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MILITARY COMMUNICATION SYSTEM IN MALAYSIA
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13.1 INTRODUCTION
Military communications or signals are a field of military activities, tactics and equipment dealing with communications. First of all, military communications are battlefield (combat) communications, including intercommunication with a higher command or country's government.

Historically, the first military communications had the form of sending or receiving simple signals (often hidden or encoded to be unrecognizable for the enemy). Respectively, the first distinctive tactics of military communications were called Signals, while units specializing in those tactics received the Signal Corps name. Later Signals and Signaller became a highly-distinct military occupation dealing rather with general communications methods (similar to those in civil use) than with weapons. Present-day militaries of an informational society conduct very intense and complicated communicating activities on a daily basis, using modern high-tech telecommunications and computing methods. Only a small part of these activities is immediately related to the combat actions. That's why some prefer the term "military communications" [1].
13.2 MALAYSIAN MILITARY
The military of Malaysia is known officially as the Malaysian Armed Forces (MAF, Malay: Angkatan Tentera Malaysia-ATM). It consists of three branches; the Royal Malaysian Navy (RMN, Malay: Tentera Laut Diraja Malaysia-TLDM), the Malaysian Army (Malay: Tentera Darat Malaysia-TD) and the Royal Malaysian Air Force (RMAF, Malay: Tentera Udara Diraja Malaysia-TUDM). The role of the Malaysian Armed Forces (MAF) is to defend the sovereignty and strategic interests of Malaysia from all forms of threat. It is responsible to assist the civilian authorities to overcome all international threats, preserve public order, assist in natural disasters and participate in national development programs. It is also sustaining and upgrading its capabilities in the international sphere in order to uphold the national foreign policy of being involved under the guidance of the United Nations (UN) [2].

13.3 MALAYSIAN COMMUNICATION SYSTEM
Today, Malaysia has developed usages of modern communication systems such as telephone (line-in and mobile cellular), internet (dial-up and broadband), radio and television (satellite and cabled). Number of people that used these kinds of technologies also increasing rapidly.

13.4 COMMUNICATION SYSTEM IN MILITARY - MALAYSIA
13.4.1 Radar
Radar is a system that uses electromagnetic waves to identify the range, altitude, direction, or speed of both moving and fixed objects such as aircraft, ships, motor vehicles, weather formations, and terrain. The term RADAR was coined in 1941 as an acronym for Radio Detection and Ranging. The term has since entered the English language as a standard word, radar, losing the capitalization in the process. Radar was originally called RDF (Radio Direction Finder). A radar system has a transmitter that
emits radio waves that are reflected by the target and detected by a receiver, typically in the same location as the transmitter. Although the radio signal returned is usually very weak, radio signals can easily be amplified. This enables radar to detect objects at ranges where other emissions, such as sound or visible light, would be too weak to detect. Radar is used in many contexts, including meteorological detection of precipitation, measuring ocean surface waves, air traffic control, police detection of speeding traffic, and by the military.

Electromagnetic waves reflect (scatter) from any large change in the dielectric or diamagnetic constants. This means that a solid object in air or a vacuum, or other significant change in atomic density between the object and what's surrounding it, will usually scatter radar (radio) waves. This is particularly true for electrically conductive materials, such as metal and carbon fiber, making radar particularly well suited to the detection of aircraft and ships. Radar absorbing material, containing resistive and sometimes magnetic substances, is used on military vehicles to reduce radar reflection. This is the radio equivalent of painting something a dark color.

Figure 13.1 Sample of radar
Radar waves scatter in a variety of ways depending on the size (wavelength) of the radio wave and the shape of the target. If the wavelength is much shorter than the target's size, the wave will bounce off in a way similar to the way light is reflected by a mirror. If the wavelength is much longer than the size of the target, the target is polarized (positive and negative charges are separated), like a dipole antenna. This is described by Rayleigh scattering, an effect that creates the Earth's blue sky and red sunsets. When the two length scales are comparable, there may be resonances. Early radars used very long wavelengths that were larger than the targets and received a vague signal, whereas some modern systems use shorter wavelengths (a few centimeters or shorter) that can image objects as small as a loaf of bread.

Short radio waves reflect from curves and corners, in a way similar to glint from a rounded piece of glass. The most reflective targets for short wavelengths have 90° angles between the reflective surfaces. A structure consisting of three flat surfaces meeting at a single corner, like the corner on a box, will always reflect waves entering its opening directly back at the source. These so-called corner reflectors are commonly used as radar reflectors to make otherwise difficult-to-detect objects easier to detect, and are often found on boats in order to improve their detection in a rescue situation and to reduce collisions. For similar reasons, objects attempting to avoid detection will angle their
surfaces in a way to eliminate inside corners and avoid surfaces and edges perpendicular to likely detection directions, which leads to "odd" looking stealth aircraft. These precautions do not completely eliminate reflection because of diffraction, especially at longer wavelengths. Half wavelength long wires or strips of conducting material, such as chaff, are very reflective but do not direct the scattered energy back toward the source. The extent to which an object reflects or scatters radio waves is called its radar cross section.

**Table 13.1** Some of radar’s frequencies

<table>
<thead>
<tr>
<th>Band Name</th>
<th>Frequency Range</th>
<th>Wavelength Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF</td>
<td>3-30 MHz</td>
<td>10 – 100 m,</td>
<td>coastal radar systems over-the-horizon radar (OTH) radars; 'high frequency'</td>
</tr>
<tr>
<td>P</td>
<td>&lt; 300MHz</td>
<td>1 m+</td>
<td>'P' for 'previous' applied retrospectively to early radar systems</td>
</tr>
<tr>
<td>VHF</td>
<td>50-330 MHz</td>
<td>0.9 – 6 m</td>
<td>very long range, ground penetrating; 'very high frequency'</td>
</tr>
<tr>
<td>UHF</td>
<td>300-1000MHz</td>
<td>0.3 – 1 m</td>
<td>very long range (e.g. ballistic missile early warning), ground penetrating, foliage penetrating; 'ultra high frequency'</td>
</tr>
<tr>
<td>Q</td>
<td>40 – 60GHz</td>
<td>7.5 - 5</td>
<td>Use for military communication</td>
</tr>
</tbody>
</table>
13.4.2 Radio
Radio is most common communication equipment use by military including Malaysian Military. Radio for a first time is use by army, anyway nowadays radio were use by public to broadcast the music or any information from commercial radio station. Radio is the transmission of signals, by modulation of electromagnetic waves with frequencies below those of visible light. Electromagnetic radiation travels by means of oscillating electromagnetic fields that pass through the air and the vacuum of space. Early speculation that this required a medium of transport, called luminiferous aether, were found to be false. Information is carried by systematically changing (modulating) some property of the radiated waves, such as their amplitude or their frequency. When radio waves pass an electrical conductor, the oscillating fields induce an alternating current in the conductor. This can be detected and transformed into sound or other signals that carry information.

Early uses were maritime, for sending telegraphic messages using Morse code between ships and land. The earliest users included the Japanese Navy scouting the Russian fleet during the Battle of Tsushima in 1905. One of the most memorable uses of marine telegraphy was during the sinking of the RMS Titanic in 1912, including communications between operators on the sinking ship and nearby vessels, and communications to shore stations listing the survivors. The first radio couldn't transmit sound or speech and was called the "wireless telegraph".
Today, radio takes many forms, including wireless networks and mobile communications of all types, as well as radio broadcasting. Before the advent of television, commercial radio broadcasts included not only news and music, but dramas, comedies, variety shows, and many other forms of entertainment. Radio was unique among methods of dramatic presentation in that it used only sound.

Aviation voice radios use VHF AM. AM is used so that multiple stations on the same channel can be received. (Use of FM would result in stronger stations blocking out reception of weaker stations due to FM's capture effect). Aircraft fly high enough that their transmitters can be received hundreds of miles (or kilometres) away, even though they are using VHF. Marine voice radios can use AM in the shortwave High Frequency (HF—3 MHz to 30 MHz) radio spectrum for very long ranges or narrowband FM in the VHF spectrum for much shorter ranges. Government, police, fire and commercial voice services use narrowband FM on special frequencies. Fidelity is sacrificed to use a smaller range of radio frequencies, usually five kHz of deviation, rather than the 75 kHz
used by FM broadcasts and 25 kHz used by TV sound. Early police radios used AM receivers to receive one-way dispatches.

Civil and military HF (high frequency) voice services use shortwave radio to contact ships at sea, aircraft and isolated settlements. Most use single sideband voice (SSB), which uses less bandwidth than AM. On an AM radio SSB sounds like ducks quacking. Viewed as a graph of frequency versus power, an AM signal shows power where the frequencies of the voice add and subtract with the main radio frequency. SSB cuts the bandwidth in half by suppressing the carrier and (usually) lower sideband. This also makes the transmitter about three times more powerful, because it doesn't need to transmit the unused carrier and sideband.

13.4.3 Military Communication Satellite
As soon as the possibility of placing a man-made satellite into an Earth orbit was recognized, speculation began as to the feasibility of using a radio repeater (transponder) for intercontinental communications. The use of geostationary satellites for this purpose was suggested by Arthur C. Clarke in an article in "Wireless World", 1946. The advantages of the geostationary orbit for general communications and for broadcasting was apparent, although there was much speculation about the acceptability of satellite links for telephone channels in view of the long echo delay of some 540 milliseconds. A public offering of satellite voice channels was not made until sixteen years later at which time they were found to be acceptable as had indeed been predicted by simulated tests.

There are four segments to the military satellite communications (MILSATCOM) architecture. First, ultrahigh frequency (UHF) satellites are the workhorses for tactical ground, sea, and air forces. Second, the superhigh frequency (SHF) Defense Satellite Communications System (DSCS), first deployed in the 1970s, supports long-distance communications requirements of military forces that cannot be met by groundbased
communications systems. The DSCS system satisfies the majority of DoD's medium- and high data-rate communications requirements. Milstar will soon be integrated as the third segment of the MILSATCOM architecture. It will provide a worldwide, secure, jam-resistant communications capability to US civilian and military leaders for command and control of military forces.

![Figure 13.4. MEASAT –The Malaysian Satellite](image)

The fourth segment consists of commercial communications satellites, which are used to support DoD's MILSATCOM capabilities where jamming protection is not required.

In 1945 British scientist and science fiction writer, Arthur C. Clarke, published a technical paper in which he suggested that communications satellites were feasible.

The Syncoms were three experimental, active satellites. The name, coined from the first syllables of "synchronous communications," referred to their orbits. Each Syncom satellite weighed about 85 pounds. Syncom I was launched February 14, 1963, but did not reach synchronous orbit and communications failed. Syncom II, launched July 26, 1963, was the first satellite placed in synchronous orbit. It was active in many successful
intercontinental communication experiments. Syncom III, launched August 19, 1964, was the first stationary Earth satellite. It demonstrated the practicality and effectiveness of stationary, active communication satellites. In orbit near the International Date Line, it was used to te lecast the 1964 Olympic Games in Tokyo to the United States, the first television program to cross the Pacific [5].

13.4.4 Walkie – Talkie
A walkie-talkie (more formally known as a handheld transceiver) is a hand-held, portable, two-way radio transceiver. The first walkie-talkies were developed for military use during World War II, and spread to public safety and eventually commercial and jobsite work after the war. Major characteristics include a half-duplex channel (only one radio transmits at a time, though any number can listen) and a push-to-talk switch that starts transmission. Typical walkie-talkies resemble a telephone handset, possibly slightly larger but still a single unit, with an antenna sticking out of the top. Where a phone's earpiece is only loud enough to be heard by the user, a walkie-talkie's built-in speaker can be heard by the user and those in his immediate vicinity. Hand-held transceivers may be used to communicate between each other, or to vehicle-mounted or base stations.

Figure 13.5 Soldier using walkie – talkie during war
The first radio receiver/transmitter to be nicknamed "Walkie-Talkie" was the backpacked Motorola SCR-300, created by an engineering team in 1940 at the Galvin Manufacturing Company (fore-runner of Motorola). The team consisted of Dan Noble, who conceived of the design using frequency modulation, Henryk Magnuski who was the principal RF engineer, Marion Bond, Lloyd Morris, and Bill Vogel.

Motorola also produced the hand-held AM SCR-536 radio during World War II, and it was called the "Handie-Talkie" (HT). The terms are often confused today, but the original walkie talkie referred to the back mounted model, while the handie talkie was the device which could be held entirely in the hand (but had vastly reduced performance). Both devices ran on vacuum tubes and used high voltage dry cell batteries.

The abbreviation HT, derived from Motorola's "Handie Talkie" trademark, is commonly used to refer to portable handheld ham radios, with "walkie-talkie" used to designate more specialized commercial and personal radios. Surplus Motorola Handie Talkies found their way into the hands of ham radio operators immediately following World War II. Motorola's public safety radios of the 1950s and 1960s, were loaned or donated to ham groups as part of the Civil Defense program. To avoid trademark infringement, other manufacturers use designations such as "Handheld Transceiver" or "Handie Transceiver" for their products.

Al Gross also worked on the early technology behind the walkie-talkie between 1934 and 1941, and is sometimes said to actually have invented it.

Since even a powerful commercial walkie-talkie is limited to a few watts of power output and a small antenna (the physical size of the package limits both battery capacity and antenna size), hand-held communication range is typically quite short, not exceeding the line-of-sight distance to the horizon in open areas, and very much less in built-up areas, within buildings, or underground. Many radio services permit the use of a repeater
which is located at some high point within the desired coverage area. The repeater listens on one frequency and retransmits on another, so that reliable hand-held to hand-held unit range can be extended to a few score miles (kilometers) or further, using repeaters linked together.

Some cellular telephone networks offer a push-to-talk handset that allows walkie-talkie-like operation over the cellular network, without dialing a call each time. Walkie-talkies for public safety, commercial and industrial uses may be part of trunked radio systems, which dynamically allocate radio channels for more efficient use of limited radio spectrum.

Walkie-talkies are widely used in any setting where portable radio communications are necessary, including business, public safety, outdoor recreation, and the like, and devices are available at numerous price points from inexpensive analog units sold as toys up to ruggedized (i.e. waterproof or intrinsically safe) analog and digital units for use on boats or in heavy industry. Most countries, at the very least, will allow the sale of walkie-talkies for business, marine communications, and some personal uses such as CB radio, as well as amateur radio designs. Walkie-talkies, thanks to increasing use of miniaturized electronics, can be made very small, with some personal two-way UHF radio models being smaller than a pack of cigarettes (though VHF and HF units can be substantially larger due to the need for larger antennas and battery packs).
In addition, as costs come down, it is possible to add advanced squelch capabilities such as CTCSS (analog squelch) and DCS (digital squelch) (often marketed as "privacy codes") to inexpensive radios, as well as voice scrambling and trunking capabilities. Some units (especially amateur HTs) also include DTMF keypads for remote operation of various devices such as repeaters. Some models include VOX capability for hands-free operation, as well as the ability to attach external microphones and speakers [6].

13.5 LATEST TECHNOLOGY IN MILITARY COMMUNICATION SYSTEM

13.5.1 4G in Military Communication Mobile
The key is to empowering the military with tactical broadband voice, video and data is 4G communications technology that requires a minimal amount of fixed infrastructure, is small and highly portable, and inexpensive enough to be standard issue for every soldier.
Robust and rich capabilities
Deployability with little or no fixed infrastructure. Military engagements are often spontaneous, and a communications solution needs to be, as well. 4G Soldiers bring their networks with them, and take them away when they leave. Network setup automatically begins the minute troops exit a transport, helicopter or ship.

Geo-location well beyond the limitations of GPS. Soldiers cannot afford to expose themselves on a battlefield to acquire GPS coordinates. GPS is also limited in that satellite signals cannot penetrate caves, underground bunkers or inside shielded buildings. Ad hoc p2p wireless has built-in geo-location using an extremely accurate form of triangulation. The 4G soldier can triangulate his or her position, or that of another soldier, based on mesh-enabled vehicles or other devices, even when hiding in caves or otherwise out of harm's way. Readings are faster than GPS (under a second) because soldiers don't have to wait for multiple satellites to acquire a fix.

Security. The device security must address both communications security (COMSEC) and a way to protect the network from unauthorized use if the device is captured. Communications are more secure when mesh networks allow for route diversity. Meshed architectures also allow devices to transmit at lower output power to neighbors rather than “shouting” at a cell tower. This lowers the probability of detection and increases battery life. Should a device be captured, the 4G soldier can blacklist that device to maintain the integrity of the network.

Anti-jamming robustness. The 4G soldier is neither dependent on a single frequency nor constrained to a military band. The meshed architecture is the best deterrent to jamming because noise can now
be routed around problem areas. These self-forming, self-healing networks will have the ability to instinctively and proactively reduce the probability of jamming.

*High-mobility connectivity.* Communications devices must operate while vehicles or soldiers are mobile, even at speeds in excess of 100 mph. 4G soldiers can receive real-time streaming video from aircraft, such as the Predator Drone flying over a battlefield. Multitap rake receivers minimize the effects of Doppler radar to maximize the impact of theater air assets.

*End-to-end IP.* Modern soldiers grew up with computers and will demand the same applications and user interfaces available to civilians. The 4G soldier, using instant messaging, can send photos of enemy positions back to the Pentagon for analysis, and use voice over IP to communicate with non-military phones in an occupied city [7].

### 13.5.2 Integrated Communication System

Integrated Communication System has been developing since the early 1980s. This system initially comprised a range of single-channel radio (SCR), division-level mobile dual-channel radio communication networks, and regional networks, and was later added with tactical SATCOM and computer-based local and wide-area networks (LAN/WAN). The current PLA regional communications networks are based on mobile high frequency (HF) and microwave communications, combined with underground wires, coaxial cable, fiber optic, and satellite communications (SATCOM).

Integrated Communication System also has been developing impressive. Some group armies and divisions or brigades are now equipped with automated this systems (Integrated Communication System) to meet the growing demand for
information and real-time intelligence in the land battlefield. Division and brigade commanders are now able to receive enemy intelligence gathered by the unit’s intelligence, surveillance and reconnaissance (ISR) assets and issue commands and instructions to the subordinated units through integrated voice and data communications networks [9].

Figure 13.7 Application of integrated communication system in military

13.6 CONCLUSION
Military communication system is still on going develop and improved days by days include our country, Malaysia. Most of our military technologies are still bought from others country through specific memorandum of understanding (MOU). This exactly stills a not good sign for our future defense. Imagine that others country buy our technologies and ask for our consultancy in their military communication system. Automatically others country will salute us in our achievement. The challenge here goes to all Malaysian to compete in developing most powerful military communication system. This could make this nation safe from our enemies. Since Malaysia has its own Defense University in Pekan, Pahang, writer hope this will be the beginning of our military communication system revolution.
REFERENCES