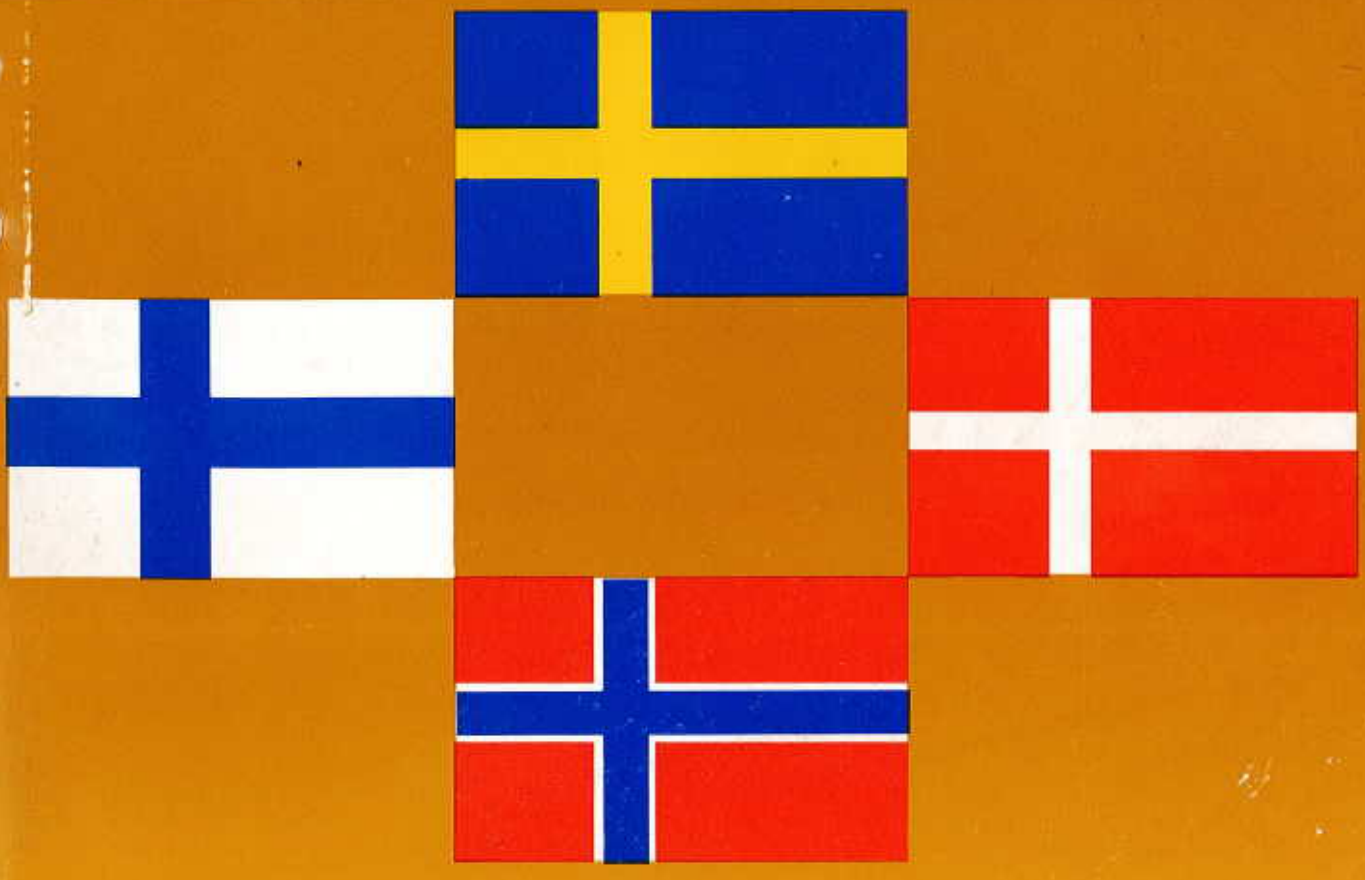
NMT

NORDIC AUTOMATIC MOBILE TELEPHONE SYSTEM

TECHNICAL OUTLINE



NMT

THE NORDIC MOBILE TELEPHONE SYSTEM—NMT— is a mobile telephone network covering the four Nordic countries, Denmark, Finand, Norway and Sweden. It was developed in cooperation between the Telecommunication Administrations of the four countries. The service was opened in 1981/1982.

The 1st of April 1983 there was in operation 6 exchanges, 343 base station sites, 1436 radio channels and 40 869 mobile telephones. 6 additional exchanges are planned.

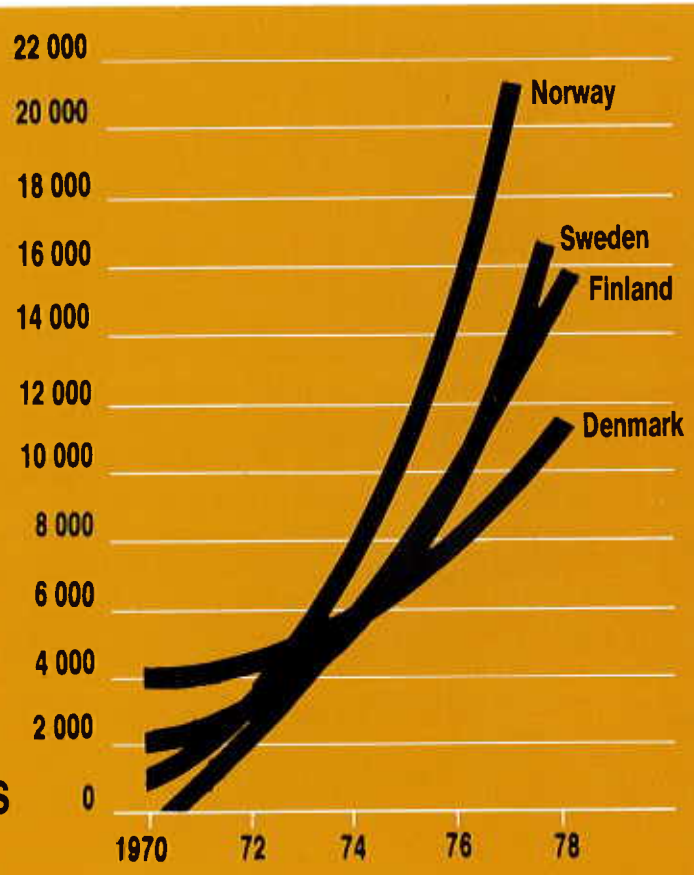
INTRODUCTION

Mobile telephone systems have existed in most of the Nordic countries since the early fifties. The earliest systems operated in the VHF band. They had a limited coverage and were generally manually served. Several of these initial systems are still in operation.

With the increasing international automobile traffic the need for a mobile telephone system permitting communication within all Nordic countries came to be realized at the end of the sixties. It was also realized that in the long run the mobile telephone network must be automated in view, among other things, of the heavily increasing costs of manual service. In 1969, therefore, it was decided to appoint a working group to draw up a joint specification for a future automatic mobile telephone system. The working group was given the name NMT, The Nordic Mobile Telephone Group.

The NMT Group realized at an early stage that a new fully automatic mobile telephone system would involve a very large amount of work in the form of investigations and specifications and would therefore be a fairly time-consuming project. In the meantime an interim solution must be found. The first task of the NMT Group, therefore, was quickly to design a new manual system which could to the greatest possible extent satisfy the most acute needs of the participating countries. The result was a manual system operating in the 450 MHz-band, which is used today in Denmark, Norway and Sweden. At the same time Finland started up its own VHF-system covering all the country.

A fundamental assumption for success for the automatic system was that a frequency band acceptable to all four countries could be found. After various difficulties it was decided to use a band in the 450 MHz range which, inter alia, comprises the channels today used for the manual system. These channels will be transferred to NMT as the manual system is successively taken out of service.



NUMBER OF MOBILE TELEPHONES IN THE NORDIC COUNTRIES

After solution of the frequency question the actual design of the system could be started on. As a starting point a number of basic requirements were set up which were considered to be well compatible with the service demands of future subscribers and with the technical and economic prerequisites. The NMT system will meet these requirements in all respects. As regards the charging principles, the administrations have decided that the call charge will be the same whatever the location of the mobile subscriber.

During the years 1977 to 1981 a trial system was in operation in the Stockholm region. Its primary object has been to verify that the fairly complicated signalling desired reliability.

basic requirements

- The system shall be capable of automatic setting up and charging of calls both to and from a mobile station.
- Conversation shall be possible between a mobile station and a fixed telephone in any of the four countries.
- Conversation shall be possible in whatever base radio station area or in whichever Nordic country a mobile subscriber happens to be.
- Conversation between two mobile subscribers shall be possible whether they are in the same base station area or in different areas, even if these are in different Nordic countries.
- The subscriber capacity shall suffice for a lengthy period, both as regards number of radio channels and of subscriber numbers.
- The use of a mobile telephone should as far as possible be similar to that of a telephone in the fixed network.

- The system shall, if technically and economically possible, permit automatic paging of a mobile subscriber and recording of the base station area in which he happens to be.
- The reliability of number transmission by the system shall be satisfactory. This applies to a particularly high degree in conjunction with automatic charging.
- In the design of the system the greatest possible attention shall be paid to costs. This applies particularly to the mobile equipment.
- The design of the system shall not necessitate any significant changes in the existing telephone networks.
- The same facilities as exist for telephone subscribers (e.g. absent subscribers service, »follow me», conference, etc) shall as far as possible be available to mobile subscribers. The system shall allow charging on the basis of the facilities used.
- The system shall ensure that a subscribers privacy of conversation in relation to other subscribers is as far as possible safeguarded.

DESCRIPTION OF SYSTEM

The NMT system is made up of the following component parts:

- **MTX (MOBILE TELEPHONE EXCHANGE)** is the brain of the system and is technically the most complicated part. The MTXs form the interface between the NMT system and the fixed telephone network. Whereas signalling and other system components of NMT are the same in all Nordic countries, their telephone networks differ in some respects. One of the functions of the exchanges is therefore to compensate for these differences.

- **THE BASE STATIONS** are intermediary links without switching function between the wire and radio transmission. There will be about 1000 base stations when the system is developed to full capacity.

- **THE MOBILE STATIONS** , i.e. the subscriber equipment, will be available in various forms, e.g. vehicle-borne, portable or of coin-box type. A mobile station is owned or leased by the subscriber and must be type-approved by the Administrations.

The adjoining figure shows the structure of the NMT system. Each country is divided into a number of traffic areas. In a traffic area there are a number of base stations spaced about between 8 and 80 km apart. Each traffic area belongs to a single exchange. This means that all base stations in the area are connected to this exchange and that all traffic in the area is channeled through it. The exchange communicates with the telephone network via the trunk exchanges.

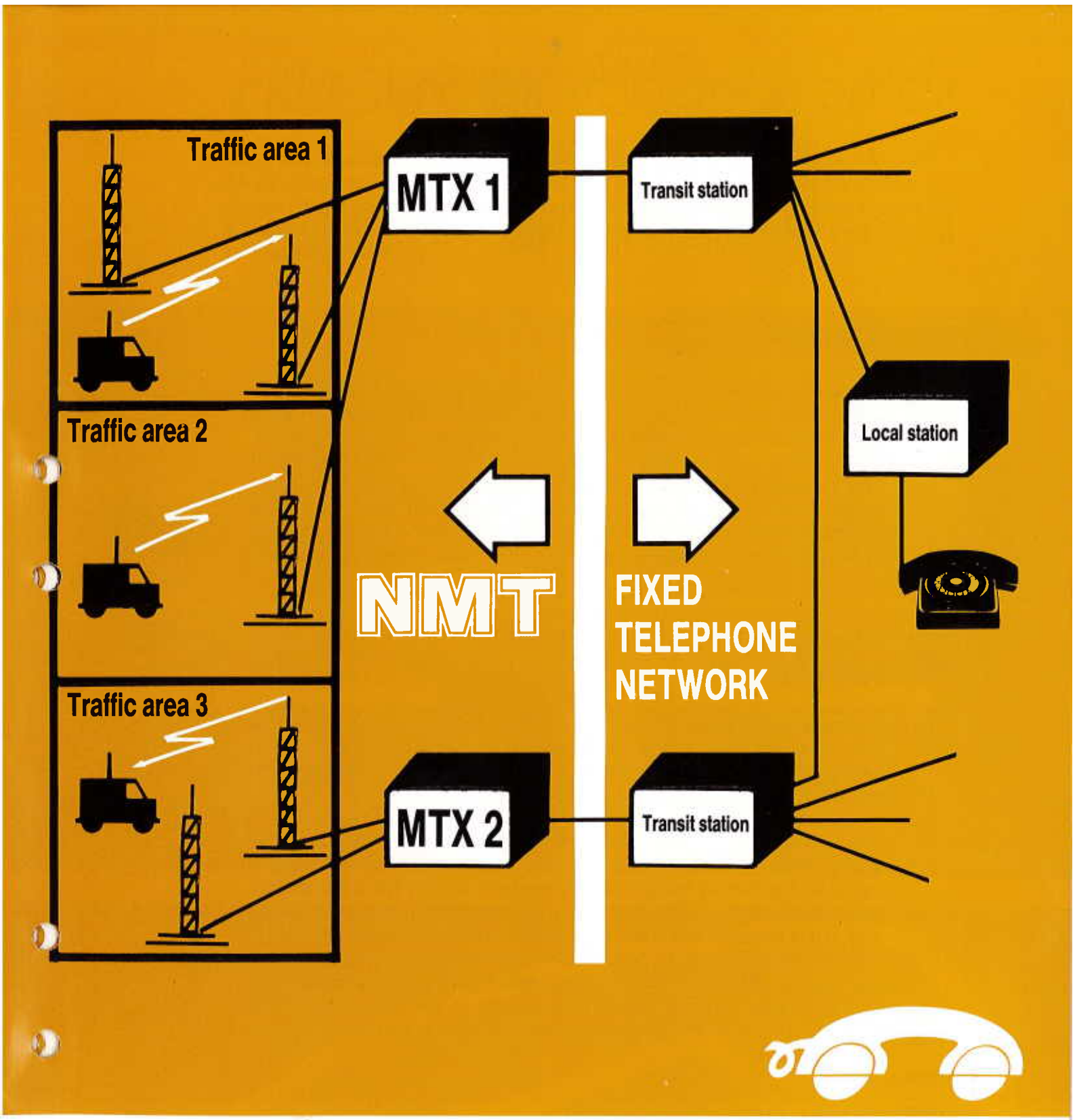
Every mobile subscriber is registered in a so-called home MTX, usually the MTX controlling the traffic area in which the subscriber normally resides.

setting up of calls

A call from an ordinary telephone subscriber is connected on the basis of the first digits of the mobile subscriber's number to his home MTX. The latter stores data of his present location and transmits a call signal over all base stations in that traffic area. The mobile station answers automatically with a call acknowledgment and the MTX then assigns the mobile station a traffic channel. The call is set up.

If the mobile subscriber is in a traffic area not belonging to his home MTX, the home MTX hands over the call to the MTX controlling the visited traffic area, and the latter MTX takes over the subsequent setting up of the call.

In this example charging is done in the calling subscriber's local exchange. If the call had been initiated by the mobile subscriber, it would have been charged in the MTX.



The example on the preceding page illustrates the following system characteristics:

- From the ordinary telephone subscriber point of view the NMT system may be regarded as a numbering area of its own. Access to the system is obtained by dialling the system's access code.

- From the mobile subscriber point of view the MTX is comparable to a local exchange. All charging data, for example, are stored in the MTX. Functions such as barred calls and special subscriber facilities such as follow-me, absent subscribers service, call priority and the like are also handled by the MTX.

some special functions in the NMT -system

ROAMING

The special function which enables a person to call a mobile subscriber without knowing where he is, is called roaming. One need not even know whether the mobile subscriber has gone to another Nordic country. Roaming is made possible by the fact that a mobile station which leaves a traffic area and enters a new one automatically notifies the MTX that it has entered the new area. The location of the mobile station is stored in the mobile stations home-MTX and used for routing calls to the correct area.

TRANSFER OF CALL TO OTHER BASE STATION

During a conversation it may happen that a mobile subscriber leaves the coverage area of the base station in which the conversation started. This results in impaired speech quality. The conversation should then be conducted over another base station.

The speech quality is supervised by means of a supervisory signal (Ø signal) one of four tones around 4 kHz. The base station sends the Ø signal to the mobile station, which sends it back to the base station. The quality of the returned Ø signal is measured in the base station and, if it is unsatisfactory, the base station transmits alarm to the MTX. The latter then orders the base station and neighbouring base stations to measure the field-strength of the radio signal from the mobile station. The base stations transmit the results to the MTX, which then switches the call to the base station with the best reception.

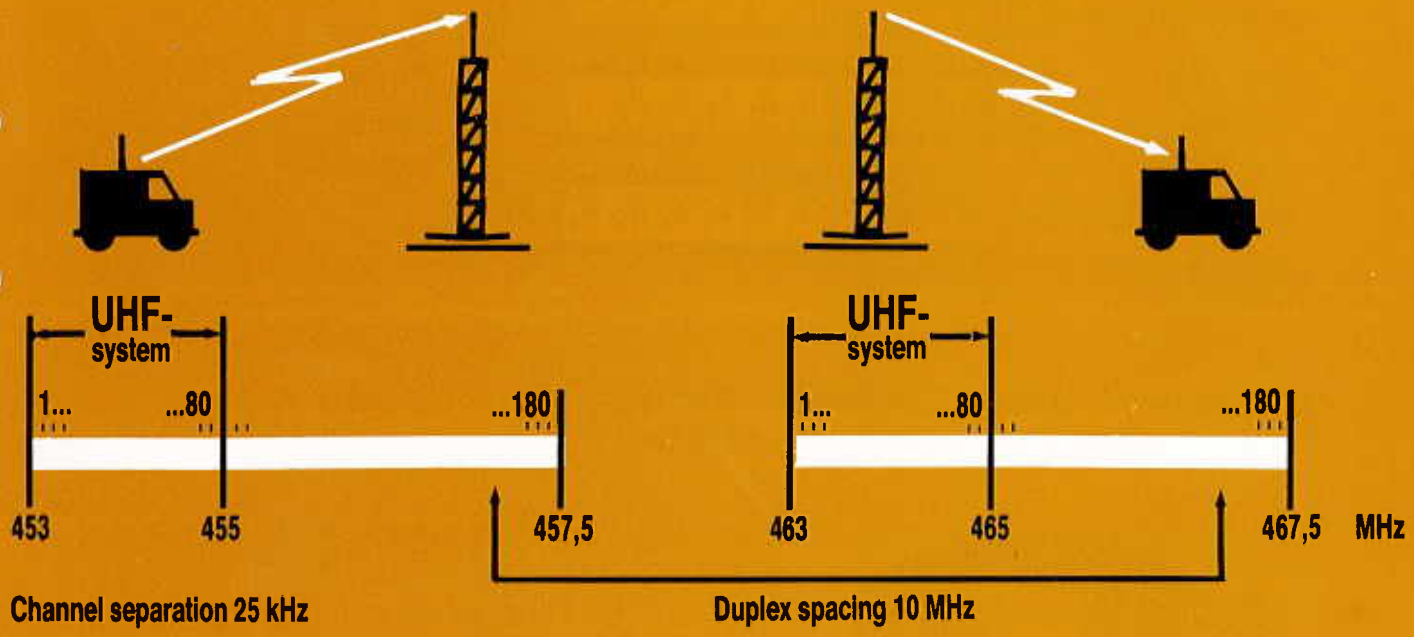
SMALL CELL TECHNIQUE

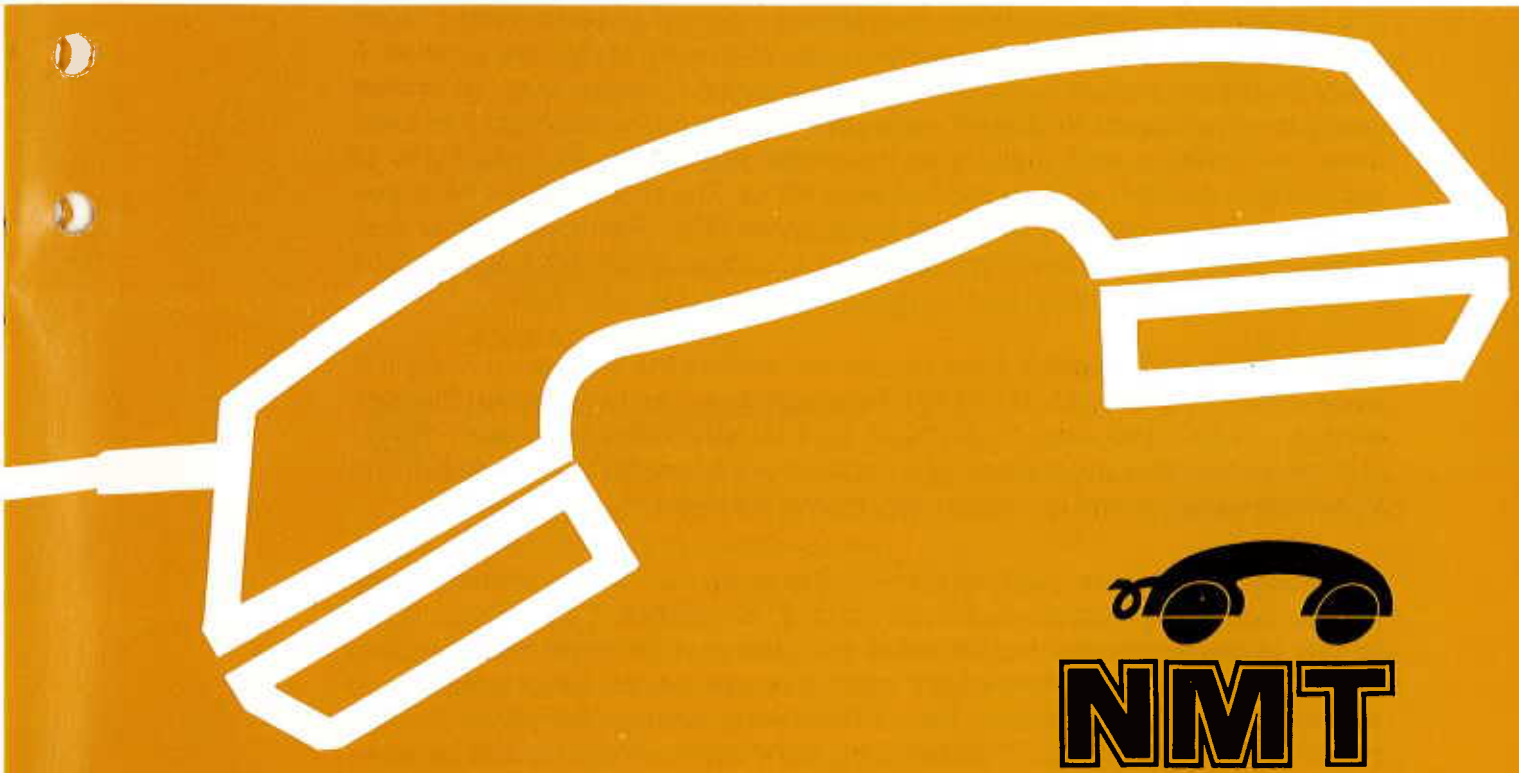
The NMT system has been allotted 180 radio channels. In the high-traffic urban areas this number of channels would not suffice in the future with conventional cell size (the coverage area of a base station). To increase the traffic capacity in these areas the small-cell technique will be adopted, i.e. the cell size is considerably reduced, so that the distance between base stations having the same radio channel can be reduced. The channels are thus used more efficiently.

In small-cell areas both base stations and mobile stations transmit with reduced power. Change of power output of a mobile station takes place automatically on order from the MTX.

FREQUENCIES

When fully developed the NMT system will comprise 180 duplex channels. Most of the 80 channels in the lower part of the band are used at present in the manual system. These channels will be successively taken over when the manual system is phased out. By about 1987 it is recconed that all 180 channels will be available for the NMT system.

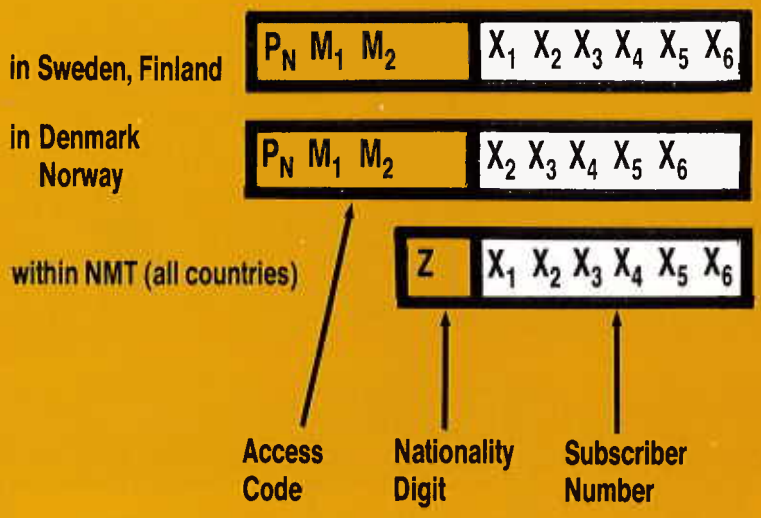




NMT

NUMBERING AND ROUTING

The figure below shows the build-up of a number for calling a mobile subscriber:



Access Codes

Denmark	049
Finland	949
Norway	094
Sweden	010

The Danish and Norwegian telephone networks permit a maximum of 7 digits after the trunk prefix P_N. With an access code of type P_N M_1 M_2 there remain 5 digits for the subscriber number. It was anticipated, however, that the system would be constructed for 6-digit subscriber numbers. The problem has been solved by adding a sixth digit (X_1)to the dialled number (X_2 X_3 X_4 X_5 X_6) in all signalling in the NMT system and between MTXs. The sixth digit will be added automatically by the mobile subscriber's home MTX. The system thus provides for 6-digit subscriber numbers in the countries which cannot introduce this length of number when their systems first come into operation.

In the Finnish and Swedish fixed telephone network the setting up of calls is done with the digitsP_N M_1 M_2 X_1 X_2. The digits X_1 X_2 are the code for the subscriber's home-traffic area. P_N M_1 M_2 X_1 X_2 thus constitutes sufficient information for routing the call to the mobile subscriber's home MTX. In Denmark and Norway the connection is similarly set up with the digits P_N M_1 M_2 X_2.

To distinguish between subscribers with the same number in different countries an additional digit, the nationality digit Z, is required. This number is not dialled by the subscriber but added to the subscriber number by the mobile subscriber's home MTX. The digit Z then accompanies the other signalling in the NMT system. On signalling from a mobile subscriber, Z is sent automatically by the mobile station. The receiving MTX can thus distinguish between calling mobile subscribers from different countries.

CHARGING PRINCIPLES

The NMT system's character of joint Nordic mobile telephone network has made it natural to adopt common principles also for charging of calls. An important principle is that the charge should be the same in both directions. A NMT subscriber will pay three compulsory charges:

- **INITIAL CHARGE.** This charge shall cover the costs involved in opening a subscription, e.g. correspondence, introduction in the accounting routines, registration in the central equipment, directory listing.

- **SUBSCRIPTION FEE.** A recurring fixed charge for coverage of traffic-unrelated costs, e.g. MTX equipment dependent on number of subscribers, costs relating to roaming, administrative costs for billing, keeping of records and telephone directory.

- **CALL CHARGE.** Variable charge covering traffic-related costs, e.g. transmission in telephone network, operation/maintenance of MTX and base stations, lines to base stations, data transfer between MTXs.

The NMT system will offer a number of special facilities, e.g. barring of certain outgoing calls, transfer to other telephone number/announcing machine. Special charges will be made for these facilities.

The technical form of the system imposes certain limitations on the rate structure. Charging in the NMT system will thus differ in some respects from that in the fixed telephone network:

- **DOMESTIC TRAFFIC.** A call from an ordinary telephone subscriber to a mobile subscriber *registered* in the same country is charged in the ordinary subscriber's local exchange. The charge is based on the digits dialled and the call is routed to the mobile subscriber's home MTX. In this case there is a technical possibility of price differentiation only between calls to different MTXs. For the eventual transfer to another MTX (possibly abroad) and for the link MTX – base station there are no means for price differentiation. But as all mobile telephone calls are switched over the trunk network, it may very well happen that local calls as well are routed over long distances. The cost difference for different domestic calls will therefore in fact be small. It has therefore been considered that a uniform rate should be charged.

  For calls from mobile to ordinary subscriber in the same country there are technical possibilities for price differentiation, but in accordance with the principle of equal charge in both directions a uniform rate is adopted here as well.

- **INTER-NORDIC TRAFFIC.** For calls from an ordinary to a mobile subscriber *registered* abroad the charge is based on the international prefix. The following digits, which route the call to a MTX, cannot be analysed by the caller's local exchange. The call will therefore be charged as an ordinary international call.

  For calls in the other direction the mobile subscriber is charged by toll ticketing in MTX. In this case price differentiation is possible, but owing to the desire for equal rates, the international rate is used here as well. The national mobile telephone rate is used, however, if the international rate is lower than the mobile telephone rate.

SIGNALLING

Many types of signal are used between the different parts of the NMT system. The signals have the following main objectives:

MTX–MS

- Setting up and clearing of calls
- Switching of call in progress
- Updating
- Ordering of power-reduction

MTX–BS

- Remote control of base station
- Transmission of alarm

MTX–MTX

- Updating of subscriber register and roaming register
- Transfer of call to roaming subscriber

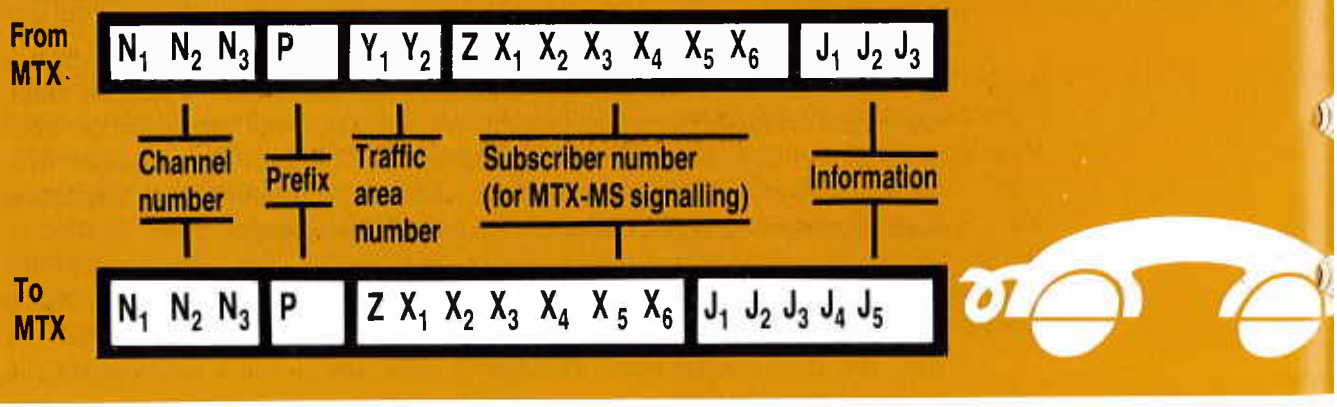
MTX–TELEPHONE NETWORK

- Setting up of calls

BS–MS

- Supervision of transmission quality

Signals are sent in the form of so-called frames. All frames have the same length. They are divided into fields, each of which contains a given type of information. Two frame formats exist depending on whether the frame is sent to or from a MTX.

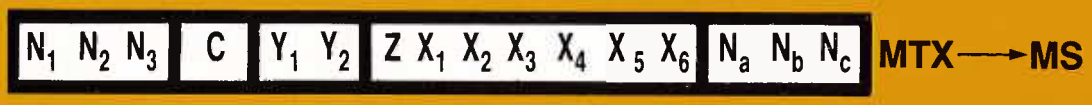


Each character (N_1, N_2, N_3, P etc) consists of a hexadecimal digit, i.e. four binary positions. All frames start with the number of the channel on which the frame is sent. If the number does not tally with that of the channel to which the receiver is locked, the frame is rejected. Faults due to intermodulation are thus avoided. The character after the channel number, the prefix P, defines the kind of message to which the frame relates. The actual message is found in the information field. On signalling from a mobile station the mobile subscriber's number is always sent. It is also sent on signalling from a MTX to a specific subscriber. Furthermore the MTX always sends the traffic area number of the base station in use.

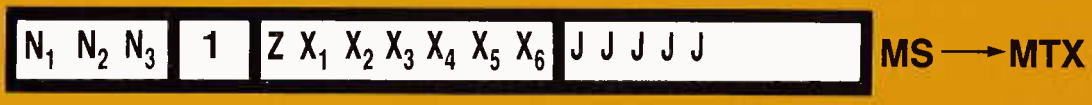
If a field in a specific frame has no significance, it is filled with idle digits (J).

EXAMPLES OF SIGNAL FRAMES

CALLING CHANNEL INDICATION. The frame is recognized by the prefix P, which has the hexadecimal value C, i.e. 12 in the decimal system. N_1 N_2 N_3 = the number of the calling channel, on which the frame is also sent. Y_1 Y_2 = the number of the traffic area in which the base station with calling channel number N_1 N_2 N_3 is situated.



ALLOCATION OF TRAFFIC CHANNEL. The frame is sent on the calling channel N_1 N_2 N_3. The mobile station ZX_1 X_2 X_3 X_4 X_5 X_6 to which a connection is to be set up is ordered over to traffic channel number N_a N_b N_c.

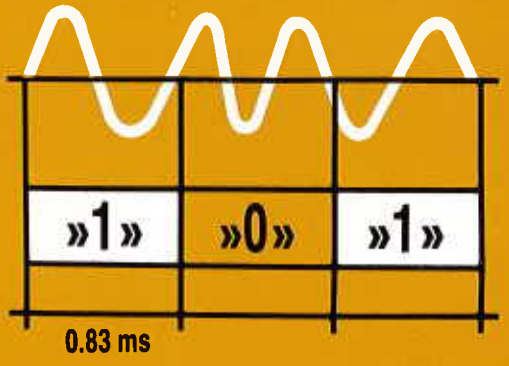


TRANSMISSION OF IDENTITY ON TRAFFIC CHANNEL. Is sent on traffic channel N_1 N_2 N_3 by the mobile station ZX_1 X_2 X_3 X_4 X_5 X_6 either as acknowledgement of an identity request or as seizure signal on a call from the mobile station.

As appears from the above, a frame consists of 4 x 16 = 64 bits. To increase the reliability the frame is sent with an error-correcting code, so that the length of the message will be 140 bits. An additional 15 + 11 bits are used for synchronization. The transmitted signal frame will have the following form:

The selected error-correcting code is of convolution type and permits correction of error bursts with up to 6 false bits in sequence for at least 19 correct bits between error bursts.

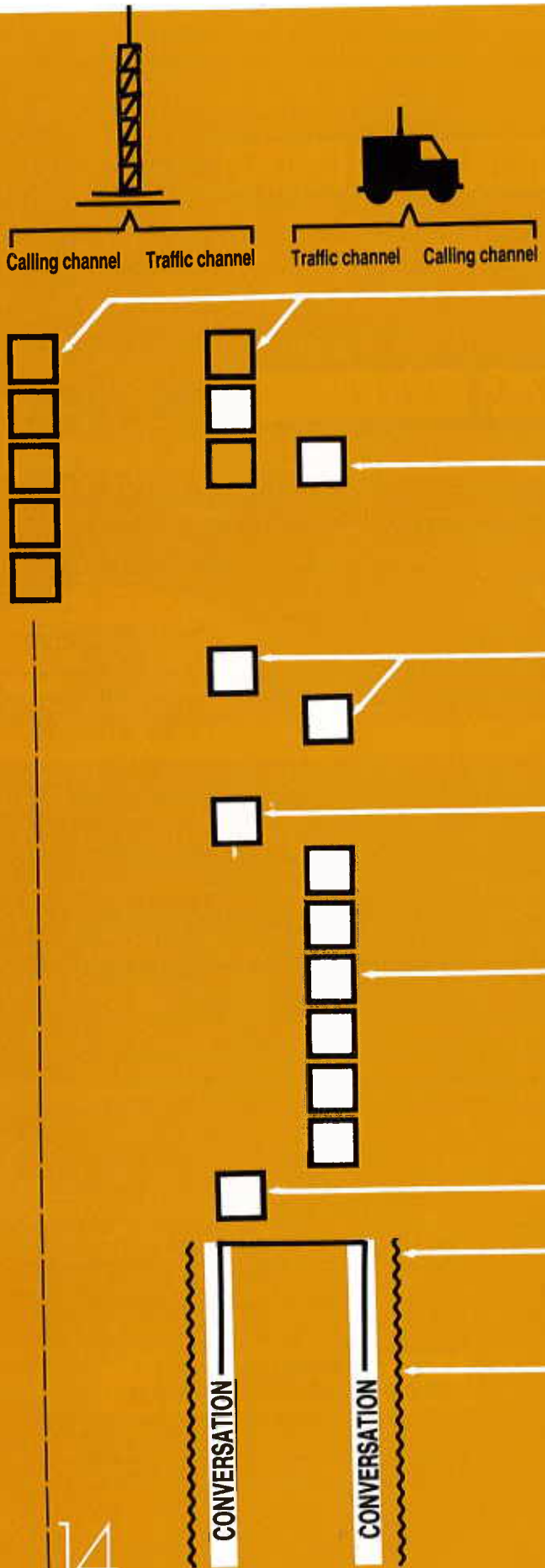
The binary positions in the signal frames are transmitted by FFSK (Fast Frequency Shift Keying) modulation. Logic »1» is represented by a cycle of the frequency 1200 Hz and logic »0» by 1 1/2 cycles of 1800 Hz. Shift between »1» and »0» takes place at the zero passage of the signal. The data speed is thus 1 200 bauds.



SIGNALLING PROCEDURES

(Simplified signalling diagrams)

call from mobile subscriber



Initially the mobile station is locked to the calling channel. The MTX sends the calling channel and »free traffic channel» indications over the base station.

The mobile subscriber keys the number and raises the handset.
The mobile station hunts for a free traffic channel and sends a seizure signal. The MTX answers by removing the »free traffic channel» indication.

Handshaking. The MTX requests renewed transmission of identity, which is done by the mobile station.

When the MTX is ready to receive the number, it sends a »proceed to send» signal.

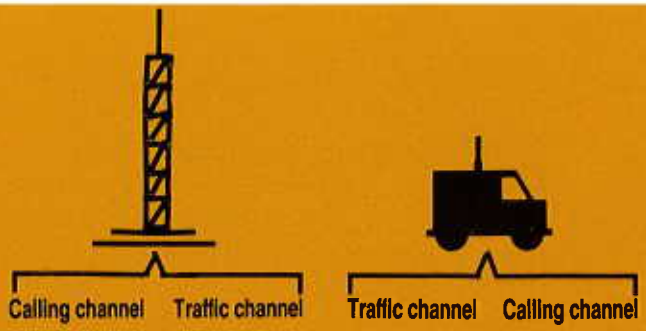
The number stored in the mobile station's memory is sent.

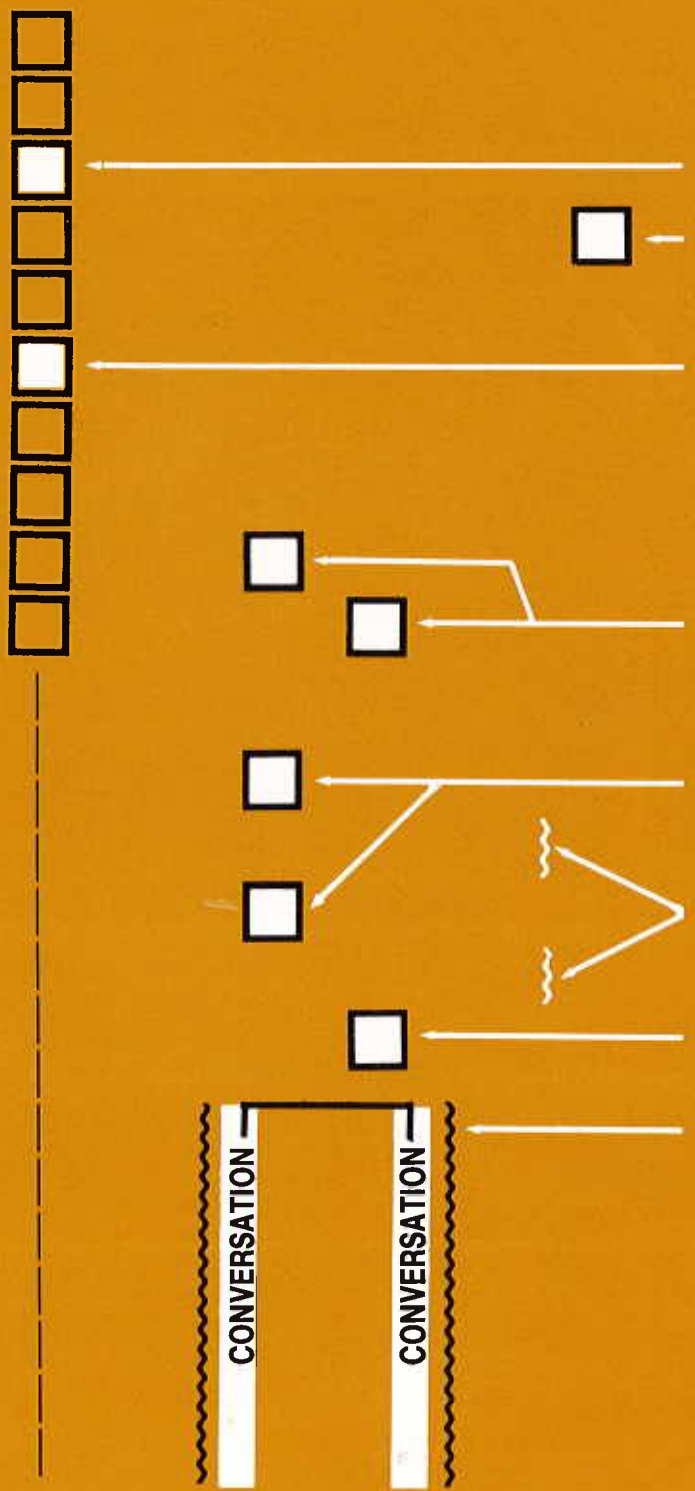
The MTX acknowledges with the »number received» signal.

Through-connection in the MTX.
Ø signal is sent from the base station.

Called subscriber answers. Conversation takes place.

call to mobile subscriber





Initially the mobile station is locked to the calling channel.

Call to the mobile station.

Call acknowledgement.

The MTX orders the mobile station over to a free traffic channel.

Handshaking. The MTX requests transmission of identity on the traffic channel, which is done by the mobile station.

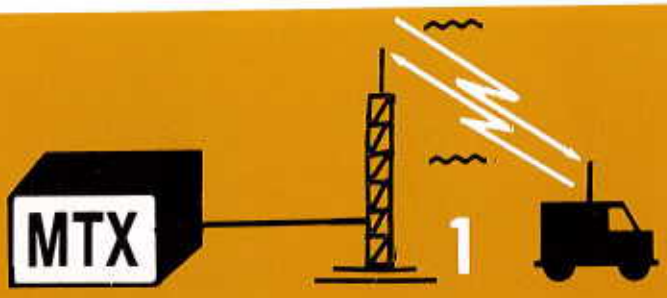
Order for ringing signal.

The mobile station generates ringing signals.

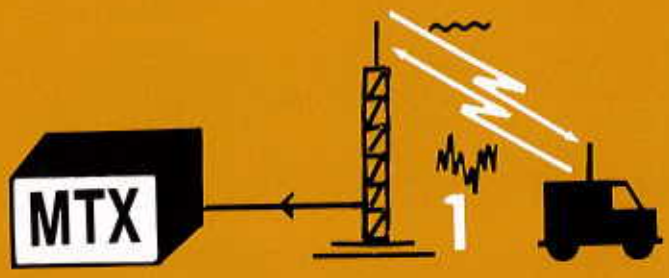
The called subscriber answers.

Through-connection in the MTX. Ø signal is sent from the base station. Conversation takes place.

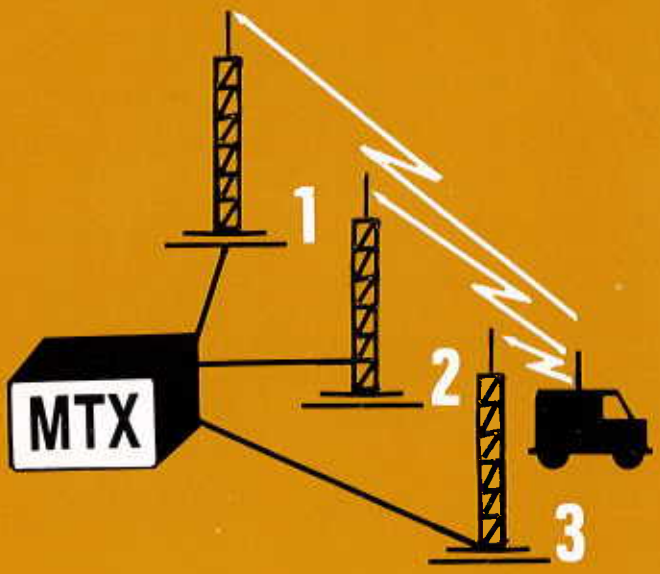
switching of call in progress



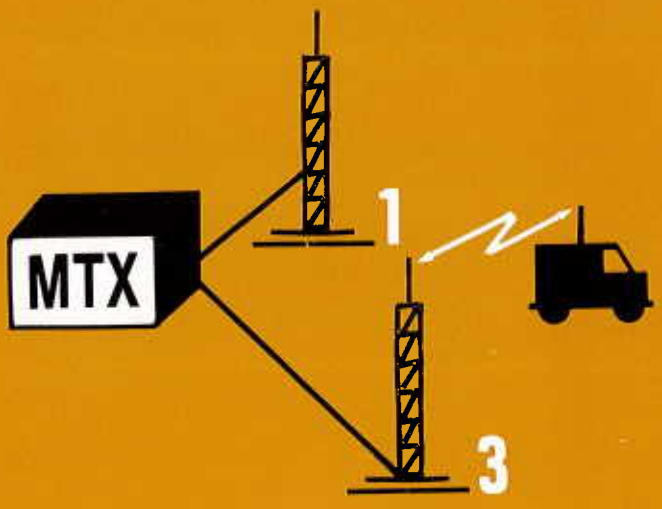
During conversation the base station sends a continuous supervisory signal which is returned by the mobile station. The signal-to-noise ratio of the returned signal is measured in the base station and found satisfactory.



As the mobile station moves further away from the base station the signal-to-noise ratio deteriorates. When a critical value is passed the base station sends alarm to the MTX.



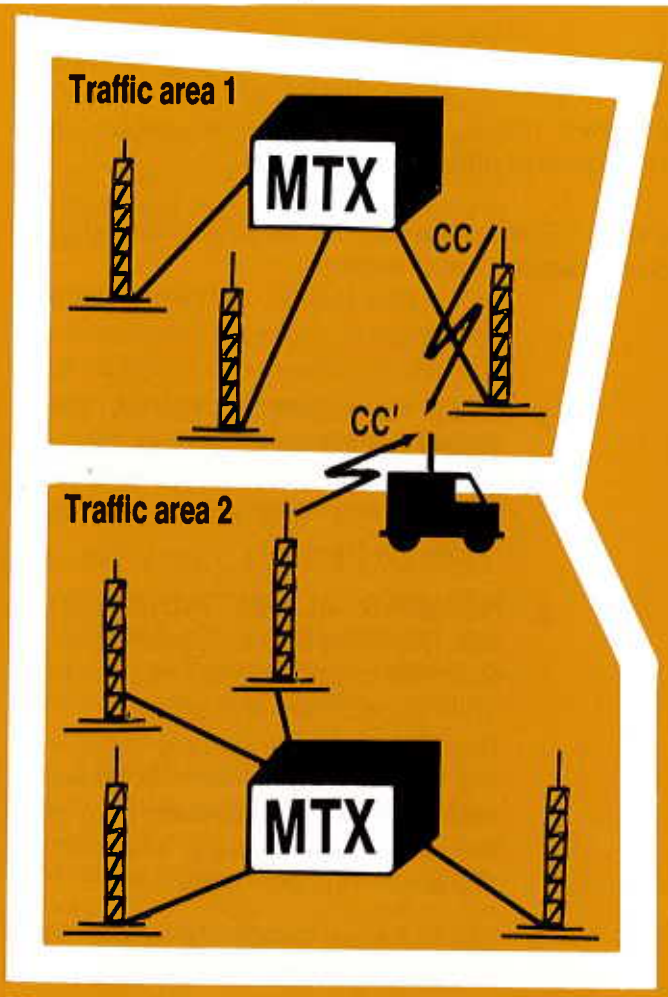
The MTX orders the actual and neighbouring base stations to measure the signal strength on the channel. The base stations return the results of the measurements to the MTX. In the example illustrated, base station 3 measures a considerably higher signal strength than base station 1.



The MTX decides that the call must be switched to base station 3. The mobile station is ordered over to another traffic channel and at the same time base station 3 starts a handshaking procedure on the same channel (cf. call to mobile subscriber). Base station 1 is disconnected.

In the mobile station the entire switching procedure is noticed as a brief interruption in the conversation.

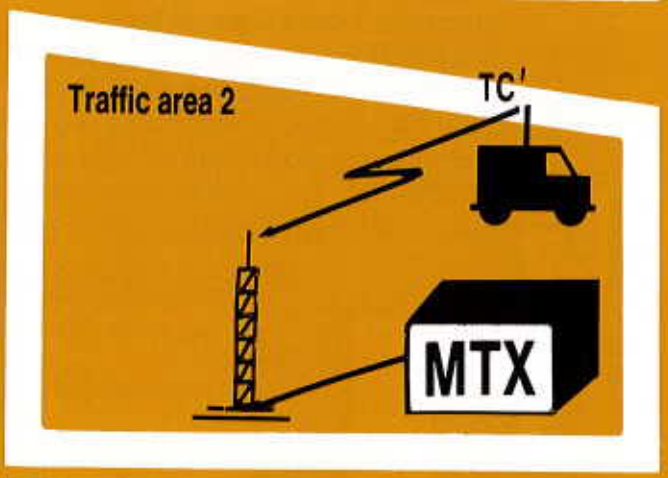
roaming



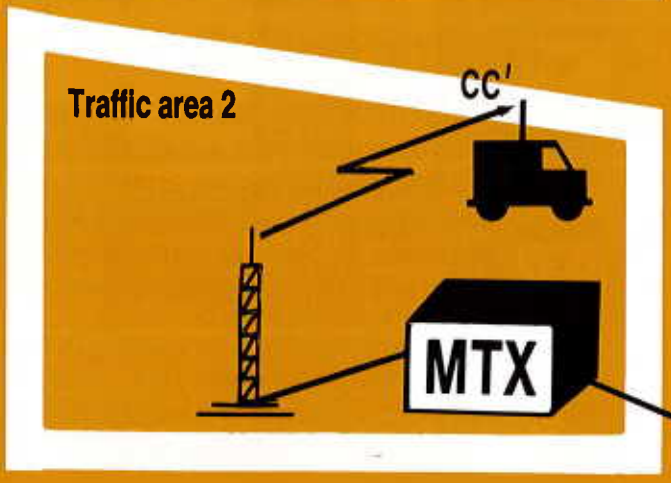
CC = calling channel
TC = traffic channel

Initially the mobile station is locked to a calling channel in traffic area 1. When the mobile station moves out of the area, it loses contact with the calling channel. It then attempts first to find a new calling channel with the same traffic area number. If this fails, it goes hunting for a calling channel with arbitrary traffic area number.

The mobile station finds a calling channel with indication »traffic area 2». It must then make an updating call to inform the system that it has entered a new traffic area.



The mobile station finds a free traffic channel. A frame for updating of roaming is sent. The MTX returns an acknowledgment.



The mobile station now locks to the calling channel in traffic area 2. From the MTX an updating message is sent to the mobile station's home MTX about its new position.

(mobile station's home MTX)

THE MOBILE STATION

The mobile station may be divided functionally into radio unit, logic unit and operational controls unit. The station can be manufactured in parts or as an integrated unit. Its power output is 15 W. Portable stations may have a lower power output than the vehicle-borne, but must have the same performance characteristics in other respects.

The symbol § below marks an obligatory function. The symbol (§) marks a non-obligatory function but one which, if existent, must fulfil a specified requirement.

CONTROLS

§ **ON/OFF SWITCH**

§ **SWITCH-HOOK**

(§) **VOLUME CONTROL.** Regulates the sound level from loudspeaker/earphone.

(§) **PUSH-TO-TALK SWITCH.** Shuts off the loudspeaker when the mobile station is to transmit. Prevents level instability.

§ **HANDS-FREE SWITCH.** Is used for switching between handset and separate microphone with loudspeaker.

§ **KEYSET, 12 buttons** 0-9, ✻ and, ⌗. For dialling. Sweden and Finland follow CCIR's recommendation for placing of the buttons. Denmark and Norway follow the ISO- standard.

(§) **KEYSET, 16 buttons** 0-9, ✻ ⌗, A–D. A–D are added to permit data transmission in the future.

§ **COUNTRY SELECTOR.** Is set to the country in which the subscriber happens to be. Prevents the mobile station from locking to a base station in a neighbouring country.

VISUAL INDICATORS

§ **ON/OFF INDICATOR, white (or yellow)**

§ **SERVICE INDICATOR, green.** Lights when the mobile station is locked to a calling channel.

§ **CALL RECEIVED INDICATOR, yellow (or flashing yellow)** Lights when a call is received and remains alight until the subscriber raises the handset.

§ **ROAMING ALARM INDICATOR, red.** Indicates that an updating call from the mobile station has failed. The subscriber should then attempt updating manually by raising the handset. When the station has received acknowledgment of the updating message, the roaming alarm indicator goes out.

§ **DISPLAY or DIGIT MEMORY INDICATOR, white.** If there is a display unit, it shall show at least 8 of the 16 digits of the dialled digits memory. The last digits entered shall be shown. If there is a digit memory indicator, it shall light as soon as the first digit has entered the dialled digits memory.

ACUSTIC SIGNALS

§ **MALFUNCTION ALARM.** Informs the subscriber that a call attempt has failed and that the mobile station has returned to the calling channel. A new attempt can be made after replacing the handset.

§ **RINGING SIGNALS.** Indicate a call to the mobile station. Each separate ringing signal is generated by a signal frame from the MTX.

FUNCTIONS

§ **DIALLING** is done while the handset is still on-hook, so-called preseizure dialling. Dialled digits are stored in the dialled digits memory. When the complete number has been dialled, the subscriber raises the handset and the call is sent.

(§) **ABBREVIATED DIALLING.** The subscriber can store a private list of numbers in a memory in the mobile station. A number is transferred to the dialled digits memory when a 1- or 2-digit code followed by # is dialled on the keyset.

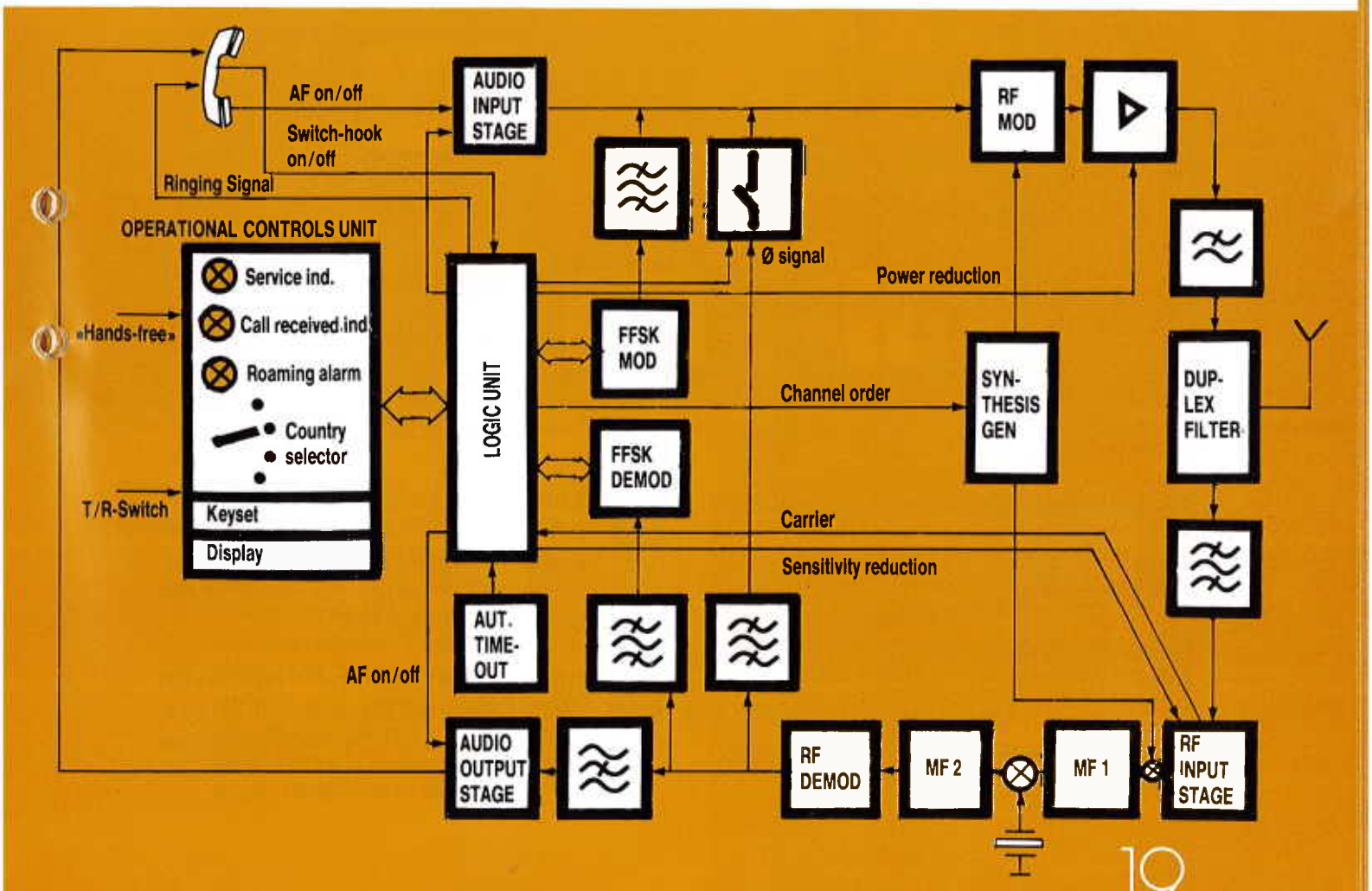
§ **HUNT FOR CALLING CHANNEL.** Can start on any channel. The channels are hunted through one by one and analysed in respect of channel number, calling channel prefix and traffic area number. In the first scanning sequence the station works with reduced sensitivity. This prevents it from locking to a weaker base station than necessary. If no calling channel is detected in the first sequence, a new hunt is made with full sensitivity.

The sensitivity reduction procedure is used also when the station is to hunt for a free traffic channel.

§ **REDUCED POWER OUTPUT.** The signal strength of the mobile station is measured by the base station on setting up of every call. If the field strength exceeds a given threshold, the MTX orders the mobile station to transmit with reduced power. This prevents saturation of the base station receiver and reduces the risk of the call disturbing other base stations.

In small-cell areas the mobile station automatically transmits with reduced power. The reduction takes place in response to an encoding in the channel number.

§ **AUTONOMOUS TIME-OUT.** The mobile station has a time-out circuit which shuts it down if an abnormal situation occurs, e.g. uncontrolled transmission.

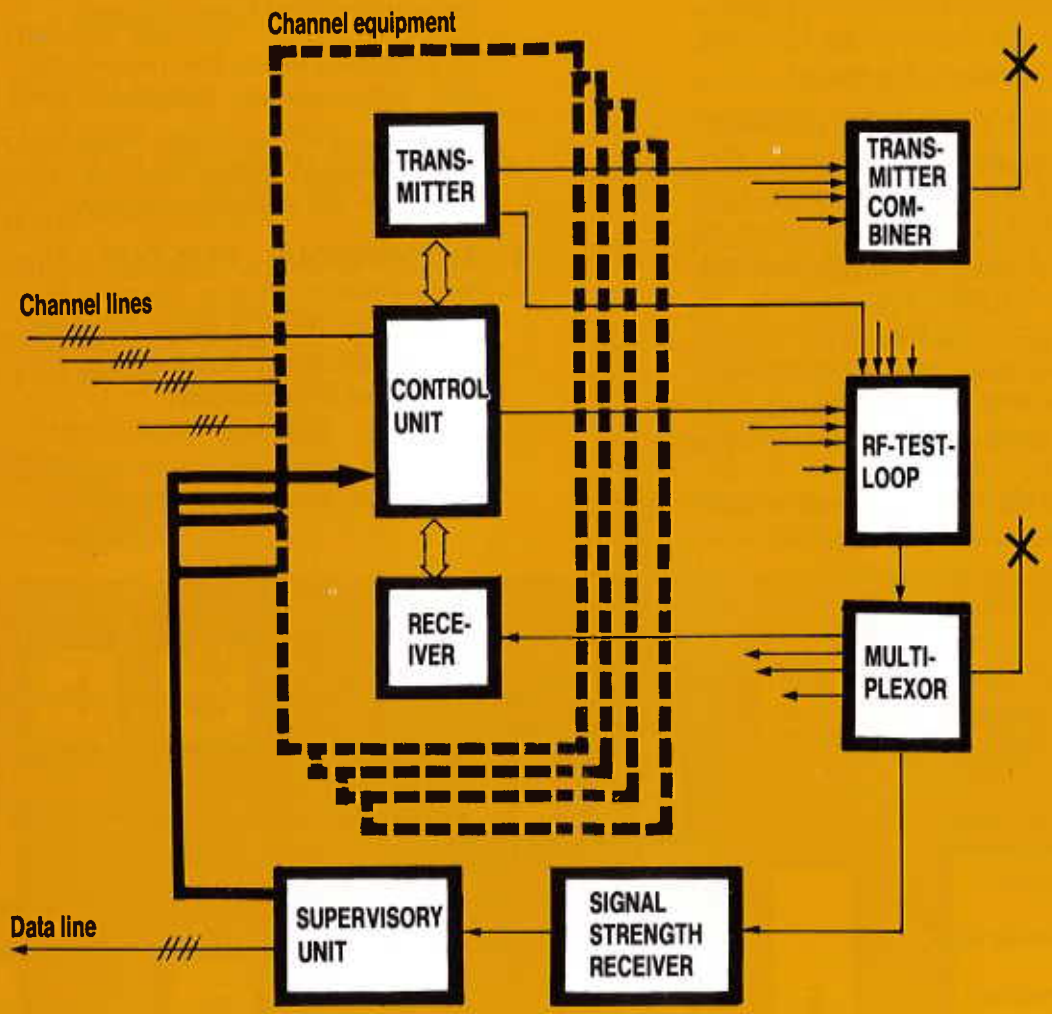


THE BASE STATION

The base stations have different numbers of channel equipments depending on the volume of traffic in the area. The stations are successively extended in step with the growth of traffic. Tuning of radio channels is done from the MTX. This will permit dynamic channel selection in the future.

The base stations are built up of a number of function modules placed on 19'' racks.

BLOCK DIAGRAM



TRANSMITTER. Power output 50 W

RECEIVER. Sensitivity – 2 dB (1 μV) e.m.f.

CONTROL UNIT (CU). Controls the function of a transceiver. Contains a modem for signalling with MTX and circuits for generation of Ø signal.

SUPERVISORY UNIT (SU). Controls the function of the signal strength receiver. Contains a modem for signalling to MTX. Sends the result of the measurement to MTX.

SIGNAL STRENGTH RECEIVER (SR). Measures the strength of a radio signal on the channel determined by the MTX.

MULTIPLEXOR. Distributes the received radio signals to the base station receivers.

TRANSMITTER COMBINER. Interconnects the signals from the base station transmitters to a common aerial.

RF TEST LOOP. Checks that the radio equipment is functioning satisfactorily. On order from the MTX a signal path is opened over the transmitter, RF test loop, multiplexor, receiver and control unit back to the MTX. At the MTX there are means for measuring the quality of the returned signal. On the event of a fault in any of the abovementioned units a too weak or a distorted signal is received.

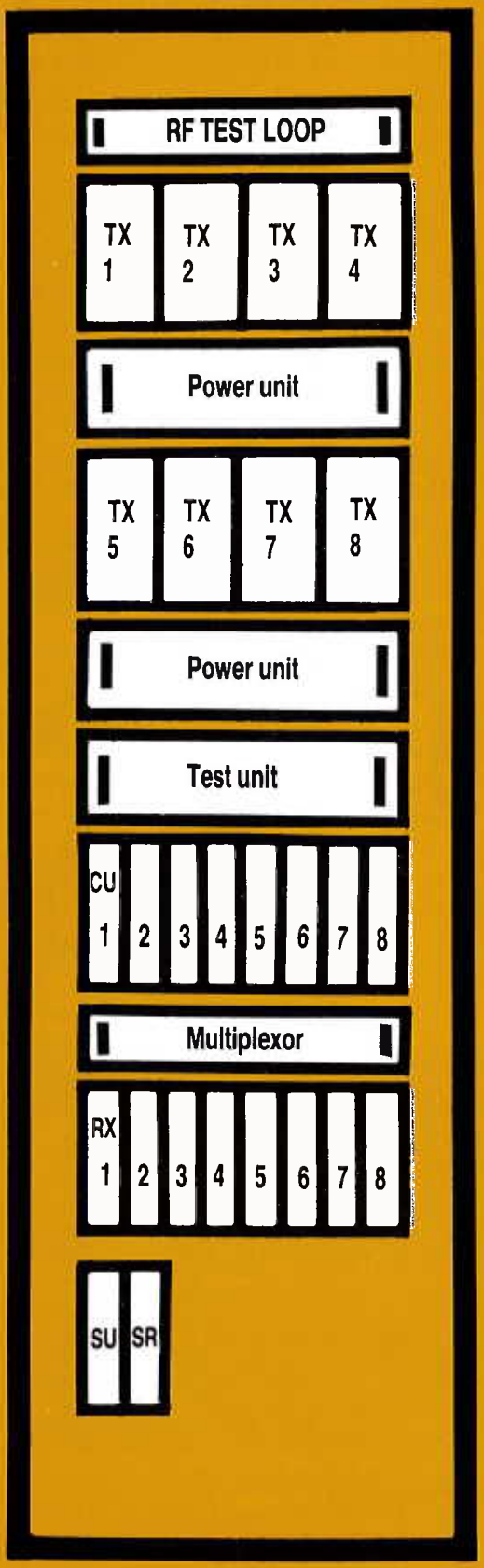
The RF test loop contains circuits for, among other purposes, conversion from transmitter to receiver frequency.

Apart from what is shown in the block diagram the base station contains power units (may be for 220 V AC or – 48 V DC) and a test unit for checking the main voltages and currents in the base station. The base station can also be controlled locally in respect of channel selection, Ø signal frequency, squelch function, start/stop of transmitter, etc.

OTHER FUNCTIONS

LINE LOOP. The incoming 4-wire line to each channel equipment can be looped in the control unit on order from the MTX. The function is used for deciding whether a transmission fault is due to a fault in the base station or on the line.

FAULT ALARMS. The base station has circuits for internal supervision of its various parts. On a fault in any part an alarm is sent to the MTX, which forwards it to an operation and maintenance centre. Apart from alarm for faults in the actual base station equipment, alarms can be transmitted which relate to the plant as a whole (power failures, fire, burglary, obstruction lights, etc).



Example of mechanical structure of an 8-channel station. Apart from the radio racks shown, two additional racks containing transmitter combiners are needed.

MOBILE TELEPHONE EXCHANGE(MTX)

The MTX consists of a telephone exchange of AXE type suplemented by a Mobile Telephone Subsystem (MTS). MTS consists of both hardware and software.

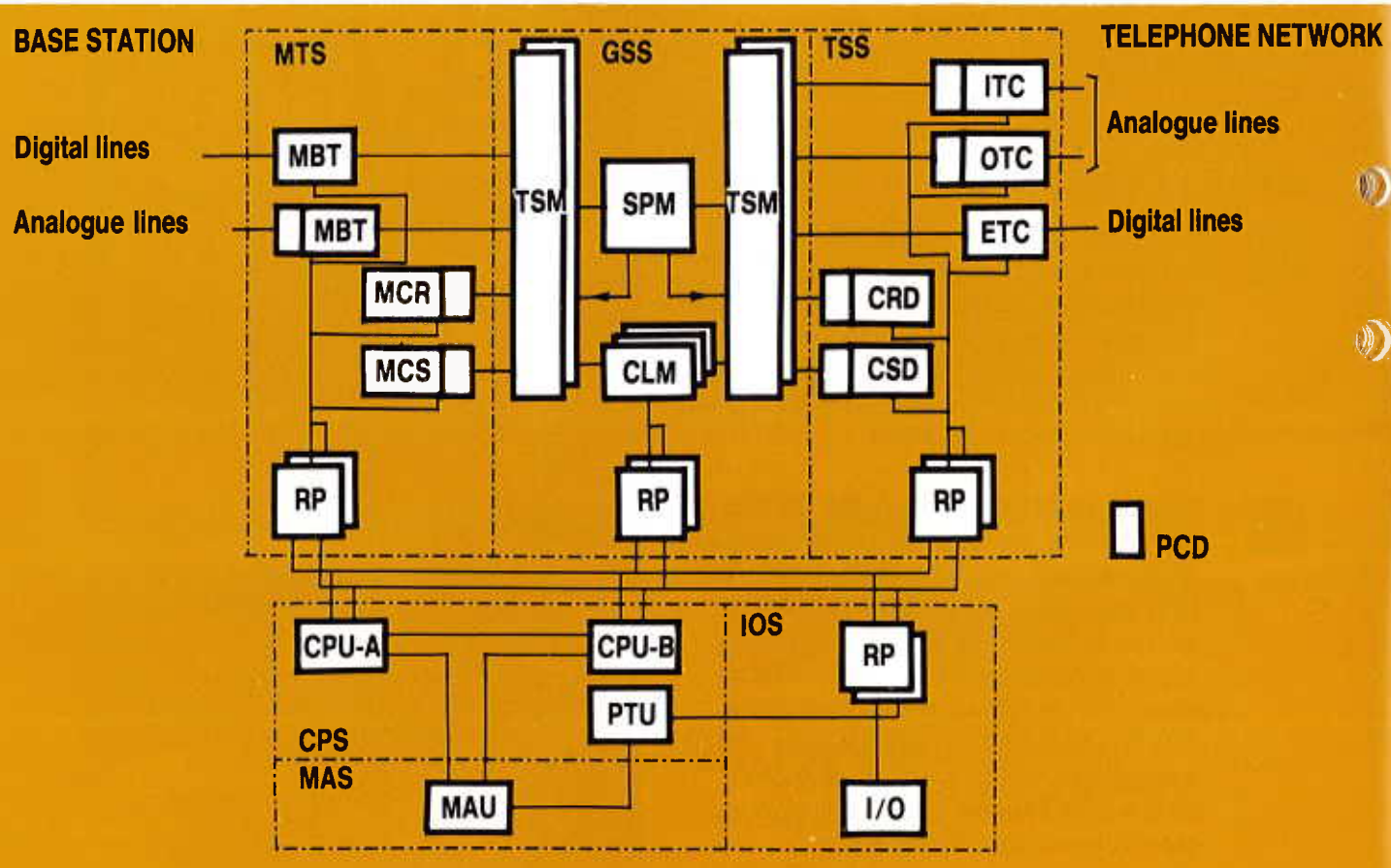
The figure below shows a simplified block diagram of the MTX. It is controlled by a central processor system consisting of two processors (CPU-A and CPU-B) working in parallel synchronism. Via a data bus the processors communicate with a number of regional processors (RP) which control the operation in each subsystem. The regional processors work in pairs and normally share the control of the various devices of a subsystem between them. If a fault occurs in one regional processor, the other takes over its work. The central processors continually scan the regional processors to collect information and issue commands.

SUBSYSTEMS

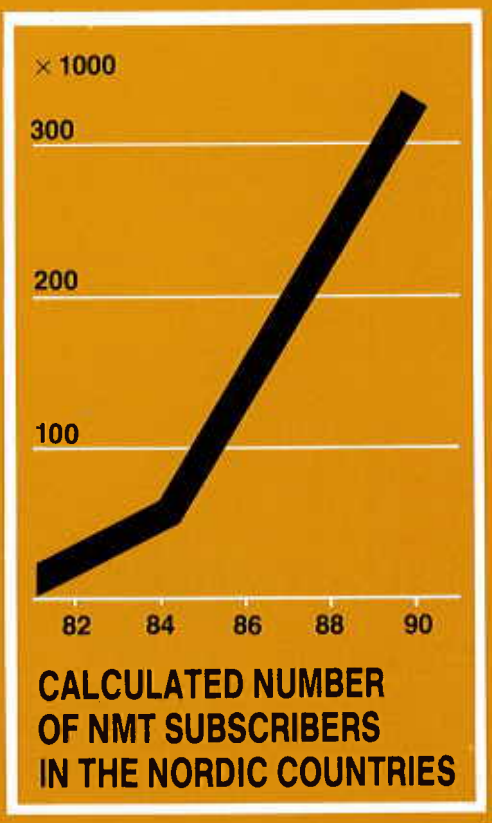
GSS	Digital group switch subsystem
TSS	Trunk and signalling subsystem
MTS	Mobile telephone subsystem
CPS	Central processor subsystem
IOS	Input/Output subsystem
MAS	Maintenance subsystem

FUNCTION BLOCKS

TSM	Time switch module
SPM	Space switch module
CLM	Clock module
ITC	Incoming trunk circuit
OTC	Outgoing trunk circuit
ETC	Exchange terminal circuit
CRD	Code receiver device
CSD	Code sender device
MBT	Mobile signalling bothway trunk circuit
MCR	Mobile code receiver
MCS	Mobile code sender
PCD	Pulse code device
RP	Regional processor
CPU	Central processor unit
PTU	Processor test unit
MAU	Maintenance unit
I/O	Input/Output



DEVELOPMENT PLANS



CALCULATED NUMBER OF NMT SUBSCRIBERS IN THE NORDIC COUNTRIES

RADIO COVERAGE

end of 1983 3

In these areas the service will be successively extended up to 1990.

MTX

If You wish some further information about the NMT-system, please contact

Post and Telegraphs Administrations
Radio Communications Office
Nørrebrogade 10
DK-2200 COPENHAGEN N Denmark tel + 45 1 393711

Posts and Telecommunications Administration
Radio Department
P.O. Box 511
SF – 00101 HELSINKI 10 Finland tel + 358 0 69661

Norwegian Telecommunications Administration
P.O. Box 6701 S t Olavs plass
N – OSLO 1 Norway tel + 47 2 48 89 90

Swedish Telecommunications Administration
Radio Department
Land Mobile Services
S – 123 86 FARSTA Sweden tel + 46 8 713 10 00

NMT