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*Receiver radiation as a real
concern of operational security.*

AGENT HAZARD IN THE SUPER-HET

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An agent is not likely to worry about counterintelligence direction-finders when he is merely listening to a blind transmission from his radio base. Yet most radio receivers radiate a measurable amount of radio-frequency energy, which can be detected at distances ranging from a fraction of an inch to many miles according to the design of the receiver and the sophistication of the detection apparatus. It is thus possible under the right circumstances to locate an agent receiver through an extension of the techniques long used in the locating of transmitters. The seriousness of this hazard varies so greatly with circumstance that no general rules can be made to deal with it, but it should be taken into account as one of the many considerations in an agent's security. An understanding of the phenomenon and some broad parameters will help one to assess the danger in a particular case.

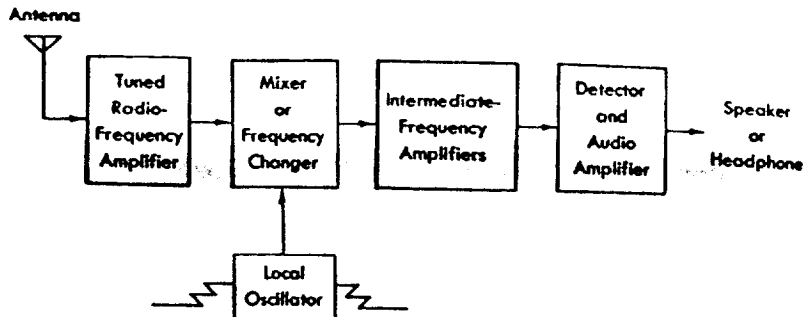
The Super-Het

In the evolution of radio receivers, the early crystal set was soon followed by the Tuned Radio Frequency receiver, which amplified the signal in the same form in which it was received by the antenna. The radio-frequency amplifiers, when tuned to the frequency of the desired station, would to some extent reject unwanted stations. But as the frequency bands grew crowded with transmitters it would have required additional components of excessive size and cost to keep the TRF sufficiently selective, and it became obsolete.

The super-heterodyne, which solved this problem of the TRF, became immediately popular and today is used exclusively in both radio and television. It mixes the incoming signal with another radio frequency it generates itself and so transforms it to an "intermediate" frequency on which most

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of the amplification can be done with high selectivity. Schematically, the process looks like this:



The tuned radio-frequency amplifier tunes in the signal as received by the antenna, amplifies it, and sends it to the mixer, where in combination with the signal generated by the local oscillator it takes on the intermediate frequency. This is then amplified before the superimposed audio frequency is brought out and amplified further. The intermediate frequency of a particular receiver is fixed, the frequency of the local oscillator being varied to produce it by subtraction. If the desired transmitter is on 3,000 kilocycles, for example, and the intermediate frequency is 455 kilocycles, the oscillator is tuned to 3,455 kilocycles. 455 kilocycles is the standard intermediate frequency in the United States; many foreign countries use other frequencies.

It is the local oscillator that creates the hazard; it is in effect a low-power transmitter. Although its signal is intended only for the mixer, a portion of it, if power is excessive or the receiver otherwise poorly designed, is radiated outside the receiver. A portion may also be introduced into electrical power lines if the receiver is plugged in or even close to them. It may therefore be possible to detect it at some distance with an intercept receiver using either an antenna to pick up the radiation or a coupling to the power lines.

Detection in Practice

When the super-het was first introduced, radio listeners began complaining of whistles and "birdies" which interfered with their reception; the source of this interference was the local oscillators in their neighbors' super-hets. In 1934 the

Federal Communications Commission established maximum local oscillator radiation levels for all radio and television receivers manufactured for use in the United States. These ceilings are such as to keep the radiation within tolerable limits at a distance of 100 feet, but they do not ensure that it cannot be detected by a sensitive receiver at greater distances.

There are in fact both government and private operations that take advantage of this otherwise objectionable radiation. The British General Post Office employs mobile detection vans to determine whether a radio or television set is being operated in households without a GPO receiver license. The technique is also used in the United States by audience-survey organizations to determine how many television receivers in a neighborhood are tuned to particular channels. It is true that in both of these operations the intercept vans are operating against a clearly defined target wherein times, frequencies, locations, radiation levels, and equipment requirements are predictable, whereas many of these factors cannot be predetermined if the search is for agents using radio receivers. But the interception and location of an agent's receiver might be facilitated by correlative intelligence on the general area in which he is operating, his base station's frequency and schedule, and the intermediate frequency and radiation level of the receiver.

Precautions

These considerations point to several ways in which the danger can be minimized:

If an agent tunes to his base station at certain hours daily the risk is increased. Infrequent listening at irregular dates and times decreases it.

Since the frequency of the radiation can be determined arithmetically by adding the intermediate frequency when the base station frequency is known, the risk depends in part upon the communications security practices of the base station. Base frequency changes, use of the the same frequencies to serve a large geographical area, dummy traffic, and lack of identifying characteristics all help reduce it.

Changing receiving locations will reduce the risk. Urban and rural locations present distinct types of risk, which

varies also with types of detection conveyance: aircraft are particularly effective against targets in the countryside. Proximity to a hostile intercept station is of course a danger.

Mere proximity to power lines increases the risk. It is best to operate from batteries at some distance from all wire carriers.

If the agent is using a manual radio transmitter, he is of course already taking a far greater risk than that created by the comparatively weak signal from his receiver.

Receiver Choice

The range at which local oscillator radiation can be intercepted varies enormously among types of receivers, from a matter of inches for some transistor sets designed especially for agent use to some two miles on the ground and up to twenty in aircraft for poorly designed vacuum-tube makes. But one cannot always make the obvious choice: there are sometimes overriding operational considerations that require the use of indigenous short-wave radios.

Five categories of receivers are listed below in descending order of radiation levels.

Foreign vacuum-tube receivers.

Vacuum-tube receivers manufactured in the United States or abroad (Japan, Germany) for U.S. markets under FCC specifications.

Vacuum-tube receivers designed for agent use.

Commercially available transistor receivers.

Transistor receivers built for agent use. Transistor sets with high battery voltage, say 12 volts, normally have higher radiation than those using low supply voltages.