

THE NEW RADIO NETWORK OF THE VAUD CANTONAL POLICE

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The radio-telephone network described herein was taken into service for the opening of the Swiss National Exhibition 1964 in Lausanne. Outstanding features of the network are the modern conception, an extremely high standard of reliability as well as flexibility with respect to future extensions.

THE changes made to international regulations regarding the use of frequencies between 30 and 500 Mc/s for mobile services compelled the cantonal and municipal police forces in Switzerland to reorganize their existing 40 and 80-Mc/s systems and to adopt the 160 or 460-Mc/s wavebands.

For the Vaud Cantonal Police other, more important reasons induced them to go in for a new, more efficient radio network. These included:

- The completion of the motorway between Geneva and Lausanne, and the prospects of it soon being extended towards Berne, necessitated the formation of a special squad of motorway police, with the necessary communication equipment.
- The opening of the Swiss National Exhibition in Lausanne was accompanied by some major problems as regards the handling of the traffic visiting the exhibition grounds.
- The unfavourable topography of the canton, from the aspect of radio propagation, prevented the existing system from providing reliable communication with certain areas.

After studying the problems for several years, and carrying out the necessary preparations, including an investigation of propagation conditions covering the entire cantonal area, as well as allowing for the future growth in police responsibilities, the new equipment was installed and commissioned early in 1964.

Fixed Installations

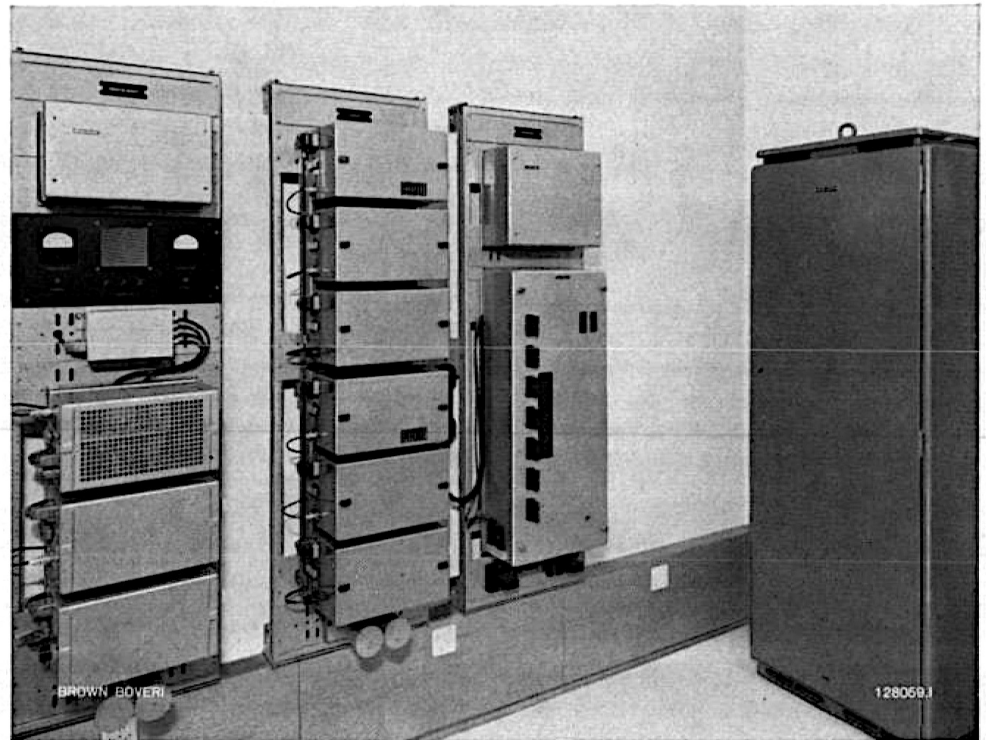
The equipment for operation and handling calls for the entire radio network is installed in the headquarters of the Cantonal Police in Lausanne. This central station is connected by a multi-channel radio link with the unmanned base station of the mobile network, located at the summit of the Rochers-de-Naye, at an altitude of 2045 m. From here all programmes are radiated (see Fig. 1 and 2, also the colour plate inside the near cover).

Since the base station is controlled completely automatically and is only accessible with difficulty, close attention had to be paid to the reliability of the equipment. The very high safety factor with respect to interruptions of the service was attained by the following measures:

- The multi-channel link between Lausanne and Rochers-de-Naye, operating in the 400-Mc/s band, was duplicated. It is monitored by a pilot tone and, in the event of a disturbance, is automatically switched over to the stand-by equipment, an alarm being given in Lausanne at the same time.
- The base stations of the area radio networks (at present 3) each possess a stand-by station which can be switched on from Lausanne if need be.
- Abnormal conditions in the Rochers-de-Naye station are indicated in Lausanne.
- In the event of the base station on the Rochers-de-Naye failing altogether (failure of the mains supply and a defect in the emergency generator set), messages can be transmitted to all area networks by a local transmitter in Lausanne; this

Fig. 1. — The v.h.f. and a.f. equipment in Lausanne

From right to left: the cabinet containing the automatic telephone equipment and control gear; the MK 3 multiplexer, RT 16 duplicate broad-band v.h.f. equipment for 400 Mc/s controlling the base stations on the Rochers-de-Naye; the monitoring and emergency RT 5 station for 160 Mc/s.



emergency station, of course, only has a limited range.

– In addition, by means of a reception monitor in Lausanne it is possible to keep a check on all signals transmitted by the base station on the Rochers-de-Naye (Fig. 3).

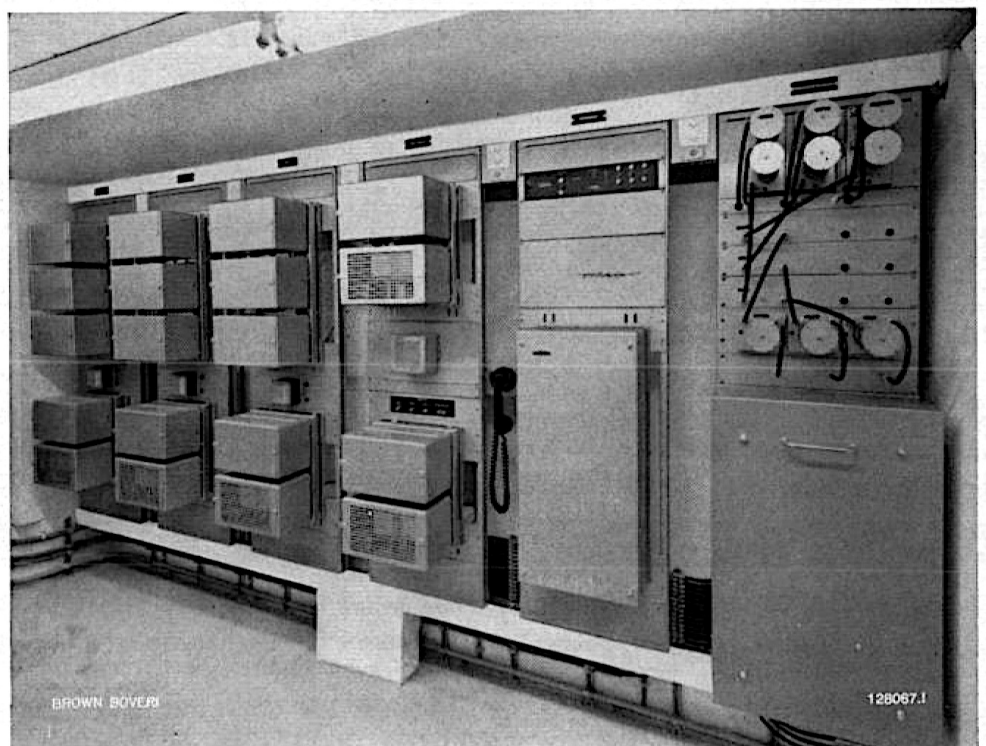
Although by transferring the operating frequencies into the 160-Mc/s band, the already precarious pro-

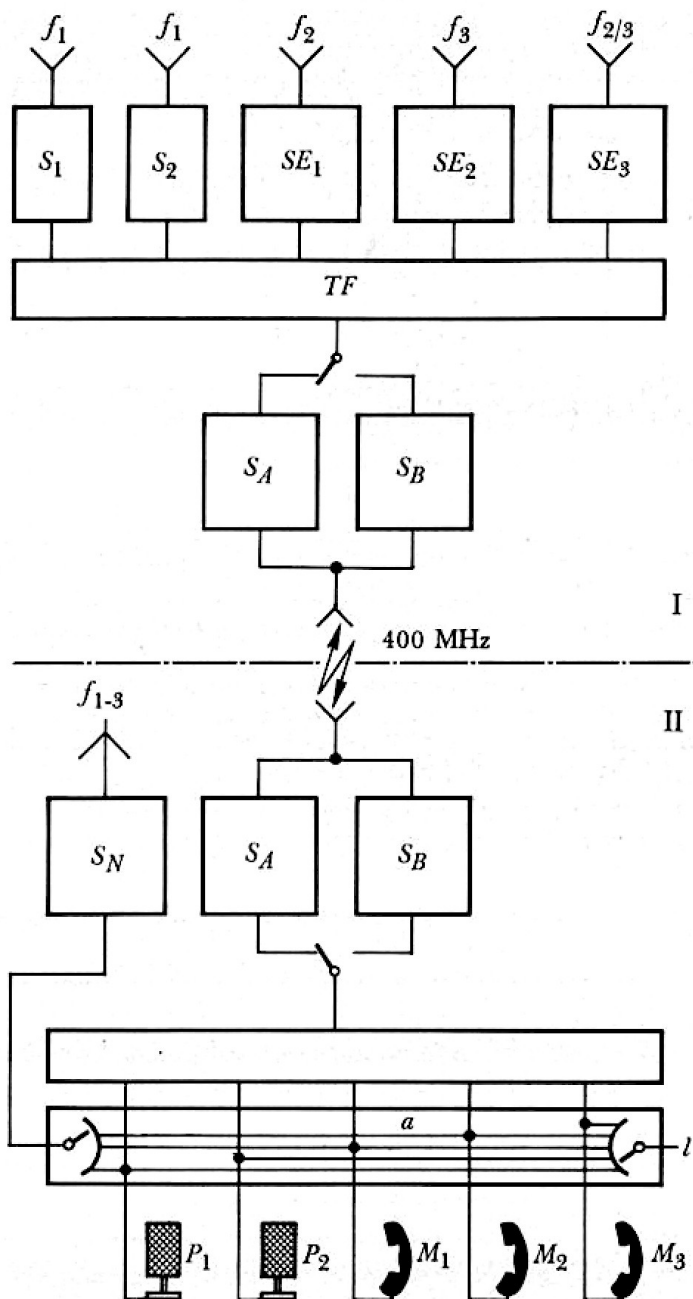
pagation conditions in Vaud were rendered even worse, special measures adopted in the aerial array on the Rochers-de-Naye made it possible to attain a range well beyond the scope of the old installation with the 40/80-Mc/s equipment.

– In addition to an omnidirectional aerial, directional aeri-als were provided for the axes Rochers-de-Naye–Geneva and Rochers-de-Naye–Payerne.

Fig. 2. — Remote-controlled base station on the Rochers-de-Naye

From left to right: the three base units type RT 5 for 160 Mc/s, each with three receivers for diversity operation, the main and standby RT 5 transmitters for traffic with local police stations on 160 Mc/s, and the aerial control system.





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These can be selected by remote control from Lausanne.

- One receiver is connected to each of these three aerial arrays. By means of a diversity unit the a.f. signal with the best quality is electronically selected and switched through to the listener. At the same time the transmitter is automatically connected to the appropriate aerial. By this means the best aerial is always selected when a message comes in from one of the mobile stations, no matter where the latter is situated.
- This system of aerial control is also effective when messages are passed between two mobile stations,

Fig. 3. - Schematic layout of the fixed installation

- P_1, P_2 = Main and standby networks for calling local police stations
- M_1, M_2 = Mobile radio networks 1 and 2
- M_3 = Reserve network for M_1 and M_2 (the frequency can be changed to suit requirements)
- S_A, S_B = Main and standby stations of the broadband networks
- S_N = Emergency station, if necessary can replace the base station in its entirety
- S_1, S_2 = Main and standby transmitter stations of the network for the local police stations
- S_{E1}, S_{E2} = Base stations for networks M_1 and M_2
- S_{E3} = Reserve base station for M_1 and M_2
- TF = Multiplexer
- I = Base station
- II = Control station
- a = Automatic equipment
- l = Telephone line
- f_1-f_3 = Transmitting and receiving frequencies

in which case the base station merely acts as a simplex relay station, thus increasing the range considerably (Fig. 4).

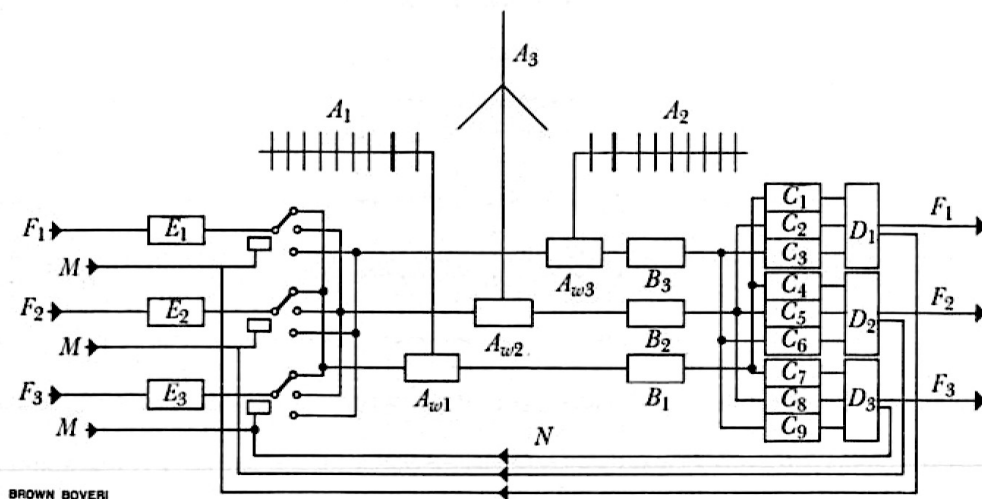
Mobile Stations

The police vehicles and boats are all equipped with type RT 18 transistorized duplex sets. These operate in the 160-Mc/s band and have an output power of 20 W. These transmitters are notable for their extremely low current consumption in standby operation (appr. 300 mA at 12 V), so that there is no need for any special precautions as regards the car battery or the dynamo. The mobile stations are selectively called on the dual-tone principle, while groups of ten can be called collectively. By pressing a button the stations can be switched to the frequencies of the different area networks, the choice of up to eight sub-channels being possible. Moreover, some of the vehicles are equipped with a second receiver, enabling them to receive on two different channels. Thus the mobile stations (Fig. 5) can handle the following kinds of traffic:

- Two-way traffic (duplex) on all networks of the Vaud Cantonal Police
- Two-way traffic (simplex) via the base station on the Rochers-de-Naye, from mobile station to mobile station

Fig. 4. - Principle of connecting any one of three duplex networks to a number of directional or omnidirectional aerials

- A_1, A_2 = Unidirectional aerials
- A_3 = Omnidirectional aerial
- $A_{w1, 2, 3}$ = Diplexers
- $B_1, 2, 3$ = Receiver preamplifiers
- $C_1, 2, 3$ = One receiver per network and aerial
- $D_1, 2, 3$ = Diversity units
- $E_1, 2, 3$ = One transmitter per network

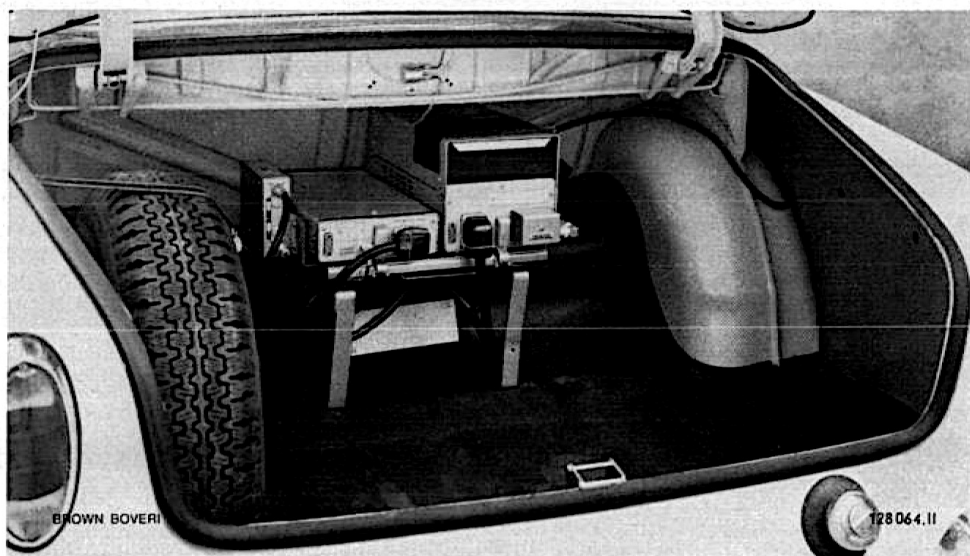


$F_{1, 2, 3}$ = A.F. inputs and outputs
 M = Manual control of transmitter connection

N = Automatic control of transmitter connection by diversity command

Fig. 5. - Transistorized RT 18 mobile set for 160 Mc/s, output 20 W, with standby receiver and duplexing filter

With the second receiver the station is always ready to receive on either of two channels.



- Two-way traffic (simplex) between vehicles and portable sets
- Duplex traffic at the cantonal boundaries with the network of the adjoining cantons, employing the intercantonal frequency.

Receivers for Police Stations

The numerous local police stations, spread over the whole cantonal area, were equipped with receiving sets served by a separate transmitting network. Here, too, the stations are called selectively, either singly or collectively (for conference calls). A memory circuit indicates that a call has been made, in the event of there being nobody in the out-station

to answer it. Outside office hours the policeman on standby duty receives calls in his home.

Operation of the Radio Equipment

All elements of the equipment for operation, handling calls and monitoring the installation are installed in a single control desk. From here the various networks can be called and incoming calls put through to their destination via the internal exchange.

Furthermore all radio traffic, i.e. the messages between mobile stations can be listened to in the control centre, with or without intervention from the control officer, and all radio messages can be recorded on tape.

(KME)

I. VANDEWALLE