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Special Topic Report - Stockholm Radio, SDJ
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1. Historical perspective

The history of coast radio services in the Stockholm area dates back to 1902 when a Royal Swedish Navy experimental coast radio station was built at the Waxholm fortress at the entrance to Stockholm from the Baltic Sea. This first station became in 1914 a public correspondence station as a joint venture between the Navy and the Royal Swedish Telecommunications Board, and was upgraded to use a Telefunken "Tonende Funken" 8 kw spark transmitter.

In the 1920's, the station's services were supplemented by radiotelephony and CW telegraphy, and the Navy operational engagement ended due to disputes about funding and management.

The station resided at the fortress until 1937, when a new station, optimized for MF radiotelegraphy and telephony, was built in the small archipelago village Stavsnas, about 40 km due east from the Stockholm City center. A new separated transmitter site was founded at the shore, and the operational center and receiving site was located in the rented top floor of a small villa in the heart of the village. Operation in these quite cramped and uncomfortable quarters continued through the war years, with a sometimes high workload due to the wartime dangers for shipping and refugee traffic in the Baltic.

In 1947, a new operational and receiver building was built at the outskirts of the village, in a "prestige" location with a breathtaking view of the archipelago.

Also in 1947 were the roles of the civilian coast radio stations in the Swedish Search and Rescue system formalized, and Stockholm Radio became the appointed Maritime Rescue Coordination Center (MRCC) for the Swedish part of the Baltic Sea.

The years to come witnessed great changes, MF gradually lost its once major role, and was replaced by VHF for volume traffic. In 1973, a major reorganization of the network was started, closing the smaller MF only stations and concentrating the VHF and MF services to the remaining three stations, at the same time MRCC's, Goteborg Radio in the west, Stockholm Radio in the east and Harnosand radio in the north.

As part of an organizational structure change in 1979, Stockholm Radio moved from its scenic site in "splendid isolation" in the archipelago to the top floor of the Telecom Administration regional office building in a southern Stockholm urban industrial district.

This move was also a part of a merger of the services with the HF Air/Ground and point-to-point station Enkoping Radio. In 1980 the moving and merging operations were complete, and VHF services for the merchant shipping and the pleasure boaters in the dense archipelago became the station's main business, together with the MRCC role.

The 1980's also became a decade of changes, the once profitable VHF services became faced with the mass market mobile telephony competition, and were reduced to a small fraction at the end of the decade. This reduction was to some extent offset by an increase of the MRCC and Air/Ground activities.

The first years of the 1990's were also to bring changes of completely unexpected magnitude and rate. It all started by a seemingly innocent statement in the fine print of a 1992 Maritime Administration study paper

that the MRCC structure was to be scrutinized, and that the new structure by all probability had no place for Harnosand Radio, the northernmost station. The management reacted quickly by assigning the crew of Harnosand Radio to other job positions, and launching a crash project for remote control from Stockholm Radio, effective March 31, 1993. This was followed only a few months later by another decision to redesign and upgrade the two remaining stations, using off-the-shelf commercial hardware and software products, into a new and more flexible architecture.

Only a few months into this project, the Maritime Administration, responsible for the MRCC funding, declared that they had decided to operate the Goteborg MRCC under their own regime, and that any involvement there with commercial coast radio was neither wanted nor necessary. Again, the management reacted without delay, declaring that the remaining MF, HF and VHF manual services of Goteborg Radio were to be immediately closed and transferred to Stockholm Radio, as soon as the new switching infrastructure was delivered and installed. This was completed in the autumn of 1994 and only weeks later the Goteborg Radio coast radio services became history.

As part of this project, the Stockholm Radio operational center moved again, this time to brand new premises about 10 km due east from the city center, occupying a top office floor overlooking the entrance to the Stockholm harbour.

At the time of writing, Stockholm Radio is the sole commercial coast radio station in Sweden, with the possible exception of the naval coast stations Karlskrona Radio (SAA) and Tingstade Radio (SAE) who still provide telegram services operated on MF and HF telegraphy and MF telephony, hitherto justified by needs for operator training, an arrangement which is a remnant of the situation before the 1920's, when coast radio responsibilities were shared between the Navy and the Telecommunications Board. Tingstade Radio is interesting in another aspect, it is probably the only naval coast station in existence staffed by the Navy, but funded by the Army and the Air Force.

It is quite safe to say that many people, inside as well as outside of the coast radio services in Sweden, were taken by surprise by the outcome of the turbulence in the 1992 - 1994 period. As late as 1990, it would have been considered quite safe and unimaginative to bet money on the assumption that Goteborg Radio would be the remaining coast station in Sweden, by virtue of its size and the massive investments made there in the 1970's and 80's. On the contrary, it turned out that its size was to be a major drawback in terms of operating costs, and that the investments were aimed to optimize traffic capacity for services that were not required any more. It is maybe appropriate to consider the fate of Goteborg Radio as a striking illustration of the dangers associated with resting on old laurels.

2. Services

Stockholm Radio has probably a quite unique station architecture providing many types of different services, all sharing a common technical infrastructure and personnel.

About 30 people are employed in the operations, and a typical day shift has about 5 - 6 crew members, compared to 3 for a night shift.

2.1 Maritime safety services

The most important safety role of the Stockholm Radio system is that it embodies the MRCC function, under a contract with the Maritime Administration. The area of responsibility for MRCC Stockholm is the Swedish part of the Baltic Sea and Bay of Bothnia, from the Finnish border in the north and to south of the island of Gotland, where the MRCC Goteborg area takes over. Stockholm Radio/MRCC Stockholm is also the technical center for the VHF-DSC (Channel 70) and MF-DSC (2187.5 kHz) distress watch systems.

Additionally, all transmissions of navigational warnings, weather reports and other maritime safety information on either telegraphy, telephony or NAVTEX takes place from Stockholm Radio, as well as the Swedish NAVAREA information coordinating and distribution functions outside office hours.

2.2 Maritime commercial services

Stockholm Radio still provides the usual coast radio commercial services with the exception of HF morse telegraphy.

Services are:

- 500 kHz watchkeeping
MF telegraphy services

- 2182 kHz watchkeeping
MF telephony services
MF fishing report message services

- Channel 16 watchkeeping
VHF telephony services

- HF telephony services ("MARITEX seaphone")
using calling and call booking through the
MARITEX radiotelex system

- MARITEX customer services and
system supervision outside office hours

The service areas for the maritime commercial services are the entire Swedish coastal waters, adding HF coverage of the Atlantic, the Indian Ocean and the Mediterranean Sea. Other commercial undertakings are the technical service provisions for harbour traffic control and pilotage control services.

Service volumes have slowly but steadily been diminishing since the 1980's, with the exception of the MF telegraphy, which due to the lifting of the Iron Curtain and the increase of Russian Federation foreign trade via Baltic ports, actually saw an increase in 1991 - 1995, up to a daily average of about 40 telegrams. The VHF traffic is extremely unevenly distributed over the year, a peak period with about 400 - 600 VHF calls per day occurs for a few weeks in the summer holidays, and outside these weeks the traffic falls to a fairly constant level of about 40 - 70 calls per day.

2.3 Air/Ground services

The Air/Ground services are aimed to the commercial airline market, and serve to provide HF equipped aircraft with means to keep in contact with their ground based company offices or the public telephone network, by either AFTN/SITA messages or phone-patches. Services of this type have been provided in Sweden since 1967, at the beginning from the HF station Enköping Radio, but since 1980 from Stockholm Radio.

Stockholm Radio has a regular customer base of about 300 aircraft operators, and the traffic has an increasing trend.

A part of the evaluation system for the automatic HF datalink system using 3 channels has been operated from Stockholm Radio since late 1992.

3. System architecture

The nucleus of the system is the switching center, which is comprised of two system halves, each using one GAREX 210 Voice Communications and Control Switch (VCCS). The GAREX 210 is a computer controlled switching system manufactured in Norway, and originally designed for Air Traffic Control center purposes.

Other GAREX installations for coast radio can be found in Iceland, Taiwan and Singapore.

All switching and control functions in the system are made in the VCCS.

Two types of operation consoles exist, one which is X-terminal Graphical User Interface (GUI) based, and one which uses conventional lighted function buttons. The GUI based consoles are connected to two UNIX servers per VCCS via an Ethernet LAN, and the function-button based consoles, which can either be locally or remotely operated, are directly interfaced to the VCCS.

3.1 Coast radio function

The coast radio function is centered around the Traffic Central where the watchkeeping of the distress and calling channels is made, as well as the reception of call bookings by telephone.

At night-time, and in off-peak seasons, the VHF and MF duplex working channels also are served here. The Traffic Central itself has 5 operating consoles. Two more supplementary consoles for MF telegraphy and weather and navigational warning broadcasts are also parts of the Traffic Central. At peak traffic in the summer season, up to 4 more dedicated VHF consoles are taken into operation in a separate room, serving only the VHF duplex channels and staffed by temporarily hired personnel. One more detail about the system organization, is that if the capacity of the Traffic Central should become inadequate for any reason, a GUI-based workstation that is placed in the reception office area (!) can be activated to absorb traffic overflow.

One X-terminal (GUI) based operator console has a design watchkeeping capacity limit of 120 channels, which never is approached in practice. A more realistic distribution limit is about 35 - 50 channels per console. Each console has up to 6 loudspeakers, to which suitable selections and combinations of channels can be directed.

There are no radio panels or conventional-looking remote control facilities whatsoever in the coast station system, X-terminal workstations and "dumb terminals" are used for all phases of system control and message handling.

3.1.1 Coast Radio Network

The network used is primarily composed of VHF base stations sited in as tall structures as possible. On the Baltic Coast extensive use has been made of the FM/TV broadcast towers, in which the VHF antennas usually are mounted at more than 300 meters above sea level. On the west coast, where the depth of the required coverage area is less, lower masts for 900 MHz mobile telephone sites are used. The total number of VHF sites is about 50, with a total number of about 170 radio channels, simplex and duplex.

A base station consists of one transceiver for channel 16 and at least one more for the duplex working channels. The transceivers used are general purpose solid-state VHF/FM types.

Presently, the addition of a channel 70 transceiver at each site for VHF-DSC is an ongoing project, which is expected to be completed in 1998.

The MF network uses all remotely controlled receivers and transmitters, at sites around the coast:

Bjuroklubb	64	28.0 N,	21	36.0 E	444, 500, 518, 2182, 2187.5, 1779 kHz
Harnosand Hemso	62	42.3 N,	18	07.5 E	444, 500, 2182, 2187.5, 2733 kHz
Stockholm Stavsna	59	16.0 N,	18	42.8 E	519, 500, 518, 2182, 2187.5, 1674kHz
Gislovshammar	55	29.2 N,	14	19.0 E	448, 500, 518, 2182, 2187.5, 1797kHz
Goteborg Vallda	57	27.9 N,	14	19.0 E	521.5, 500, 2182, 2187.5, 1710 kHz

Most MF telephony transmitters are Standard Radio SST490 0.8 kw solid-state SSB/ISB types feeding vertical resonant radiators, complemented by Rockwell/Collins HF-80 and S.P.Radio 1.2 kw solid-state types at sites where antenna efficiencies are marginal. The remote controlled general purpose receivers are Standard Radio CR300 and CR90 types.

ICOM IC-R71's and Drake RR-1's are commonly used for watchkeeping channels.

For MF telegraphy and NAVTEX dual Nautel 1 kw solid-state CW/MCW/FSK transmitters are used at each site. One set of Wilcox Electric 96D 2 kw CW/MCW transmitters from 1943 is still kept in working order as a standby at one site.

3.1.2 Radio infrastructure services

For many years, the performance of the purpose-built radio networks used by for example port operations, icebreaking and traffic control services have been found to be lacking in capacity and in coverage area. Envious remarks had been made about the high performance of the coast radio VHF system for years and when the new VCCS system was installed in 1994, with its inherent capability for "remote operator consoles", the Oxelosund (80 km SW from Stockholm) port operations radio system was replaced with a connection to the Stockholm Radio technical infrastructure, as a trial project, sharing channel 16 and a handful of duplex channels, and operating two dedicated simplex channels. The differences in operational quality and coverage were dramatic, and today 5 more pilot and port operations radio systems are connected into the system. The gains attained have been twofold, firstly that the high-performance channel 16 and duplex installations are better utilized, and secondly that a much fewer number of dedicated channels are needed to cover a given area, as the offered antenna height is much greater than in previous systems.

3.2 MRCC function

The MRCC is a subset of the operational functions of the whole network, concentrated into two operating positions. From each workstation, the MRCC officers have access to all communications facilities, radio and landline, in the whole network. These facilities can be combined and used at will, providing the Search and Rescue Coordinating officer with a powerful communications, command and control tool.

Even though the Goteborg MRCC is operated and staffed by the Maritime Administration, and not co-located with any coast station, it shares the same systems architecture and radio network. The Goteborg MRCC has several operating positions connected to the VCCS system by means of a fibre-optic data and telephony trunk.

3.3 Air/Ground radio function

In the Air/Ground radio function, no distinctions are made between the calling and traffic channels, so no traffic central exists. 6 primary or calling channels are loudspeaker monitored in the system, at up to 4 operating consoles.

Primary frequencies are:

3494 kHz (22 - 05 UTC)
 5541 kHz (H24)
 8930 kHz (H24)
 11345 kHz (H24)
 13342 kHz (H24)
 17916 kHz (H24)
 23210 kHz (05 - 22 UTC)

The operator consoles used were originally designed to work into the relay-logic based HF traffic system at the previous location of the station, and as the relocation project progressed, it was felt that they were too valuable to be scrapped. A decision was taken to design an interface adapter enabling them to be used in the VCCS system as ordinary function-button based operator consoles.

Any Air/Ground operator has the selection between up to 16 receivers, 12 transmitters and 18 landlines, as well as SELCAL and access to computer data banks for airport weather information, customer data and message handling.

3.3.1 Air/Ground HF Radio Network

The HF network, like the VHF and MF networks, uses all remotely controlled receivers and transmitters. The transmitters are situated in two sites in western Sweden, Karlsborg and Grimeton, which were originally built in the 1920's for LF point-to-point traffic.

A large number of HF transmitters were installed there in the mid-1960's, to cater for an anticipated increase of HF point-to-point traffic that never materialized. Instead, the sites and equipment were primarily used for mobile HF services.

The aeronautical services has access to a total of 13 HF/SSB transmitters from Telefunken, Rohde & Schwarz and Rockwell/Collins having power levels of 20, 10, 3 and 1 kw, feeding log-periodic, dipole and rhombic radiators.

Receivers, of the Standard Radio CR300, CR90 and ICOM IC-R71 types, are primarily installed in the Enköping station, and secondarily in the old Goteborg Radio receiving site and in the MF receive sites along the coast. The antenna system employed are a mixture of TCI horizontal and vertical log-periodic arrays, together with dipoles and vertical omniantennas.

4. Future of the Stockholm Radio services

It is difficult to predict, especially regarding the future, it has been said.

The commercial part of the system has a combined traffic load of more than 200000 transactions over the year, which generates about sufficient revenues to keep out of red figures.

Presently, it seems that the Stockholm Radio maritime services have a reasonably assured future for the next seven years or so, as the Maritime Administration has agreed to a long-term involvement in the maritime safety field. It is reasonable to expect that the flourishing mobile telephony market will further reduce traffic revenues from merchant shipping and boaters, maybe down to a level where the commercial aspects are neglected.

Morse telegraphy distress and safety services on MF is expected to be in operation up to and including the year 2001 according to the latest Maritime Administration prognoses.

Finally the Air/Ground HF voice services, whose future is very much linked to the rate of exchanging old aircraft for new.

It has been found in the past that the acquisition of new aircraft by an airline leads to the sale of the old to a more penny-pinching airline, that usually don't want to make the investment in SATCOM and feels that HF has a good enough price/performance ratio for his company communications. New aircraft on the other hand, usually are HF datalink, ACARS and SATCOM equipped from the beginning.

Stockholm Radio celebrated its 75th anniversary in 1989, and the possibilities that the station will be around in some form to celebrate its 100th anniversary have increased. It can be appropriate in this aspect to quote an old anecdote from the wireline telegraph days in the mid-19'th century, when a hurried customer rushed to the Stockholm Central telegraph office to hand in a telegram, asking the clerk at the counter when the office closes.

The clerk responded:

"Close? We close earliest at doomsday, but quite late in the evening."