required between executive and secretary.



Called line engaged. The line switches of the called party are already allotted the time position of another connecting circuit and must not be actuated by the new call in such a way as to disturb the conversation. *SN* sends seven busy tones to the calling party and then clears the connection.

Congestion tone. If no *SN* is free, *ID* in *T8* sends a special congestion tone to the calling party before clearing the line.

Priority. If the wanted extension or all *SN* are engaged, an extension with priority can make use of this facility by pressing his talk button. A discreet "hurry-up" tone is then sent to the conversing extensions.

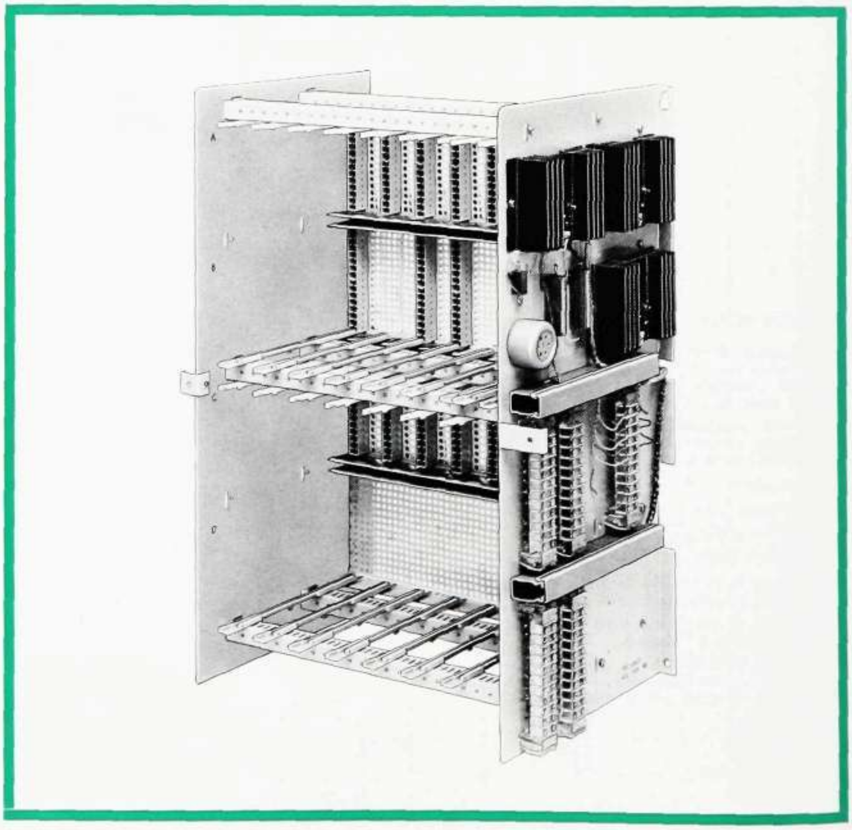


Fig. 6
Rack BDC 604

Clearing of a call takes place automatically or when either of the conversing parties presses his clearing button. A call which cannot be set up is cleared after a short time.

Secretary connection. An executive who wishes to remain undisturbed can press his secretary button. This is indicated in the exchange and calls to the executive are then put through direct to his secretary. The latter can override the privacy and call the executive if necessary (fig. 5).

Feed Voltages

All voltages are stabilized and distributed from the exchange to the microphone amplifiers and microphone circuits of the extension stations. During conversation the call lamps are lit on the stations supplied via the loudspeaker circuits.

Mechanical Features

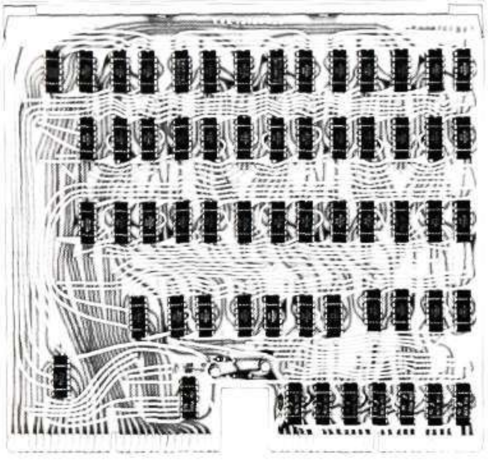
The rack *BDC 604* (fig. 6) is constructed on a modular system which permits vertical and horizontal variations. Between two side walls there are spacers with slots for the guides of the printed circuit boards. The spacers can be arranged for different widths of board. In *ASE 432* all boards are of the same size.

The printed circuit boards are connected to the cabling via L M Ericsson's connectors mounted on an earth plate. On one side of the rack there are terminal blocks for termination of the extension lines. The terminal blocks can also be used for cross-connections.

Fig. 7
Extension stations and exchange ASE 432 (cover removed)

Fig. 8

Memory board (REG) containing 60 integrated circuits



A test jack and the power transistors for the voltage feed of the exchange are also placed on the side of the rack. The rack is protected by a grey-enamelled aluminium cover.

A complete exchange system (fig. 7) contains extension stations, mains power unit and rack with max. 16 printed circuit boards. There are six types of boards, four of which for the basic equipment. These are the identifier board (*IDE*), the memory board (*REG*), the number code receiver board (*KME*) and the stabilization board for internal voltages (*STB*). An optional number of line boards may be added (1-10 *LDE*, each with equipment for two extensions) and one or two connection circuit boards (*SNE*).

Some printed circuit boards are equipped chiefly with integrated circuits. The memory board (fig. 8) is made up of 60 integrated circuits. Other printed circuit boards are equipped solely with discrete components e.g. the line boards (fig. 9).

Technical Data

Operating voltage, 48 DC (4 A), can be taken optionally from a battery or mains power unit.

Line data. The extension stations can be connected via max. 240-ohm line resistance.

Current feed to lamps and microphone preamplifiers of extension stations is connected centrally in the exchange with transistors.

Busy tone consists of seven rapid tones at a frequency of about 445 Hz. Pulse-off and pulse-on times about 1/4 s each.

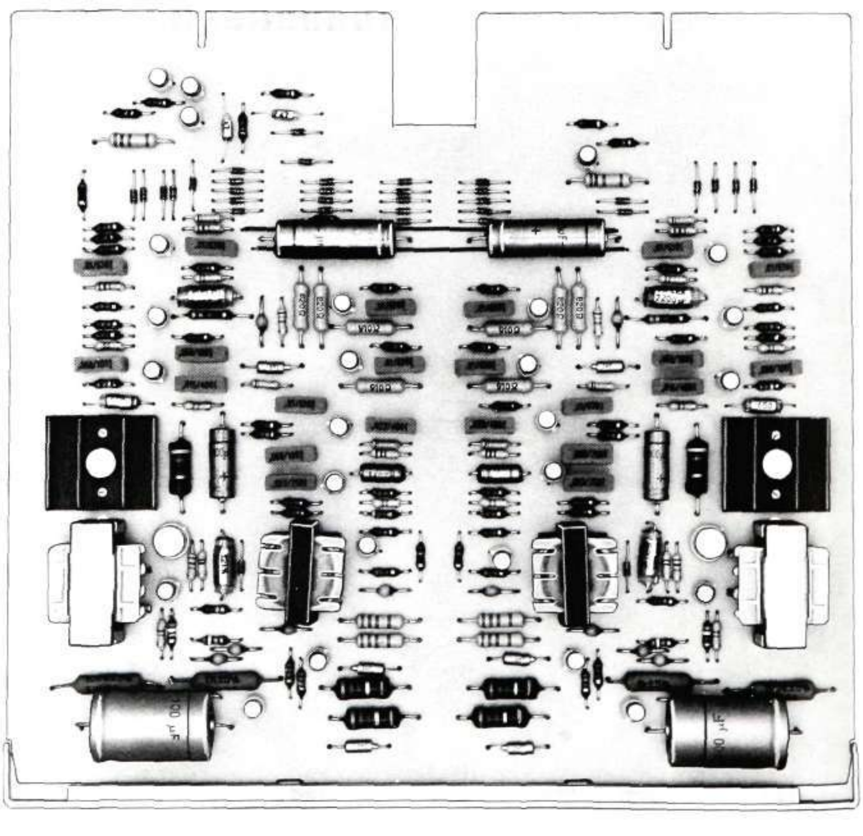


Fig. 9

Line board containing equipment for two extensions

Call tone consists of one 1/2 s tone and, with normal position of privacy button, is repeated about every fifth second.

Congestion tone consists of four tones of 1/4 s length with 3/4 s silent period.

Dimensions 55×39×30 cm.

Weight approx. 19 kg.

Summary

The new intercom exchange is all-electronic, made up of printed circuit boards, and is of low weight. It is of small volume and is silent. It can thus be placed in ordinary office rooms. It is entirely in line with L M Ericsson's other modern intercom exchanges within system *AVF 404*.

The use of time-division multiplex provides a flexible system which permits the use of identical printed circuit boards for exchanges of different sizes.

For the customer the new exchange technique offers convenient means of extension of the system, small space requirement for the exchange, quicker installation, quick and effective service, high reliability and low operating costs.

New, Flexible Register Arrangement ANA 12 for Transit Exchanges Type ARM

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UDC 621.395.344
LME 834

The register is an extremely vital part of a conventional telephone exchange. Especially in national, international and intercontinental transit exchanges the design of the register is of great importance. It should be based on the building block principle to allow for the simultaneous use of several signalling systems. Extensions or alterations of the signalling systems must be simple to perform at any time. There must also be simple means for the introduction of new facilities such as storage of the A number, addition of digits to the B number, etc. The functions which are dependent on the traffic routing should be concentrated to a few devices so as to facilitate changes in the traffic routing. This article will describe how these demands, among others, are fulfilled by the register arrangement ANA 12 for national, international and intercontinental transit exchanges of ARM type.

Basic Principles of System Structure

The register arrangement is divided into a number of units (devices), which are allotted well defined functions. Such functions, which are dependent on the traffic conditions, have been concentrated to special relay sets. In this way it has been possible to standardize the basic equipment of the register and to give every customer a well tested register arrangement.

The signalling and its logic are concentrated to special code receivers *KM* and code senders *KS* (fig. 1). Up to five entirely independent groups of *KM* and four groups of *KS* can be connected to the register arrangement. This ensures that a sufficient number of different signalling systems can be handled in *ANA 12* and that new systems can be simply introduced at any time.

For storage of the *A* number an *ANM/ATT* can be added, and for prolongation of the *B* number by the international code digits an *EMA* is required.

One analyser *AN* is required for up to 24 registers, and in this analyser are concentrated the functions which are dependent on the traffic routing. The necessary reconnections can be made on easily accessible strapping fields in these analysers.

Functions of the Various Devices

Register REG

Before entering into a detailed description of the individual relay sets in *REG*, a brief account will be given of the function of the entire register.

It stores all information relating to the register arrangement originating from

- incoming circuits (*FIR* etc.)
- originating exchange (via *KM*)
- marker arrangement (*VM*)
- analyser (*AN*)
- subsequent exchanges (via *KS*)

After carrying out its own analysis or receiving a request signal, it distributes the stored information to the device concerned at a specific point of time.

The register *REG* contains the following relay sets:

INT stores indications of origin, traffic routing information from preceding exchange, *A*-subscriber category, language digit for operator-controlled international traffic, and end-of-selection signals from *KS*. Sends end-of-selection signals to *FIR* and supplementary signals which may be required for special types of traffic.

MAG stores the *B* number and contains also functions for tests, seizure, supervision and interworking with *AN* and *KS*.

VMS receives and stores prefix information from *MAG*, receives route selection information from *VM* and initiates calls to *KS*.

EMA is a supplementary relay set used for extension of *B*-number storage, e.g. on international calls.

ANM is a supplementary relay set for *A*-number storage when toll ticketing takes place at a superior national transit centre. For international centres with toll ticketing an *ANM* is always required.

ATT with *A*-number storage is used instead of *ANM* at national centres with toll ticketing equipment. For international centres an international *ATT* is used without *A*-number storage for settlements with other countries. If toll ticketing is required for international calls, an *ANM* of normal type is added.

Analyser AN

As indicated by its name, *AN* carries out the necessary analyses. One analyser can serve up to 24 *REG*.

The analyser *AN* consits of the following units:

IDR identifies the calling register and, after selection of one register in case of simultaneous calls from several such devices, connects this register to *TSA*. To reduce the switching time for a waiting register, *IDR* identifies such a register at the same time as *TSA* serves preceding calls.

TSA stores the prefix from *VMS* and the subsequent three digits from *MAG*. If additional digits are required, a supplementary unit must be added. *TSA* analyses stored digits and sends to *MAG* a signal which decides the starting point for *calling of VM*.

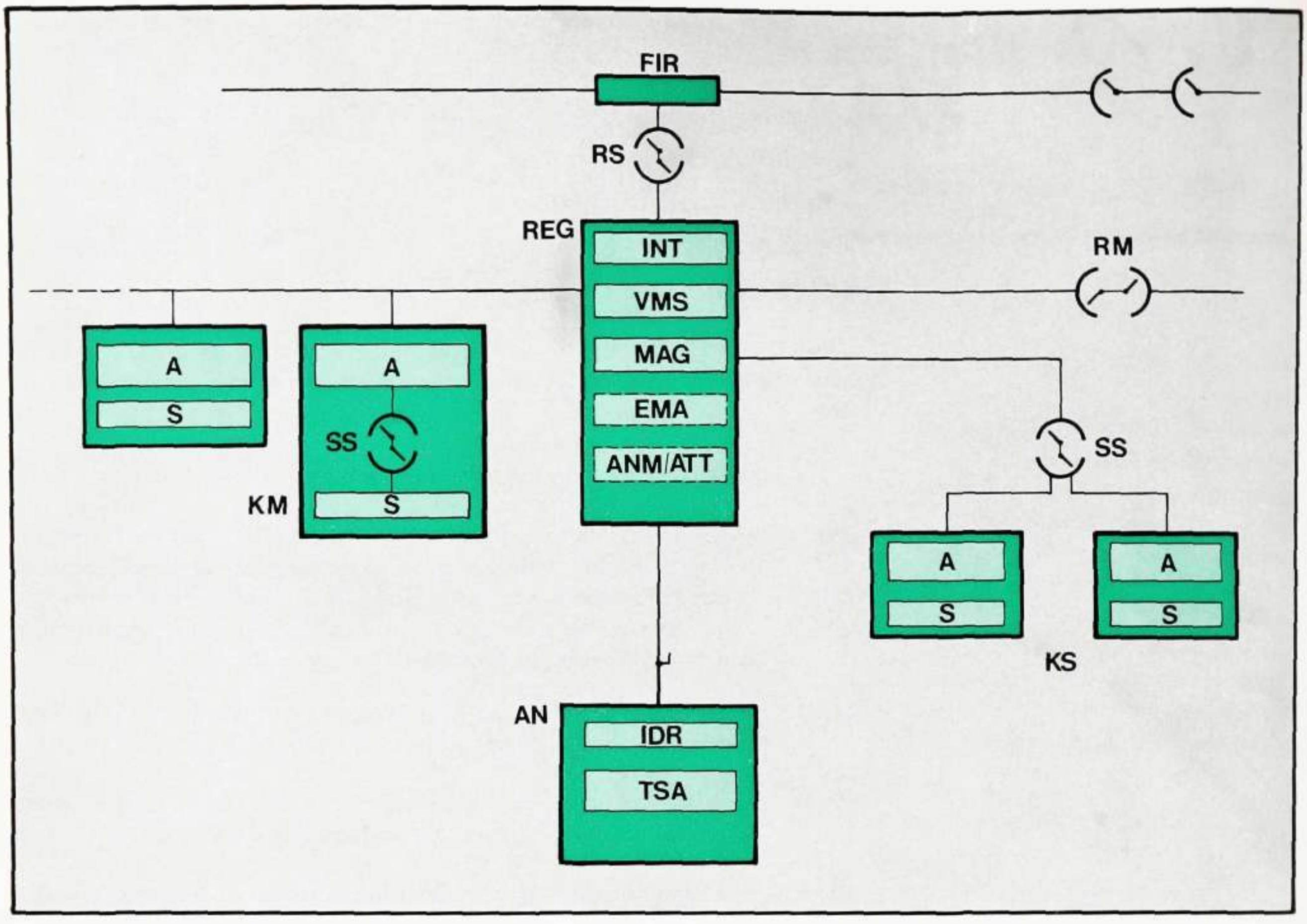


Fig. 1

Block schematic of ARM register arrangement, ANA 12

FIR Line equipment
RS Register finder
REG Register
A A-unit
S S-unit
KM Code receiver
AN Analyser
SS Sender finder
KS Code sender
RM Equiqment for connection of register to route marker

Code Receiver KM

As noted, five types of code receiver can be connected to the register arrangement (two are shown in fig. 1). *KM* contains two types of equipment, the *A-unit* and *S-unit*. The *A-unit* is directly connected to the register. The connection between the *A-unit* and the *S-unit* can either be arranged directly or via a finder *SS*. The two units have the following functions:

A-unit Different types are provided for different signalling systems of the calling *FIR* such as decadic pulsing, *MFC* etc. The correct type of *A-unit* is connected via *REG* to the speech wires of this *FIR*. For decadic pulsing the *A-unit* repeats the *FIR* signals to the *S-unit*, but for *MFC* signalling makes a direct through-connection. After recoding in the *S-unit* the result is transmitted to *REG* via the *A-unit*, which directs the information to the correct store.

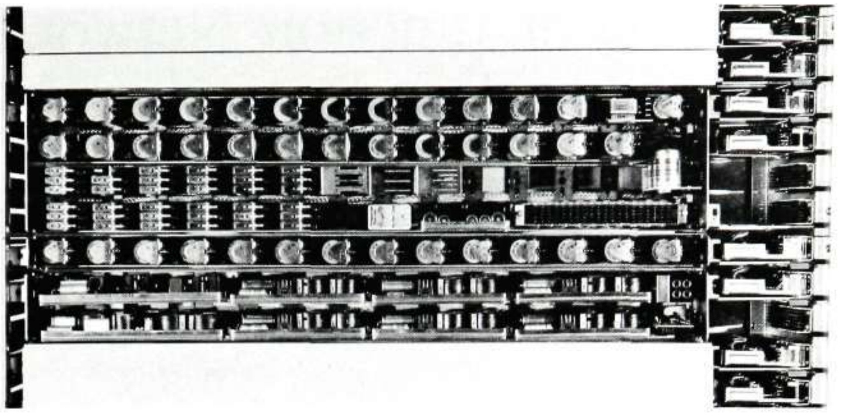
S-unit Also available in variant types matched to the register signalling systems; performs the recoding of information received.

Code Sender KS

Up to four types of code senders *KS* can be connected (two *KS* shown in fig. 1). A maximum of three types of *KS* can be connected to the same group of *SS* finders. If four *KS* groups are to be connected, a second *SS* group is required. One *KS* consists of two units with the following functions:

A-unit receives information from *REG* concerning the type of call, e.g. ordinary call from *KS*, switch-over from other *KS*, or test call. It

Fig. 2
ANA 12, code receiver equipment



stores information concerning the type of traffic and indicates, for example, which digit should be transmitted as first digit in the forward direction.

S-unit sends information in the forward direction in accordance with the signalling scheme of the outgoing line. For *MFC* or similar signalling it also receives signals in the backward direction.

Register Finder RS

Finder with 20-pole through-connection which connects *FIR* to *REG*.

Finder SS

10- or 20-pole finder which connects *REG* to *KS* or the *A-unit* in *KM* to its *S-unit*.

Summary

As a result of the well devised building block principle, a flexible register arrangement is obtained with a limited number of types of relay set, which however cover all requirements of different markets. In view of the uncertainty of future developments this choice of register arrangement permits simple addition or limited replacement of equipment when new system requirements and/or types of traffic arise.

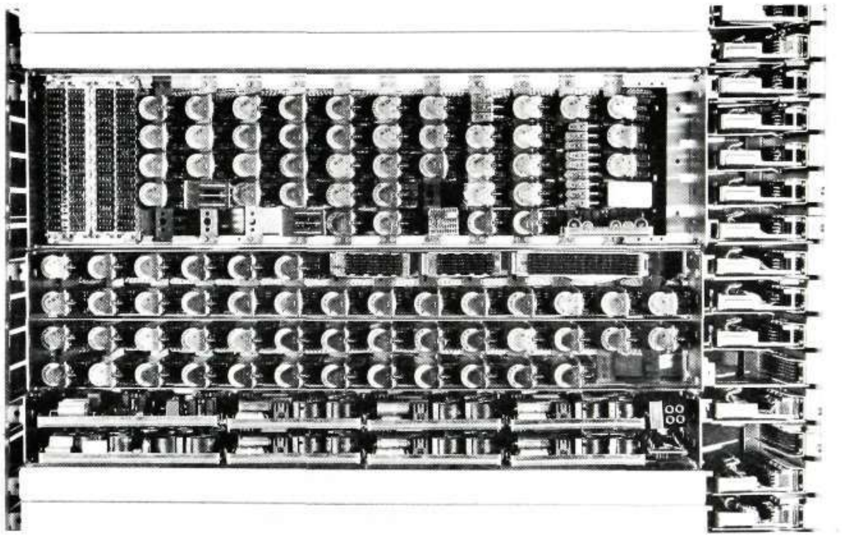


Fig. 3
ANA 12, code sender equipment

Planning of Junction Network with Non-Coincident Busy Hours

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*In contradistinction to the planning of junction networks with coincident busy hours, which is done with the aid of a single value for the offered traffic between each pair of exchanges, the planning of a network with non-coincident busy hours has to be done with the aid of a traffic profile indicating the traffic during a number of time intervals.**

This involves a complication of the problem to such an extent that it is not possible to solve it by traditional methods.

Admittedly an algorithm for exact solution can be developed. But on account of the complicated nature of the problem a considerable calculation time is required on computers available at present.

For this reason an approximate method is presented in this paper, which seems to have an accuracy sufficient for practical applications.

A comprehensive account of the subject has been given in Ericsson Technics No. 1, 1971.

Coincident Busy Hours

In a network with coincident busy hours, in which the offered traffic between each pair of exchanges may be sufficiently described by a single value valid for one and the same busy hour, the planning is done as is known, by a successive treatment of triangles consisting of one high usage route and two tandem routes.

Fig. 1 shows such a triangle where i and j are exchanges and λ a tandem-stage.

The number of high usage circuits is obtained with good accuracy by the following approximate formula

$$F_n(A) = \varepsilon\eta \tag{1}$$

where

$F_n(A) = A \mid E_n(A) - E_{n+1}(A) \mid =$ improvement function

A = offered traffic between the exchanges i and j

n = number of high usage circuits

ε = cost ratio between incremental costs for high usage circuits (i—j) and tandem circuits (i—λ—j)

η = efficiency of incremental tandem (marginal utility)

$\varepsilon\eta$ = improvement factor

Comprehensive calculations on computer has shown[1,2] that

$$\eta = 1 - 0.3(1 - \varepsilon^2) \tag{2}$$

is a good approximation.

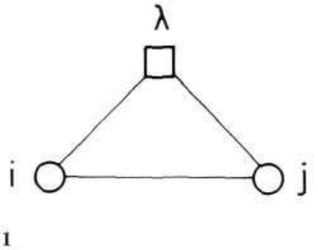

Fig. 1
A triangle in a junction network

i, j Exchanges
λ Tandem stage
ij First choice route
$i\lambda j$ Second choice route

* Extension of a paper "Planning of Junction Network with Non-Coincident Busy Hours" presented at the Sixth International Teletraffic Congress in Munich, September 9—15, 1970.

After having calculated the number of high usage circuits between all exchanges in the network in this way, the traffic rejected to the tandem routes can be calculated and the number of tandem circuits established with the aid of formulae loaned from traffic theory.

From the data regarding the state on the tandem routes it is possible to improve the result obtained with the approximate formulae (1) and (2) by using more sophisticated methods. [1–3]

Non-Coincident Busy Hours

In a network with non-coincident busy hours the traffic between each pair of exchanges has to be defined by a number of data, a *traffic profile*

$$|A| = |A^{(1)}, A^{(2)}, \ldots, A^{(\nu)}| \tag{3}$$

valid for different time intervals, $t = 1, 2, \ldots, \nu$, in order to arrive at an optimal layout.

For any given number of high usage circuits between the exchanges it is possible to calculate for each tandem route a traffic profile

$$|M| = |M^{(1)}, M^{(2)}, \ldots, M^{(\nu)}| \tag{4}$$

The maximum traffic, $\max_t |M|$, attained at a specific time interval t, is evidently decisive for determination of the number of tandem circuits. With known costs for high usage and tandem circuits, together with preassigned values for the permissible traffic losses, it is possible to determine the cost of the network for any preassigned number of high usage circuits.

But the inverse problem, viz. to determine the number of high usage circuits in such a way that the cost of the network is as small as possible, meets with difficulties. This because the specific time interval during which the maximum traffic on a tandem route will occur depends on the number of high usage circuits—which it is our task to determine.

Expressed in another way, one may say that the cost of the network cannot generally be expressed as a derivable function of the number of high usage circuits.

Numerical Example 1

Before going further, the nature of the problem will be elucidated by a simple numerical example.

Say that the traffic between three exchanges i, j, λ in fig. 1, of which λ contains a tandem stage is given during two time intervals $t = 1$, $t = 2$ according to table 1.

Table 1. Traffic profile between 3 exchanges

Traffic	Time interval t	
	$t = 1$	$t = 2$
A_{ij}	12	7
$A_{i\lambda}$, $A_{\lambda j}$	15	18

For simplicity it has been assumed that the traffic profiles for the tandem routes $i\lambda$, λj are identical.

Table 2. Traffic offered to the tandem routes

n = number of high usage circuits

Offered traffic	Time interval
$15+12\ E_n(12)$	$t=1$
$18+7\ E_n(7)$	$t=2$

A calculation shows that the traffic offered to the tandem routes according to table 2 is greatest during the time interval $t = 1$ as long as $n \leq 10$ and greatest during the time interval $t = 2$ as long as $n \geq 11$. From a table over the improvement function, $F_n(A)$, one finds that $n = 9$ as long as

$$F_9(12) = 0.7020 \leq \varepsilon\eta < 0.7468 = F_8(12)$$

and that $n = 12$ as long as

$$F_{12}(7) = 0.08896 \leq \varepsilon\eta < 0.1445 = F_{11}(7)$$

Comparing the incremental cost for $n = 10$ and $n = 11$ one finds them to be equal when $\varepsilon\eta = 0.289$.

From the above it is seen that the number of high usage junctions is determined according to table 3 for different values of the improvement factor ($\varepsilon\eta$).

Table 3. Number of high usage circuits for different values of the improvement factor $\varepsilon\eta$

Improvement factor, $\varepsilon\eta$	Number of high usage circuits, n
$\varepsilon\eta < 0.1445$	from $F_n(7) = \varepsilon\eta$
$0.1445 \leq \varepsilon\eta < 0.289$	$n = 11$
$0.289 \leq \varepsilon\eta < 0.702$	$n = 10$
$0.702 \leq \varepsilon\eta$	from $F_n(12) = \varepsilon\eta$

Fig. 2

Number of high usage juctions, n, as a function of the improvement factor, $\varepsilon\eta$, for traffic profiles on high usage and junction routes according to the example in table 1

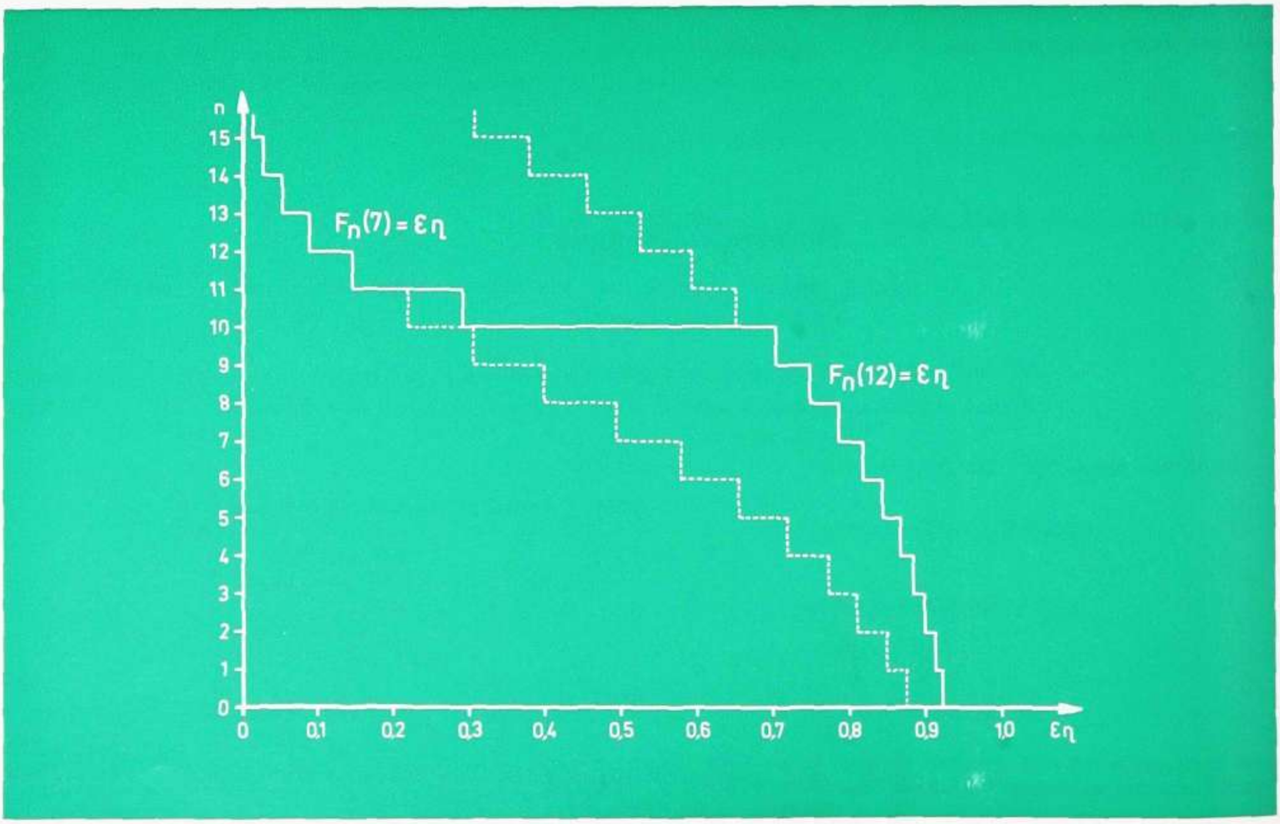

Fig. 2 summarizes the result of the calculations.

The example shows clearly that the number of high usage circuits cannot be determined in the usual way on the basis of a single value for the traffic between the exchanges. The absolute value of the traffic rejected to the tandem routes during different time intervals and for different numbers of high usage circuits must also be taken into account.

A Step towards an Exact Solution

The analysis above suggests the following algorithm for solving a problem of this simple kind when the improvement factor $(\varepsilon\eta)$ is given from the outset.

- Determine an interval (n_0, n_0+1) for the number of high usage junctions within which the traffic offered to the tandem routes intersects for the time intervals $t=1$ and $t=2$ respectively. (If no intersection point exists the traffic at one of the time intervals is dominant and the problem is solved in the usual way, cf. eq. (1).)
- Calculate $F_{n_0-1}(A^{(1)})$ and $F_{n_0+2}(A^{(2)})$ $\qquad (A^{(1)}>A^{(2)})$
- If $\varepsilon\eta \geq F_{n_0-1}(A^{(1)})$ calculate n from $F_n(A^{(1)})=\varepsilon\eta$
- If $\varepsilon\eta < F_{n_0+2}(A^{(2)})$ calculate n from $F_n(A^{(2)})=\varepsilon\eta$
- If none of these inequalities is fulfilled, calculate the cost for $n=n_0$ and $n=n_0+1$ and select the value for n which gives the lowest cost.

The described algorithm may be extended to be valid for several time intervals[4] (up to 24 for international circuits).

With several time intervals and many exchanges, however, this becomes a painstaking task. Furthermore, the complicated nature of the algorithm and the iterative process contained therein will lead to long running time on an electronic computer.

Therefore it seems worthwhile to look for an approximate method for the determination of the number of high usage circuits with an accuracy sufficient for practical applications.

In the next paragraph a proposal for such a solution is presented.

Approximate Formulae for Determination of the Number of High Usage Circuits

In order to calculate the number of high usage circuits the *time-dependent traffic* between two exchanges i and j

$$|A_{ij}| = A_{ij}^{(1)}, A_{ij}^{(2)}, \ldots, A_{ij}^{(\nu)}| \tag{5}$$

is replaced by a fictive *time-independent traffic*, $\bar{A}_{ij}$, according to the following heuristic formula

$$\bar{A}_{ij} = \frac{1}{2}\left| \max_t |A_{ij} + A_{i\lambda}^0| + \max_t |A_{ij} + A_{\lambda j}^0| - \max_t |A_{i\lambda}^0| - \max_t |A_{\lambda j}^0| \right| \tag{6}$$

where $|A_{i\lambda}^0|$ and $|A_{\lambda j}^0|$ are the traffics rejected to the tandem routes $i\lambda$ and λj, respectively, from all high usage routes except the route ij.

Using the value for the fictive traffic obtained from eq. (6) the number of high usage circuits, n_{ij}, is calculated from the formula

$$\boxed{F_{n_{ij}}(\overline{A}_{ij}) = \varepsilon\eta} \tag{7}$$

Calculation of a Junction Network

With the aid of eqs. (6) and (7) the number of high usage circuits in the multiexchange area is calculated iteratively in the following way:

- Put $n_{ij} = 0$ for all high usage circuits and calculate $|A^0_{i\lambda}|$ and $|A^0_{\lambda j}|$
- Calculate $\overline{A}_{ij}$ and n_{ij} from eqs. (6) and (7)
- Adjust the values for $|A^0_{i\lambda}|$ and $|A^0_{\lambda j}|$
- Repeat the calculations using again eqs. (6) and (7).

After determination of the number of high usage circuits in this way the maximum traffic (mean and variance) on the tandem routes is calculated, whereafter the number of circuits is determined with the help of formulae borrowed from the congestion theory[1-3] and a preassigned value for the permissible traffic losses.

Considerations Underlying the Formula for the Fictive Traffic, Eq. (6)

The construction of the heuristic formula for the fictive traffic, eq. (6), is based on the following considerations:

- For coincident busy hours $\overline{A}_{ij} = A_{ij}$ must be valid
- For entirely time separated traffic $(\overline{A}_{ij} = 0)$ must be valid as long as $A_{ij} \leq \min |A^0_{i\lambda}, A^0_{\lambda j}|$
- The type of formula chosen should probably have a certain similarity to the expression for the necessary traffic handling capacity in a simple symmetrical network.[4]

Numerical Example 2

The traffic profile between three exchanges is given in table 4 and one wishes to determine the fictive time-independent traffic, $\overline{A}_{ij}$ and the number of high usage circuits, n_{ij}, for an improvement factor $\varepsilon\eta = 0.4$

Table 4. Traffic profile for three exchanges

Traffic	Time interval t		
	t'	t''	t'''
$\lvert A_{ij} \rvert$	24	5	3
$\lvert A^0_{i\lambda} \rvert$	18	32	17
$\lvert A^0_{\lambda j} \rvert$	29	6	46

One obtains

$$\max_t |A_{ij} + A^0_{i\lambda}| = 24 + 18 = 42 \qquad t = t'$$

$$\max_t |A_{ij} + A^0_{\lambda j}| = 24 + 29 = 53 \qquad t = t'$$

$$\max_t |A^0_{i\lambda}| = 32 \qquad t = t''$$

$$\max_t |A^0_{\lambda j}| = 46 \qquad t = t'''$$

Eq. (6) gives

$$\bar{A}_{ij} = \frac{1}{2}(42 + 53 - 32 - 46) = 8.5$$

If the improvement factor is $\varepsilon\eta = 0.4$, one obtains from eq. (7) $F_n(8.5) = 0.4$ and $n = 10$.

A check made by calculation of the cost for different numbers of high usage junctions ($n_{ij} = 0, 1, 2, \ldots$) gave the result shown in table 5.

Table 5. Check of the numerical example

Grade of service on the tandem routes $E_{i\lambda} = E_{\lambda j} = 0.005$

Variance to mean ratios on the tandem routes	Optimum numbers of high usage circuits	Cost penalty in percent for $n = 10$
1	9	0.3
2	7	0.9

In the next paragraph an account of a computerized numerical check of the proposed approximate method will be given.

Numerical Check of the Proposed Approximate Method

A check of the cost penalty resulting from the use of the proposed approximate method for planning of junction networks with non-coincident busy hours has been made with triplets of random numbers satisfying the following constraints:

$$2 \leq \max_t |A_{ij}| \leq 50$$

$$10 \leq \max_t |A^0_{i\lambda}|,\ \max_t |A^0_{\lambda j}| \leq 100$$

$$\max_t |A_{ij}| \leq \max_t |A^0_{i\lambda}|,\ \max_t |A^0_{\lambda j}|$$

$$A_{ij}, A^0_{i\lambda}, A^0_{\lambda j} \geq 1$$

$$E_{i\lambda}, E_{\lambda j} = 0.005$$

At the same time random number for the variance to mean ratio on the tandem routes were generated fulfilling the condition

$$1 \leq \frac{V^0_{i\lambda}}{A^0_{i\lambda}},\ \frac{V^0_{\lambda j}}{A^0_{\lambda j}} \leq 3$$

to be used for the check of the result obtained from the approximate formulae (6) and (7).

The result of the check is summarized in table 6.

Table 6. Cost penalty in percent for the approximate formula (4.3)

ε = cost ratio between high usage and tandem circuits

k = cost ratio between tandem circuits

Percentile 99 % = upper limit of cost increase for 99 % of examined 2000 triplets of random numbers examined for each value of ε and k

Total of cases tested: $2000 \cdot 3 \cdot 9 = 54{,}000$

Mean *error in the determination of number of high usage circuits* $+1.2$
standard deviation $\sigma = 3.4$

ε	$k = 1$			$k = 1.5$			$k = 2$		
	Mean value	Max value	Percentile 99 %	Mean value	Max value	Percentile 99 %	Mean value	Max value	Percentile 99 %
0.30	0.16	2.97	1.80	0.20	3.38	2.30	0.26	4.46	2.70
0.35	0.14	3.50	1.50	0.19	3.93	1.90	0.28	4.42	2.40
0.40	0.13	3.57	1.60	0.20	3.98	1.70	0.30	4.56	2.20
0.45	0.15	3.59	1.70	0.22	3.94	1.90	0.31	4.54	2.30
0.50	0.21	3.78	1.60	0.24	4.60	2.20	0.32	5.25	2.80
0.55	0.27	3.61	1.90	0.28	4.36	2.50	0.33	5.73	3.20
0.60	0.31	4.08	2.30	0.32	5.02	2.90	0.34	6.61	3.50
0.65	0.35	3.69	2.70	0.35	5.82	3.20	0.36	7.39	3.80
0.70	0.37	4.44	3.10	0.37	6.52	3.20	0.37	8.05	3.90

As seen, the mean cost penalty for the 54,000 cases examined does not exceed 0.5 %.

In this context it may be of interest to note that other methods for calculating the number of high usage circuits, for instance proceeding from the maximum, mean or minimum value for the offered traffic and using eq. (1), give a considerably lower accuracy.

A calculation under simplified assumptions embracing 5000 triplets of random numbers for the traffic on the high usage and tandem routes, during three different time intervals gave the result shown in table 7.

Table 7. Cost penalty in percent resulting from the use of different approximative methods for determination of the number of high usage circuits

Cost ratio $\varepsilon = 0.5$, $k = 1$

Marginal utility $\eta = 0.8$

No regard to the variance of the traffic on the tandem routes

No. of tandem circuits $= L(1/\eta \cdot A)$, a linear function of the offered traffic

Cost penalty	Proposed method eqs. (6) and (7)	Traffic on high usage route		
		max	mean	min
Mean value	0.1	3	1	2
Max value	1	30	11	27

From the table it is seen that a determination of the number of high usage circuits on the basis of the maximum value of the offered traffic between the exchanges gives the worst result.

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ERICSSON *News*

from All Quarters of the World

King Gustav Adolf is shown the voting system by Mr Erkki Mikkelinen during his visit to the new parliament.

Telecommunications Package from L M Ericsson in New Swedish Parliament

There are many impressive features in the new parliament building at Sergels Torg, not least the telecommunications equipment, which is the most extensive of its kind in Sweden. Thanks to meticulous planning, the suppliers, L M Ericsson Telemateriel AB, were able to install the whole of the equipment in as short a time as 15 months. A computer had to be used for planning of the main item, the voting system.

The complete "package" consists of a score of telecommunications systems, of which the voting system is the largest item and, like many of the other systems, is tailored for its purpose.

Contacts between the Swedish parliament and L M Ericsson are of old date. In the early thirties L M Ericsson delivered the first voting system and in 1966 a second voting system to the Swedish parliament.

The new voting system for the single-chamber parliament and its 350 members collects, records, distributes and photographs the results of every vote. The members can throughout follow the voting on a panel behind the speaker's chair. After automatic counting of the votes the result is displayed via TV cameras and a large screen projector on a screen above the voting panel and on a small panel on the speaker's desk, as well as on all TV monitors in the podium and outside the chamber. At the same time a panel showing the vote cast by each member and identifying the question voted on is automatically photographed. The voting system is, of course, provided with extensive alarm and control equipments to avoid breakdowns to the greatest possible extent. 30,000 m of cable was used for the voting system alone.

Apart from the large voting system L M Ericsson's "telecommunications package" contains many types of equipment, among which a sound distribution system through which speech is relayed from microphones to 507 loudspeakers in the chamber and by radio the 536 loudspeakers in the members' rooms and elsewhere.

(cont. p. 76)

From the chamber, where Tage Erlander, senior member of parliament, bids the members welcome to the new single-chamber parliament at its opening on January 11, 1971.

Large Order from Swedish Telecommunications Administration

The Swedish Telecommunications Administration has ordered from L M Ericsson equipment for extension and modernization of the long-distance network to a value of about 80 million kronor. The order comprises carrier equipment for 135 repeater stations, 50 of which are new stations.

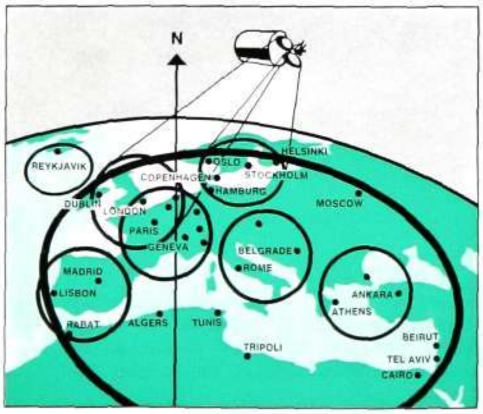
The equipment on order will be delivered over a three-year period starting at the end of this year. The equipment was designed to specifications drawn up jointly by the Administration and L M Ericsson.

Two Important ESRO Assignments for Space Group

The electronics enterprises within the STAR consortium (Satellite for Telecommunications Applications and Research) have received from ESRO (European Space Research Organization) an order valued at 8 million kronor for the planning and development of a repeater (combined receiver and transmitter equipment) for advanced communication satellites.

The repeater to be developed by STAR is intended for a European communication satellite which will transmit telephone calls and TV programmes within Europe (Eurovision). The repeater has a bandwidth of 500 MHz with midfrequency 12 GHz. It will thus make use of a range not previously employed for communication satellites.

The area to be served by the planned communication satellites.



The STAR consortium was created in January this year to develop equipment for advanced telecommunication satellites. L M Ericsson is Swedish member of the consortium, on which there are eight other European enterprises from seven countries.

A first step has now been taken towards the realization of a European telecommunication system with satellites. ESRO have commissioned STAR to investigate the technical problems that must be solved for the effective and economical development of a complete telecommunication system for Europe, consisting of satellites and ground stations.

It is expected that the investigations will be completed during 1971. The system will be based on a very advanced satellite technique, using an entirely new frequency range (12—13 GHz). It is planned that the satellite system shall be brought into use during 1978 and that it will transmit part of the telephone traffic between the European capitals and will also be used for international European TV transmissions within Eurovision.

L M Ericsson's new factory at Kuala Lumpur, Malaysia.

Opening of L M Ericsson Factory in Malaysia

A new L M Ericsson factory for telecommunications material, especially automatic telephone exchange equipment, has been opened in the Malaysian capital, Kuala Lumpur. The opening ceremony was presided over by the Prime Minister, Tun Abdul Razak, in the presence of, among others, the Ministers of Industry and Communications and around 300 other prominent guests.

The factory will initially employ about 150 persons, apart from some 40 employees of L M Ericsson's sales company in Malaysia. The head of the factory and the sales company is Allan Uvhagen.

The factory in Kuala Lumpur is the 26th foreign production unit of the Ericsson Group. Under a general agreement drawn up in 1967 L M Ericsson will deliver during the 5-year period 1967—1972 equipment for public telephone exchanges for 110,000 subscriber lines in Malaysia. The decision to build the new factory was made after a new general agreement had been drawn up in December 1969, comprising equipment for an additional 150,000 subscriber lines for installation during the period 1972—1979.

New Order from Kuwait

L M Ericsson has received from Kuwait an order for telephone exchange equipment to a value of 13.7 million kronor. The order comprises equipment for extension of four existing telephone exchanges. All material on the order will be delivered from L M Ericsson's factories in Sweden.

The new order implies that L M Ericsson retains its leading position as supplier of telecommunications equipment in Kuwait. Its products were introduced in Kuwait as late as 1966, despite which, after implementation of the new order, LME will have delivered equipment for althogether 88,000 of the roughly 128,000 subscriber lines which are then expected to be in operation in the country. Kuwait has a very high telephone density and is rapidly approaching European levels. Within a year or so it is expected to have reached a density of 20 telephones per 100 inhabitants, roughly the same figure as for West Germany. The entire telephone system in the country is automatic.

On December 2, 1970, L M Ericsson's main plant in Stockholm was visited by the French Ambassador, M. P. Francfort, who is here seen with Mr C.-H. Ström, L M Ericsson.

In March L M Ericsson was visited by representatives of the Dutch PTT. (From left) Fred Sundkvist, Vice President of L M Ericsson, A. van Bruggen, Vice President of Ericsson Telefoonmaatschappij, H. Reinoud, Director General of the Dutch PTT, and Björn Lundvall, President of L M Ericsson.

The South Korean Ambassador, H. E. Droon Bong Kang, trying out an old model of a telephone set during his visit to Midsommarkransen on Feb. 17, 1971.

In the last week of February an "Electronic Components" exhibition was held at the US Trade Center in Stockholm. The US Ambassador, Jerome Holland, is seen with Dr Chr. Jacobæus, Technical Director of L M Ericsson, at the opening ceremony.

L M Ericsson's new office building, "Centro Ericsson", in São Paulo, Brazil, has now been completed. It at present houses some 700 persons but can accommodate roughly twice this number. ➤

L M Ericsson's intercom telephones, Centrum and Dirivox, are now made also with jacaranda casing. This elegant variant of the two models has been very highly appreciated especially in the USA, which is L M Ericsson's largest export market for intercom telephones. Each model is provided with a handset.

Licence Agreement with National Semiconductor Corporation

L M Ericsson's subsidiary AB Rifa, which in recent times has been very active within the field of integrated circuits, has taken further measures to quickly establish itself as a large-scale manufacturer. A licence agreement has been signed with National Semiconductor Corporation, Santa Clara, USA, under which Rifa will have access to know-how and designs of bipolar digital integrated circuits. Factory buildings totalling more than 5,000 m² are being erected at Bollmora and Solna for the purpose. Full-scale production of monolithic integrated circuits is expected to start before the end of 1971.

Telecommunications Equipments for Hospitals

L M Ericsson Telemateriel AB are at present working on a number of telecommunications systems for large hospitals. The Karolinska Hospital in Stockholm will soon have available the first stage, comprising 1890 lines, of Sweden's largest intercom system. When fully extended it will comprise 5,400 lines.

The Jakobsberg Hospital has recently been opened with an extensive telecommunications package from L M Ericsson, and for the Central Skövde Hospital telecommunications equipment has been ordered comprising, among other items, intercom, visual nurse call and paging systems, sound distribution equipment including radio and sound amplifiers, master clock with electronic control equipment, and fire and burglar equipment.

Ericsson Technics

Ericsson Technics No. 1, 1971, which was recently issued, contains two papers.

In the first, by Y. Rapp, *Planning of Junction Network with Non-Coincident Busy Hours*, a heuristic method is presented for planning of junction networks when the traffic between the exchanges is defined by traffic profiles with non-coincident busy hours.

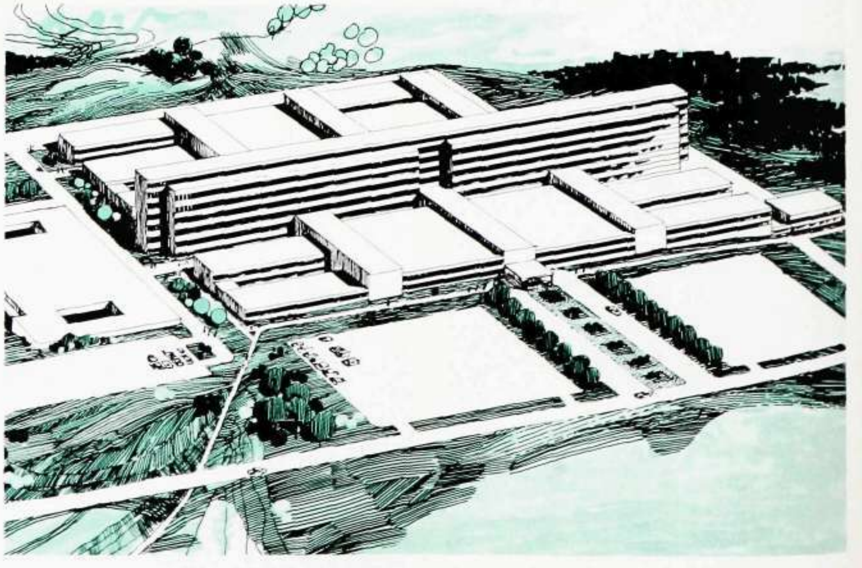
The second paper, by S. Hellström, *The Frequency Change Due to Small Component Variations in Passive RC Twin-T Filters with π Rad Phase Shift*, presents expressions for frequency and attenuation as functions of the component values, after which the effect of small variations in the latter on the frequency is shown. The derivations are made with regard to applications in hybrid circuits.

Telecommunications package . . .
(Cont. from page 73)

Communication on all floors and with all modern aids has been the aim in the design of the telecommunications equipment for the new parliament building. In whatever room or corridor a member happens to be, he will be accessible on intercom, PAX or paging system. The work in the chamber can be followed on internal TV both inside and outside the chamber. A system for simultaneous interpretation in five foreign languages as well as Swedish is also installed, as also a system for exact time indication on about 300 clocks.

The value of the system delivered by L M Ericsson Telemateriel AB amounts to some 5 million kronor. The project has been in the hands of a special project group within the company under the leadership of Erkki Mikkelinen.

Central Skövde Hospital, the first stage of which is expected to be completed in 1973.



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Cont. on next page

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The Arab Trading & Development Co. Ltd. *Amman*, P.O.B. 6141, tel: 259 81, tgm: aradeve

KUWAIT

Morad Yousuf Behbehani *Kuwait, State of Kuwait*, P.O.B. 146, tel: 270 71, tgm: barakat, telex: 048, "BEHBEHANI KUWAIT"

LEBANON

Swedish Levant Trading (Elié B. Hélou) *Beyrouth*, P.O.B. 931, tel: 23 1624, tgm, skefko

PAKISTAN

Panasian Marketing Service Ltd. *Karachi*, P.O.B. 3941, tel: (90) 51 2051, Ext. 53, tgm: panasian

PHILIPPINES

USI Asia Industries, *Makati, Rizal*, P.O.B. 1322, tel: 87 7011, tgm: usi asia, telex: 7222233, "7222233 AII PH"

SAUDI ARABIA

Engineering Projects & Products Co. Ltd. (Eppco)

Riyadh, P.O.B. 987, tel: 222 22, tgm: eppcol

Yeddah, P.O.B. 1502, tel: 4567, tgm: eppcol

Dammam, P.O.B. 450, tel: 222 22, tgm: eppcol

SYRIA

Constantin Georgiades *Damas*, P.O.B. 2398, tel: 266 73, tgm: georgiades

TAIWAN

Trans-Eurasia Enterprise, Ltd. *Taipei*, P.O.B. 3880, tel: 51 7038, tgm: esbtrading

REPUBLIC OF VIETNAM

Vo Tuyen Dien-Thoai Vietnam *Saigon*, P.O.B. 1049, tel: 226 60, tgm: telerad

International Business Representative *Saigon*, 26—28, Hai Ba Trung Street, tel: 226 60, tgm: ibur

AFRICA

ETHIOPIA

Mosvold Company (Ethiopia) Ltd. *Addis Ababa*, P.O.B. 1371, tel: (01) 101 00, tgm: mosvold, telex: 21090, "MOSFIRM ADDIS"

GHANA

R.T. Briscoe Ltd. *Accra*, P.O.B. 1635, tel: 669 03, tgm: briscoe, telex: 295, "BRISCOE ACCRA"

KENYA, TANZANIA, UGANDA

The Old East African Trading Co. Ltd. *Nairobi, Kenya*, P.O.B. 30013, tel: 271 61, tgm: broche, telex: 22261, "OLDEAST NAIROBI"

LIBERIA

Post & Communications Telephone Exchange *Monrovia*, Corner Ashmun & Lynch Streets, tel: 222 22, tgm: radiolibe

LIBYA

ADECO African Development & Engineering Co *Tripoli*, P.O.B. 2390, tel: 339 06, tgm: adeco

MOZAMBIQUE

J. Martins Marques & Ca. Lda *Lourenço Marques*, P.O.B. 2409, tel: 5953, tgm: marquesco

SOUTH AFRICA
SOUTHWEST AFRICA

Dryden Communications (Pty.) Ltd. *Johannesburg, South Africa*, P.O.B. 2440, tel: 838 5454

SUDAN

El Rahad Trading Corporation *Khartoum*, P.O.B. 866, tel: 776 95, tgm: suconto, telex: BHN 251

AMERICA

BAHAMA ISLANDS

Anglo American Electrical Company Ltd. *Freeport, Grand Bahama*, P.O.B. 104

BOLIVIA

Prat Ltda *La Paz*, Casilla 4790, tel: 277 12, tgm: prat

COSTA RICA

Tropical Commission Co. Ltd. *San José*, Apartado 661, tel: 22 5511, tgm: troco

DOMINICAN REPUBLIC

Humberto Garcia, C. por A. *Santo Domingo*, Apartado 771, tel: 3645, tgm: gartler

GUATEMALA

Nils Pira *Ciudad de Guatemala*, Apartado 36, tel: (021) 622 57, tgm: nilspira

GUYANA

General Supplies Agency *Georgetown*, P.O.B. 375, tgm: benwlks

HONDURAS

Quinchón Leon y Cia *Teguicigalpa*, Apartado 85, tel: 251 71, tgm: quinchon

NETHERLANDS ANTILLES

S.E.L. Maduro & Sons Inc. *Willemstad, Curaçao* P.O.B. 304, tel: 130 00, tgm: madurosons, telex: CU 92

NICARAGUA

Roberto Teran G. *Managua*, Apartado 689, tel: 224 00, tgm: roteran

PANAMA

Sonitel, S.A. *Panama 5, R.P.*, Apartado 4349, tel: 64 3600, tgm: sonitel, telex: 368674, "368674 SONITEL"

PARAGUAY

S.A. Comercial e Industrial H. Petersen *Asunción*, Casilla 592, tel: 9868, tgm: pargtrade

EL SALVADOR

Dada-Dada & Co. *San Salvador* Apartado 274, tel: 21 7940, tgm: dada

SURINAM

W.E. van Romondt's Trading Company Ltd. *Paramaribo*, tel: 2831, tgm: vanromondt

TRINIDAD, W.I.

Leon J. Aché Ltd. *Port-of-Spain*, 100 Frederic Street, tel: 323 57, tgm: achegram

AUSTRALIA & OCEANIA

NEW ZEALAND

ASEA Electric (NZ) Ltd. *Wellington C. 1.*, P.O.B. 3239, tel: 706 14 tgm: asea, telex: 3431, "ASEAWELL NZ 3431"

SÄTHERLUND & KROOK