SURUHANJAYA KOMUNIKASI DAN MULTIMEDIA MALAYSIA
Malaysian Communications and Multimedia Commission

AMATEUR RADIO HANDBOOK

First Edition
(20 December 2022)

Notice:
The information contained in this document is intended as a guide only. For this reason, it should not be relied upon as legal document. Parties should still refer to the legislative provisions contained in the law.

Malaysian Communications and Multimedia Commission
MCMC HQ Tower 1
Jalan Impact
Cyber 6
63000 Cyberjaya
Selangor Darul Ehsan
Malaysia

Tel : +6 03 8688 8000
Fax : +6 03 8688 1000
Website : www.mcmc.gov.my

Published by MCMC

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PREFACE

This “Amateur Radio Handbook” is published by the Malaysian Communications and Multimedia Commission (MCMC) in collaboration with the Malaysian amateur radio clubs and societies. The purpose of this handbook is to provide basic knowledge on the various aspects of amateur radio operation.

The document is adapted from International Amateur Radio Union (IARU) Amateur Radio Manuals and other international publications as listed in the references section. It is developed by Malaysian Amateur Radio Proficiency Certification Working Group (MARPC WG) under the supervision of MCMC.

ABBREVIATIONS

AA - Apparatus Assignment
AFSK - Audio Frequency Shift Keying
AMTOR - Amateur Teleprinting Over Radio
APRS - Automatic Packet Reporting System
APRS-IS - APRS Internet Service
AROC - Amateur Radio Operator's Certificate
ARRL - American Radio Relay League
COR - Carrier Operated Squelch
CTCSS - Continuous Tone-Coded Squelch System
CW - Continuous Wave (Morse Code)
DTMF - Dual Tone Multi Frequency
EOC - Emergency Operations Centre
EME - Earth-moon-earth
FM - Frequency Modulation
FSK - Frequency Shift Keying
GPS - Global Positioning System
HF - High frequency
HEO - High Earth Orbit
IARU - International Amateur Radio Union
IGATE - Internet Gateway
IOTA - Island On The Air
IRCs - International Reply Coupon
ISS - International Space Station
ITU - International Telecommunication Union
LEO - Low Earth Orbit
MEO - Medium Earth Orbit
MFSK - Multiple Frequency-Shift Keying
MODEM - Modulator/Demodulator
NVIS - Near Vertical Incidence Sky wave
PBBS - Packet Radio Bulletin Board Service
PEP - Peak Envelop Power
PSK - Phase-Shift Keying
PTT - Push To Talk
RF - Radio Frequency
ROIP - Radio Over IP
RTTY - Radio Teletype
RX - Receiver
SSID - Secondary Station Identifier
SSTV - Slow Scan Television
TEP - Transequatorial Propagation
TNC - Terminal Node Controller
TU - Terminal Unit
TX - Transmitter
UHF - Ultra High Frequency
VHF - Very High Frequency
VSAT - Very Small Aperture Terminals
WAC - Worked All Countries
WPX - Worked All Prefix

CHAPTER 1 : AMATEUR RADIO – ALL ABOUT OPERATING

What is Amateur Radio?

Amateur Radio, which is also commonly known as "Ham Radio", is a hobby of constructing, experimenting, and communicating enjoyed by thousands of people all around the globe. To operate an amateur radio station in Malaysia, the operator must have an Amateur Radio Operator's Certificate and an Apparatus Assignment (AA) or a foreign amateur radio licensed from countries that have a reciprocal arrangement with Malaysia.

A number of radio frequencies have been allocated for Amateur Radio usage where ham can communicate with each other across the city, state, country and even around the world all without the Internet or cell phones.

The integration between computer and amateur radio has also been increasing these days. For example, a transmission mode called Slow Scan Television (SSTV) is a mode allowing the transmission and exchange of colour images to other amateurs around the globe, while another transmission mode called Radio Teletype (RTTY) is another mode which allows amateurs to have a contact in text form.

Who can be Hams?

In general, anyone can be Amateur Radio operator which also known as Ham. Young people find Amateur Radio a great training ground while older people find "hamming" as an absorbing retirement hobby.
In fact, Amateur Radio is more than just a hobby. It is also a service that brings people, electronics, and communications together. Hams will provide their equipment and operating skills whenever the need arises such as for emergencies and rescue operations.

Who Reads This?

This introduction to amateur radio is meant for all levels of Hams, irrespective of their skill level or how long they have been operating / licensed. It's a simple introduction to Amateur Radio / Ham Radio and the activities associated with this hobby. The manual is not 100% comprehensive at which some of the information may need to be referred to other documents.

Each section of this manual will introduce the various aspects of Ham Radio including basic terminologies, the ideas behind them and also why it is operated in that particular way. There may be specific equipment and / or technical "know how" that is required and new terms of concept might be learnt.

1. Newbies

If readers are new to this hobby, you'll find this introduction a wealth of information with regards to Ham Radio. Some of the activities you may have participated in or heard about, some may be totally foreign. It is advised to go through briefly the book in its entirety before reading each chapter or the chapter that interests you in detail.

2. Experienced Hams

After operating for some time, you would've found the activity / activities that you like within Ham Radio operations. You would also find yourself expanding out to other modes / operations that you were not interested in earlier. If that is the case, you might need to refer to this introduction to find out more on those areas that now interest you. The information provided may not necessarily to make you an expert in the field, but it'll help you learn more about it.

3. Elmers

These days, Ham operations have diversified so much that it is no longer possible for a person to be an expert in each mode / activity. New activities /

modes of operations are developed continuously. Technological advances are transforming existing activities even to this day. Even if you are conversant in most activities / modes of operations, you'll find some new modes of operations / activities peculiar and probably need a refresher or re-introduction.

Getting Started

Various amateur radio clubs and societies around the country frequently carry out amateur radio examination preparation classes. Check out nearby local club, societies' website, or Facebook page regularly for such announcements. It is recommended that those who are new to the hobby join one of these classes to get a better understanding and will help to prepare for the examination.

Once you are ready, register yourselves for the Class C radio amateur examination conducted by MCMC. Once you have sat and passed this examination, you can choose to either apply for a Class C Apparatus Assignment (AA) and operate under class C privileges or continue taking the Class B examination. If you pass the Class B examination, you will be allowed to apply for a Class B AA and operate under Class B privileges instead. However, you will need to hold a valid Class B AA for at least one year before you are allowed to register and sit for the Class A examination.

The reason for this is that Class A gives the license holder access to the low bands, microwave bands and higher transmission power. These, if handled by inexperienced amateurs will not only cause danger to the neighbours or people around you, but will also endanger yourself and might cause interference to commercial, aviation, public safety, government and other critical wireless services which might be life threatening. The intention of this is really to protect the amateur and other critical wireless services. It was never intended to discourage one from progressing in the hobby.

Where can I Operate From?

Licensed amateur radio operators are allowed to operate anywhere within Malaysian territories. The AA allows operator to operate either from base station, mobile or portable. Base station is defined by the address in the AA while mobile is defined by any station that is movable from one place to another. This includes setting up a station in vehicle or simply holding a handheld radio and walking around.

A portable station is defined as a station away from the address stated in AA that is setup temporary and is not easily movable. This can include setting up a temporary station in another residence, setting up a field day station in the park or by the beach side, or simply operating from a temporary station in a hotel room during the vacation.

Operating in foreign countries is also possible if the foreign country recognises the Malaysian AA. The conditions for this could change from time to time and it is advisable to check with the foreign country's telecommunication authority or the national amateur radio society on the prerequisites before attempting to operate aboard. In Malaysia, the national amateur radio societies and clubs could also offer advice and supporting documents if required by the foreign country in order to obtain a local license. Please note that the operation at the common border area is subject to coordination with the neighbouring countries within the coordination zones. Under no circumstances should an amateur operate in a foreign country if he or she does not have a valid amateur radio license from that country.

The Do and Don't of Amateur Radio

A number of rules have been established to make amateur radio more enjoyable, fun, interesting and as a courtesy to others. It is must always remember that amateur radio operators consist of people from all walks of life, irrespective of their political beliefs, religion, race and etc. Today, with the introduction of linking repeaters and the opening of HF bands to more

amateurs, the conversation might be heard throughout the country or even across the globe. Therefore, it is important that amateurs follow good and standard operating practice and be courteous to other amateurs at all times.

As a courtesy to those who are already on the band, always listen first before attempting to transmit. This would avoid you stepping over other amateurs who might be already using the frequency or repeater. If you are not familiar with the operating procedures, do spend some time to listen to other conversations first before transmitting.

Discussions pertaining but not limited to politics, religion, race, sex, harassment are strictly forbidden in amateur radio. Always keep in mind that one should avoid any other sensitive topics too that could cause discomfort or affect the feelings of other amateurs. Any radio checks or tests that need to be carried out should be done by connecting the radio and transmitting into a dummy load instead of on the air. This is to minimize interference and disturbance to other amateurs.

Another important aspect of practice is to leave a few seconds pause between overs. This practice which is not only limited to repeater but also simplex operation which is to allow others to join in the conversation, and allow those who are in emergency or priority traffic to seek assistance. Do always bear in mind that emergency and priority traffic always have the highest priority over all other traffic. Amateurs are required to render help to any station in a life threatening or distress station that they come across whenever possible.

In repeater operation, particularly with linked repeaters, one should always wait a split second before talking after keying PTT to ensure that all repeaters that make up the linking system have fully keyed up. Failure to do so might cause the first few words of the conversation to be lost especially on a distance repeater. Allowing a few seconds pause between conversations will also help to allow all repeaters fully stop transmitting first before the next users keys up the links.

Remember that all other amateurs will appreciate good and courteous operation and it goes a long way.

Antenna Safety

Whichever antenna that operators decide to use, please have them installed safely. DO NOT endanger own life or someone else's in the pursuit of hobby

1. Keep the antenna and its support clear of any overhead power lines. This includes the incoming power supply to the own home / station.
2. Ensure that should the antenna or it's support or mast falls / fails, it will not have any contact with any overhead power lines.
3. Installation of the antenna must not be easily contacted by people as RF radiation may cause harm.

These points on antenna safety are thoroughly elaborated in the following chapters of this introduction.

Amateur Radio Bands

The frequency bands for Amateur Radio Service are allocated on primary and secondary service allocation in the Spectrum Plan issued by MCMC. The principles for primary and secondary services are as follows:

1. The operations of primary services are given priority as compared to the operations of secondary services;
2. The operations of secondary services shall ensure that no interference is caused to any of the primary services;
3. The operations of secondary services shall not claim protection from any of the primary services to which frequencies have been assigned or may be assigned to at a later date;
4. The operations of secondary services may, however, claim protection from interference caused by other secondary services; and

5. There there are more than one primary services in the same frequency band, service providers shall abide to a coordination process as mentioned in the relevant administrative documents or guidelines issued by MCMC from time to time.

For further information on the frequency bands, please refer to the **Guidelines for Amateur Radio Service in Malaysia** and **Spectrum Plan** in MCMC website. Below are the summary of the most popular operating amateur radio bands in Malaysia.

1. 23cm (1240 – 1300 MHz) Band – Secondary Service Allocation

At the top end of the frequency range, the antenna sizes are very small in comparison. As the frequency reduces, the bandwidth increases and so does the antenna sizes.

As the size of the antenna is small, operators can use an antenna with a very high gain (20 – 30 dB gain) that will fit into car boot lid or car roof. Comparatively a larger antenna of 10m bandwidth may only offer a 10dB gain.

Operating on Ultra High Frequency (UHF) will provide good penetrative power and works well inside buildings. However, it will have a much shorter range given the same power of transmission.

2. 70cm (430 MHz – 440 MHz) Band – Secondary Service Allocation

This band is used mainly on mobile and handheld sets. It offers better penetrative power when compared to the 2m band. It's ideal for use indoors although the range is limited.

It is normally used within large cities and the range can be extended via the use of a Repeater System or a Linking Repeater System. The sets are very compact and normally mobile or handheld sets.

3. 2m (144 – 148 MHz) Band – Primary Service Allocation

This is by far the most common and popular band in use by Ham Radio operators. Most Repeater Systems or a Linking Repeater Systems use this band. The sets are very compact and normally mobile or handheld sets. Unlike the 70cm bandwidth, the range for 2m sets can go up to a few kilometres simply by using 5W and upwards of 20km when using higher power (point to point through varying terrain).

Repeater Systems installed on high elevated locations that are transmitting on 25W can reach up to 100 kilometres or much more (depending on the height of the repeater antenna).

4. 6m (50 – 54 MHz) Band – Primary Service Allocation

This band is by far the most interesting Amateur Radio band. It's also known sometimes as the "Magic Band". When solar activity is high, one can communicate with another person 1,000km or more. When solar activity is low, even a few kilometres is not possible on SSB.

One can also use FM mode on this band that is not dependent on solar activities. A few / tens of kilometres range is possible depending on the power of transmission utilised. There are some handheld / mobile radios with 6m capabilities but these are rare.

5. 10m (28 – 29.7 MHz) Band – Primary Service Allocation

On years of high solar activities, 10W of power will be good enough to contact pretty much anyone throughout the globe. On the other hand, low solar activity will render this band sporadic with openings only at certain times of the day and only for short periods of time.

SSB activities are normally centred between 28.3 MHz and 28.5 MHz. CW activities can be found below 28.3 MHz down to the band edge with digital operations between 28.070 MHz and 28.120 MHz. FM & AM operations are normally conducted above 29.0 MHz.

6. 7m (18.068 – 18.168 MHz), 15m (21 – 21.45 MHz) & 12m (24.89 – 24.99 MHz) Bands – Primary Service Allocation

Again, there is “High Solar Activity” phrase being used. These 3 bands also depend very much on this phenomenon. The 15m band tends to be more crowded and popular compared to the 17m and 12m.

When the propagation is good and the bands are open, operators will be able to have QSOs nonetheless as there will be activities on whatever band that is open. After all, whether the bands are crowded or less so, operators only can work one station at a time.

7. 20m (14 – 14.35 MHz) Band – Primary Service Allocation

Known as the workhorse band of Ham Radio, the 20m band is perhaps one of the most popular and most utilised band for Amateur Radio. Even during periods of Low Solar Activity, the 20m band is still usable in one or another part of the work in one direction or another.

A wide variety of activities or modes are used on this band from SSB Voice to CW and other digital operations such as PSK, RTTY and SSTV. It is one of the easiest bands to work on. During Low Solar Activity, signals may be weaker but still readable nonetheless over several hours in a day. All hours of the day may be possible during periods of High Solar Activity.

8. 30m (10.1 – 10.15 MHz) – Secondary Service Allocation & 40m (7.0 – 7.2 MHz) Band – Primary Service Allocation

Between 30m & 40m bands, the former is not as crowded as the latter. The reason being the skip distance being a little more when compared to 40m and also the accessibility. Nonetheless, it is still used whenever propagation is good and the band is open.

For 40m, it is widely used in this part of the world. Very popular amongst Hams in neighbouring Indonesia, the band is in use throughout the day and night so long as conditions are right for the band to be open. It is not surprising to find this band so crowded that one cannot find a spot to “park” and call CQ. Ragchews can be found every few kHz between stations that they sometimes “drown” out other DX stations from Europe, Oceania, and the Americas.

9. 60m (5.3515 – 5.3665 MHz) Band – Secondary Service Allocation

This band is unique in the sense that it uses a channelized system. Users are to use the middle frequency of the channel. Apart from that, users are only Secondary Users meaning that this band is being shared with a Primary User, who has priority of use over Ham Radio users. The other restriction is that users may only transmit 15W EIRP instead of 1000W PEP as allowed in other HF Bands. EIRP means the output from the antenna as opposed to the input into the antenna.

An example of EIRP means that if the antenna has a gain of 3dB, the power input into the antenna permissible may only be 7.5W PEP.

10. 80m (3.5 – 3.9 MHz) & 160m (1.8 – 2.0 MHz) Bands – Primary Service Allocation

Known as the “Top bands”, they are less popular with Hams this part of the world probably due to the antenna size / dipole length. Nonetheless, it is also used whenever propagation is good especially during contests as there will be contesters trying to rake up multipliers to improve their scoring.

These two bands tend to be susceptible to interference especially if one is operating in populated areas as neon lighting adds to the “noise” on the bands.

Coordinated Universal Time Explained

Coordinated Universal Time (UTC) is used not only in Ham Radio but a wide variety of other activities such as Flight Operations and etc.

The theory of UTC being used is that there will be no misunderstanding of the time used in recording QSOs as well as communications between stations as one station may not know the time zone of the other station that he / she is communicating with. Thus the reference to UTC will not cause any confusion.

In Malaysia, the local time is UTC +08:00 meaning to say that if the local time is 4:00pm, the UTC time shall be 8:00am or 08:00 hours UTC. In Ham Operations, it is normal to use the 24 hour time format as this leads to less confusion.

Similarly, dates used are also based on the UTC time. An example of this would be that at 4:00am on 2nd May MST (Malaysian Standard Time), the corresponding UTC time would be 20:00 hours on 1st May (i.e. 8 hours behind).

Another peculiarity with the 24 hour time format is that 00:00 is also interchangeable with 24:00 as one signifies the beginning of a day and the other, the end of a day – which coincidentally is the same time!

In some countries, there is the occurrence of “Daylight Savings Time” whereby the clock is set forward an hour to lengthen the evening sunset time. Please note that this has no effect of UTC time as this remains the same as all refer to the same time which does not change.

QSL Cards

QSL card is an age old tradition in Ham Radio operations. The exchange of QSLs is enjoyable and fun. They can also serve as a sometimes much need confirmation for the qualification of a great many Operating Awards on offer. As the world and technology progresses, electronic QSL systems are now abound but Hams will probably still continue to exchange QSL cards especially after an initial first time contact.

There are many readymade QSL cards. Alternatively, operator may want to print their own and personalise the cards. Some use readily available software whilst some have them professionally designed and printed. Whatever way it may, the most important thing is that the QSO information is contained on the card that is important. A standard QSL card should be 3.5 inches x 5.5 inches (standard postcard size) and should contain the following information whether printed or written on. Permanent ink should be used to ensure it doesn't fade over time or with exposure to light.

Your Call – This is operator's callsign. Should be portable or mobile, this should be indicated on the card along with operator's actual location when the contact was made.

The Geographical Location of Operator's Station – As indicated earlier, if the station were portable or mobile, this should be indicated on the card along with operator's actual location when the contact was made. If operator's location will count towards awards such as Island On The Air (IOTA), include that information as well. The Grid Locator which is the 6 character Grid Square should be included.

The Call of Remote Station – This refers to the callsign of the station that operators contacted. As this is normally written by hand, please ensure that operator's handwriting is legible and not confusing (i.e. Number One (1), Small Letter L (l), Capital i (I) can be misread or misinterpreted).

Date & Time of Contact – As far as possible, use UTC Time and date as this will make it less confusing. Operators can use the local time (Zulu Time) but they should indicate what it is in relation to UTC (i.e. Malaysia is UTC + 08:00). Keep it simple is the motto so just use UTC time.

Frequency – The band that operators were working on when they made the contact in either Wavelength (meters) or approximate frequency in kHz or MHz is the minimum required. Some people indicate the exact frequency and that is also acceptable.

Mode of Operation – This is the mode that the contact was made on. Please use the correct abbreviation (i.e. CW, SSB, RTTY, PSK31, AM, FM etc). Emission designation (i.e. F3E etc) may not be widely understood by people.

Signal Report – Use the RS System (or RST System if in CW etc) to indicate.

Do leave no doubt that it was a 2 – way QSO by indicating as such on operator's QSL Card. Should operators make a mistake whilst filling up their QSL card, DO NOT cross it out and re-write it. This is unacceptable especially for award claim. Destroy the card and start fresh.

Cards can be sent directly to the contact (via obtaining the contact's mailing address online through websites such as QRZ or via Bureau. Normally if sent directly to the contact, operators should enclose a Self-Addressed Stamped Envelope (SASE). This ensures that the contact will reply at his / her earliest convenience.

Figure 1.1 : Example of QSL Card

CHAPTER 2 : VHF/UHF - FM REPEATERS, DIGITAL VOICE AND DATA

FM Repeaters

Many newly licensed amateur radio operators start the hobby by working on the VHF (2m) and UHF (70cm) bands in FM mode. Some would setup their own base station, mobile station, or a combination of both. One of the reasons is due to the relatively lower cost of VHF/UHF equipment as compared to HF or Microwave equipment. This also a stepping stone until they upgrade their system to better setup.

Unfortunately, due to the line-of-sight propagation characteristic of the VHF and UHF bands, the signals distance travelled are limited. The use of FM repeaters helps to overcome this obstacle and able to extend the range, especially for handheld and mobile users. Repeaters are typically located on top of a hill, mountain, or tall structures, and they help mobile and handheld stations to extend their communications range or overcome obstacles that prevent simplex point-to-point communications to take place.

In Malaysia, there are many available repeaters that licensed radio amateurs can use. Some of them are local repeaters that cover a certain area or town while others are linked repeater to cover a wider area or even across the country. Although most repeaters operate on the 2m band, there are a few that also work on the 70cm band.

Repeater Basics and Operations

An FM repeater in its most basic form consists of two radios, one of which receives on one frequency (known as the repeater's input frequency) and another of which transmits on another frequency (known as the repeater's output frequency). They are integrated with the help of a repeater controller. A repeater basically 'repeats' what it hears on its receive frequency to its transmit frequency.

Most commonly available 2m and 70cm transceivers should allow an amateur to access a repeater with the help of its built-in repeater shift and CTCSS tone encoding function. The only problem here is that some older transceivers might not have the required tone encoding function available. Some allows this to be added as an option while some may not have this feature available at all.

Before Hams attempt to access the repeater, it is important for amateur to know the basic repeater operating details such as the following:

1. The output frequency of the repeater. This is the frequency that operators should receive from the repeater and it is also the frequency that should be set on operator's transceiver's dial.
2. The input frequency shift (or offset) of the repeater. This is the offset between the input and output frequencies of the repeater. In Malaysia, the standard 2m shift is -600 kHz while the standard 70cm shift is -5 MHz.
3. The necessary CTCSS tone to access the repeater. Some repeaters may require the CTCSS tone to be imposed on the TX repeater in order to activate it. This is useful and encouraged to avoid unwanted key up due to QRM or interference from non-repeater users. The repeater will only open once the correct CTCSS tone is imposed on the TX signal from the amateur.

Once operators have obtained these parameters, operators can proceed to program them into the transceiver and then attempt to access the repeater following the standard operating procedures. If the operators have programmed the transceiver properly, operators will notice that it will automatically switch to the input frequency of the repeater when pressing PTT. When operators release PTT, it will switch back to the output frequency of the repeater automatically and continue receiving.

How does a Repeater Work

It is good to have a basic understanding of how FM repeaters works as this will help operators to understand the on-air operation. A repeater generally does not differ from standard transceivers. However, it has some extra components that have been added to channel the received audio by the RX radio to the TX radio and automatically key PTT of the TX radio. The block diagram in figure 2.1 illustrates basic repeater architecture.

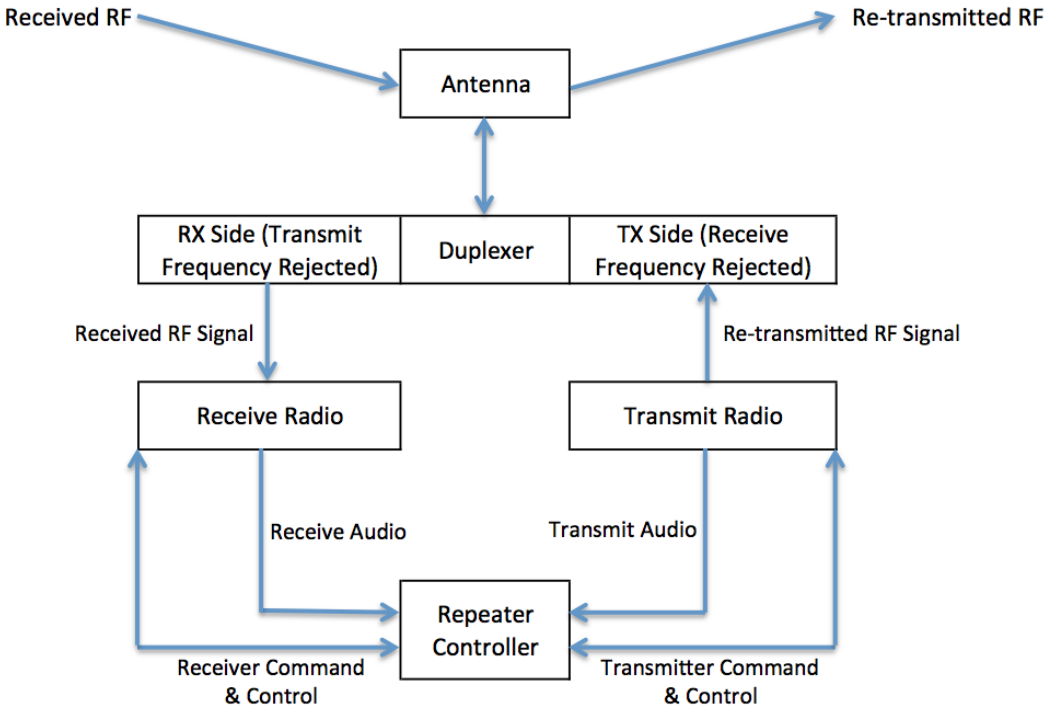

Figure 2.1 : Basic FM repeater block diagram

Duplexer

As repeaters are generally located at hilltop station sites where tower space is limited and precious, most repeaters utilize one antenna for both simultaneous receive and transmit. However, because this happens simultaneously involving two different frequencies and radios that are very close to each other, a duplexer is required to split the single connection from the antenna and allow it to be connected safely to both transmit and receive radio at the same time.

The duplexer also provides the necessary isolation and rejection between the receiving and transmitting radios. This is essential and necessary to prevent the RF from the transmitter from entering the receiver which will cause the reduction of radio receiving sensitivity with the risk of permanent sensitivity degradation in the long run or burning of the front-end RF components.

Although it might be possible to achieve sufficient isolation between the transmitter and receiver by using two separate antennas at different height and with enough spacing between each other, this luxury is not available all the time especially at popular and packed hilltop stations. Furthermore, if the particular location has many other users especially high-powered ones, some form of isolation is mandatory to ensure that other user's transmission does not interfere with your own receiving and your transmission will not cause harm to theirs.

In its most basic form, a duplexer consists of a set of resonant circuits that serves as a sharp and narrow RF filter. When it applied on the receiver side, this will keep the transmitted frequency out from receiver while allowing the receive frequency to pass through. In other words, it rejects the transmit frequency and stops it from going to the receive radio while allowing the intended receive frequency to reach the receive radio. On the transmit side, when the duplexer is applied, it will cause the received signal to be directed to the path towards the receiver instead while allowing the transmitted signal to be passed on to the antenna unhindered.

Controller

A controller is the heart of a repeater system. Its task involves routing the audio from the receiver to the transmitter, detecting COR from the receiver and subsequently triggering PTT on the transmitter when someone accesses the repeater, introducing a tail or hang time before PTT drops once the users seizes to transmit and transmitting the repeater's ID in CW or voice at predefined intervals. All this happens automatically without user intervention once the

controller has been programmed correctly as repeaters are classified as automatic control stations.

There are also more advance controllers that allows repeater administrators to control the repeater system remotely via DTMF or other methods. This includes but not limited to shutting down the repeater such as in case of an interference, changing the repeater's output power, the tail or hang time, or even connecting it to another radio, telephone, or Radio Over IP (ROIP) devices for the purpose of linking and phone patching.

VHF/UHF Digital Data Modes

There are few digital data modes that are being used in VHF/UHF but packet radio seems to be the most popular and widely used. Mode like a Slow Scan TV (SSTV) is still being used today, but others like RTTY have been killed off and only popular on HF.

Packet Radio

Packet Radio is usually used for a point-to-point communications between two computers. Each side requires a PC, Terminal Node Controller (TNC) and a radio. A TNC takes a stream of data from a PC, encode the data, and send the signal via radio while the other end will do the vice-versa, receiving the signal via radio, TNC will decode it into data stream and push back to the PC. Packet radio is named that way due to the way it sends data in small bursts or packets.

At the end of 80s, the interest in PC and communications was at its high and this has made the packet radio the most popular mode among amateur radio enthusiasts. The Packet Radio Bulletin Boards (PBBS) were quite popular and served well. The amount of email and bulletins become at their peak by then and people were starting to experiment with a higher speed packet and Internet. By the early 90s, when the Internet was taking its foot, the interest of PBBS had died down, but some of them managed to survive and serve as a niche service up until now.

Packet radio is usually chosen over other data modes in VHF/UHF band because of the following three advantages: transparency, error correction and automatic control. The other advantage is that operators could ‘networked’ few stations and added the range coverage to the sent packets. This is can be done by setting a relay station called digipeater. Digipeater is a device that works in simplex mode and will accept a packet and then re-send it almost immediately after a check on error and duplication is done.

The operation of packet station is transparent to the user. The user could create a message, and the system will send it automatically as described above. Packet radio also provides an error-free communications because of the built-in error checking. The received data will be checked for errors before it being presented to the user.

A packet station usually consists of the following equipment:

1. A Terminal Node Controller (TNC)

   A TNC usually consist of a modem, a microprocessor, and the required circuitry to enable a communications between the TNC itself with a computer or terminal. The modem will do the decoding and encoding of data coming from a computer or terminal, do the necessary error checking, and modulates or demodulates into or from audio frequencies before sending the data to a radio.

   With the advance development of PC, a sound card interface and a special software could replace a purpose-built TNC. For PC, a software called AGW Packet Engine (AGWPE) has been developed by SV2AGW and available for free.

   Some newer radios have built-in TNC too, though some are very much restricted for Automatic Packet Reporting System (APRS) use only.

2. A Computer or Terminal

   A computer running a special packet software or terminal is needed to display or send the packet. This however is not a must since the user interface could be built into a radio itself.

3. A Radio

   A radio is a must have in the setup. For commonly used speed which is at 1200bps, a narrow band VHF/UHF radio can be used but for the higher 9600bps speed, a radio which supports wider bandwidth might be needed. Newer radios usually support 9600bps speed well without a need of modification.

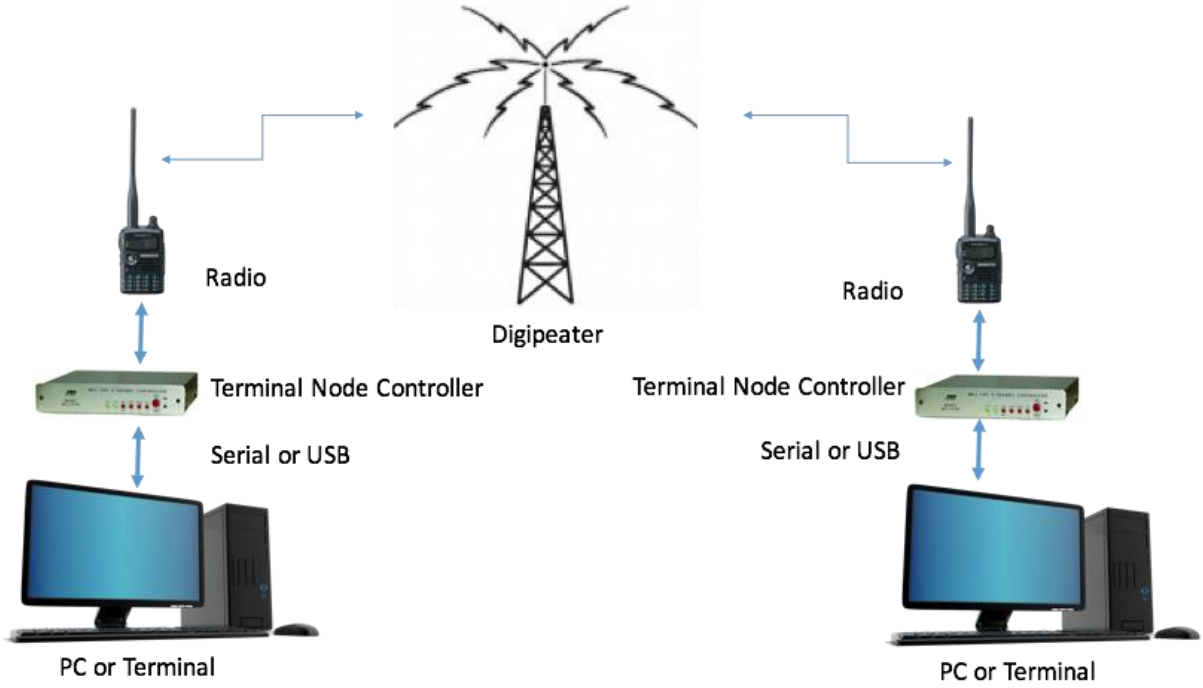

Figure 2.2 : Typical packet radio setup with a digipeater at higher places.

Automatic Packet Reporting System

Automatic Packet Reporting System (APRS) was designed by Bob Bruninga in the late 80s, where the initial abbreviation of APRS was derived from his

callsign. Although the ‘P’ in the APRS abbreviation stands for **P**acket, people have for years refer it to as **P**osition. This is mainly due to the position data that is available in most of the APRS packets that get sent out and the common use of APRS in tracking object positions. However, Bob has stressed this out, APRS is not a vehicle tracking system, but a two-way tactical real-time digital communications system between all assets in network sharing information about everything going on in the local area.

APRS is based on packet radio, but there are few differences between APRS and normal packet radio implementation. Differences include, first, the integration of maps with other data to display and organize the data. Second, the use of one-to-many protocol leads to everyone in the system is updated immediately. Third, by using a generic digipeating with callsign aliases, a prior knowledge of the network is not required. Fourth, the use of intelligent digipeating with callsign substitution reduces network flooding. And fifth, APRS supports two-way messaging and distribution of bulletins and news and this leads to faster dissemination of information.

While the normal packet radio will mainly support point-to-point communications where a bulk data transmission is appropriate, normal communications during emergencies will require a real-time data and the data usually have a short life time. As such, APRS is more suitable to be used during emergencies and public service events where a real-time tactical communications and display system is required.

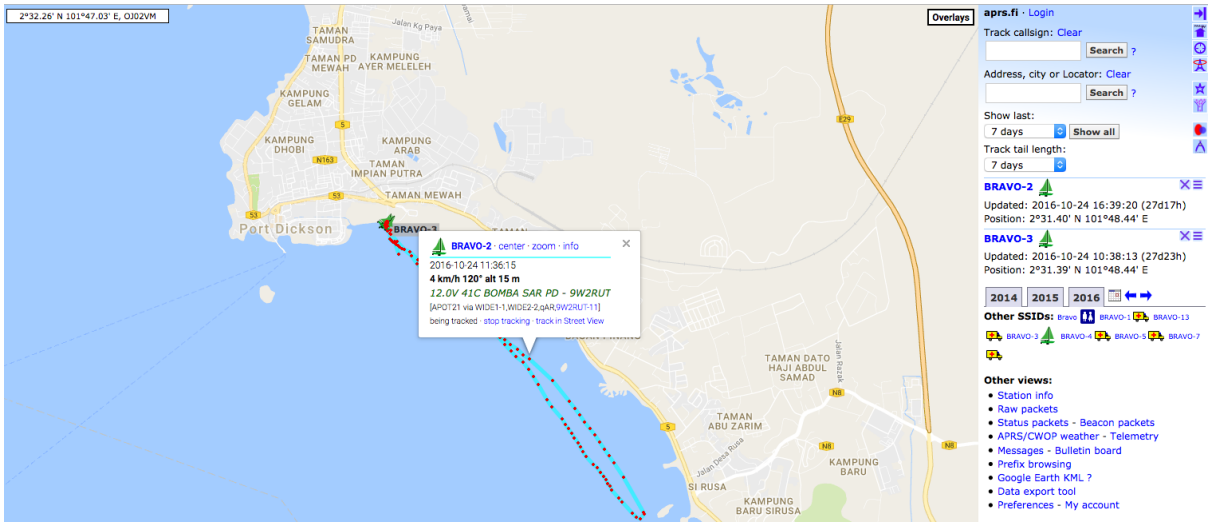

Figure 2.3 : APRS real-time tactical mode during Search and Rescue Mission at Port Dickson on Oct. 2016.

As mentioned before, most if not at all APRS packets contain a position information, hence it was mainly used for tracking, but this is not the primary objective. What kind of information other than position are transmitted? Each APRS packet may contain a symbol, a position and varieties of other data types including weather information from weather stations, text messages, announcements, bulletins, queries, statuses and telemetry data.

CALLSIGN-SSID>TOCALL,PATHS:DATA

The first part of the packet is the callsign with SSID. Previously, the SSID is used to identify the icon or symbol to be displayed on the receiving end. This however has been replaced and the SSID stays there as an informal way of indicating one of the many type of applications. The most commonly used SSIDs are -1 for Internet-Gateway, -3 for Digipeater and -9 for mobile.

The second part of the APRS packet identifies the APRS version. This is also known as TOCALL and used to identify the device or APRS versions. The TOCALL is also used to distinguish specialised traffics which with certain software that honours the concept, to ignore the packet fully. A list of TOCALL identifiers can be found in http://aprs.org/aprs11/tocalls.txt.

The third part is the PATHS, which is being used for data propagation. The newer N-N paradigm should be used to avoid congestion. For a normal usage and with the number of digipeaters currently active in Malaysia, the proposed setting for mobile trackers is WIDE1-1, WIDE2-1. This WIDE1-1 will make sure that the packet is covered by a nearby fill-in digipeater and the WIDE2-1 will make sure that the packet gets propagated by mountain-top digipeaters.

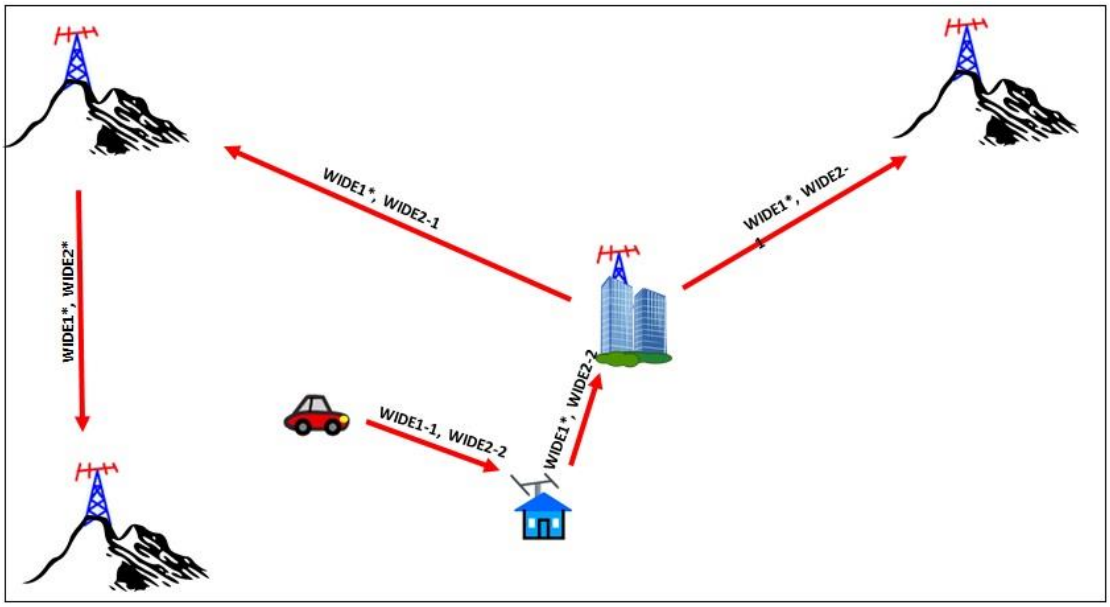

Figure 2.4 : How PATHS works in APRS

The final part is the data. As explained before, the data format varies according to the data types. For position report, the latitude and longitude data are supplied with different notation on the first character as different position report types and along with it, the symbol for the object is inserted within. For weather report, temperature, humidity, pressure, rain, wind speed and wind direction are supplied accordingly. For messages, an acknowledge (ACK) message will be returned to the sender by the recipient after successfully receiving the message.

To get started in APRS, the equipment needed are almost similar to the one needed for packet radio. A Terminal Node Controller (TNC), a radio which is capable of transmitting at least 1200bps and a terminal or PC. To enable tracking, a GPS is needed to automatically update the object's position. Adding a GPS which is easily available will complete the kit to be called a tracker. A

tracker can be a set to transmit only or with additional kit for keyboard and display, it can be converted into a two-way communications terminal.

There are companies available in market also produce certain models with APRS support built-in, some with GPS thrown in and some are not. With these features, the radios can work in standalone mode without the need for external TNC or terminal.

Figure 2.5 : Radios with APRS support built-in

APRS frequency varies according to regions, with North America and South East Asia fixed at 144.390MHz, Europe at 144.800MHz, and some part of Asia having their APRS frequencies fall somewhere between 144.640 to 144.660 MHz APRS is also active on the International Space Station (ISS) at 145.825MHz, however APRS usually deactivated during scheduled school contacts.

In recent years, the take up on APRS has been quite high due to the availability of data passed through the airwaves and ended up on the Internet. The APRS users won't need to run any specialised software to display their tracks, objects, or information. Few useful websites with vast historical data and information have sprung up. This has made available with more and more APRS users putting Internet Gateway (IGATE) at their homes and channelling the data from the airwaves (RF) to the Internet. The APRS packets travelled through the IGATEs into regional APRS-Internet Service (APRS-IS) which then replicated over to other parts of the world. These APRS-IS servers are run and maintained purely by volunteers around the world.

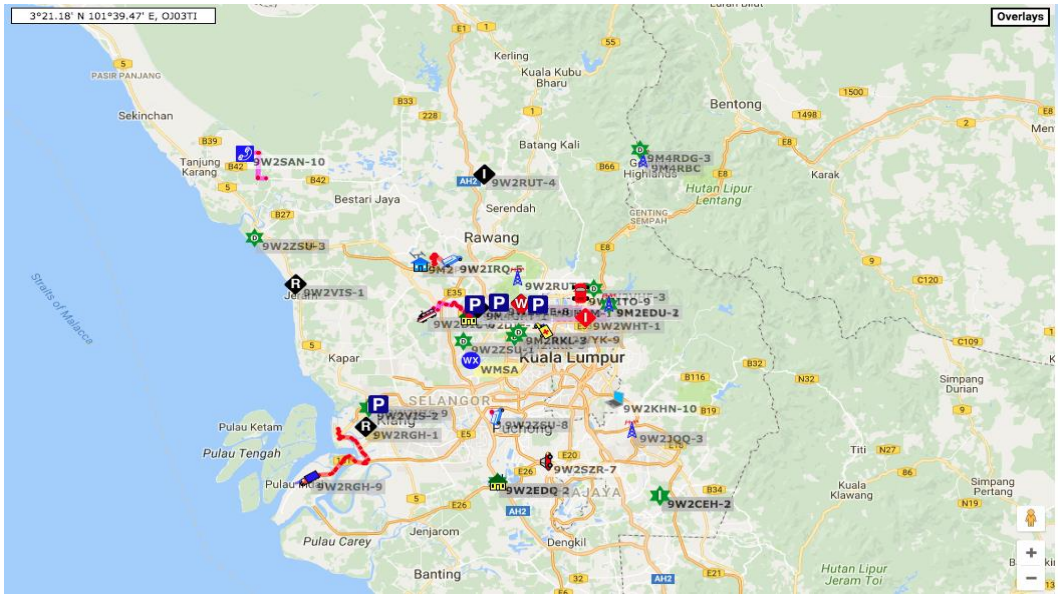

Figure 2.6 : Normal APRS activities in Kuala Lumpur and Selangor.

CHAPTER 3 : VHF/UHF BEYOND REPEATERS

In additional to operating local simplex and via repeaters, DXing is another interesting operating aspect on the VHF and UHF bands. VHF and UHF operation are normally limited to line of sight propagation or the radio horizontal whichever is smaller. However, under suitable propagation conditions, they too get reflected by the atmosphere and can result in contacts. VHF/UHF DXing is therefore generally more challenging but not impossible.

Weak signal VHF and UHF activity generally takes places on the lower portion of the spectrum as per Table 3.1.

VHF	
Frequency (MHz)	**Usage**
144.000 – 144.035	Exclusive EME CW
144.035 – 144.100	EME and Terrestrial Weak Signal CW
144.100 – 144.250	EME and Terrestrial Weak Signal CW/SSB/NB Data
144.250 – 145.000	All Mode Simplex
144.390	APRS Spot Frequency (AX.25 1200 bps)
144.489	WSPR

UHF	
Frequency (MHz)	**Usage**
430.000 – 430.500	CW / Phone DX
430.500 – 430.700	NB Data
430.700 – 431.900	Simplex, All Mode
431.900 – 432.240	EME
432.240 – 434.000	Simplex, All Mode

Table 3.1 : General activities at lower portion of VHF and UHF spectrum

To make the most of VHF and UHF communications, it is essential to understand further on the conditions under which band they are operating. It is noted in passing that the radio horizon is a function of the altitude of the antenna

above ground, the effects of earth curvature, atmospheric conditions and other interferences and can be conservatively expressed as horkm = 3.57 * $\sqrt{hm}$ where horkm is in kilometer and hm, the height above ground level, is in meter unit.

Preferred Emission Mode

Although it is not impossible to use FM mode for VHF and UHF DXing, most VHF and UHF DX activity usually resort to using CW and SSB modes. These modes have found to be most suitable under the condition of fading signals (which is common on VHF and UHF long distance contacts) and their application have proven to be able to get the most out of the transmitted power.

Nowadays the use of a computer in the shack is becoming a norm. The many functionalities of the former have opened a brand new avenue with many enhanced and useful features for radio communications. The utilization of some features has led to the advent of digital modes such as JT65 and PSK31 and their subsequent application to VHF and UHF DXing. They process the ability of being able to complete an exchange under very difficult propagation conditions. Its deep searching DSP algorithm allows contacts to be made when signals are weaker than what can be heard by human's ears. Recent advancement in modes such as JT65 has ensured its continuous gaining of popularity.

Antenna Polarization

Generally the horizontal polarity is preferred for VHF and UHF long distance contact. This is due to the fact that horizontal polarized signals are less prone to ground absorption and therefore generally works better for long distance contact. Examples of horizontal polarized antenna are the horizontal loop, cubical quad fed at the horizontal side or a yagi with its elements mounted horizontally or parallel with the ground.

Long distance contact can also be achieved using vertical polarized signals. This is sometimes being used when attempting to work distance repeaters or amateurs who do not have horizontally polarized antennas. Sometimes varying propagation conditions might also yield better results when using vertical instead of horizontal polarization, however this is generally rare with the exception of EME.

Vertical polarization on repeaters and mobile stations are generally preferred due to the mechanical advantage in obtaining an omni-directional signal. Serious VHF and UHF DXers generally use antenna with dual polarity (such as a linear cross yagi) to take advantage of the above effects. However, this kind of yagi requires special consideration to be given to its feed points. When the technique of stacking is further employed to improve bandwidth and gain, the feed system can be quite elaborate.

Some form of antenna offers yet another polarity and that is circular polarization. This is particularly applicable in space communications where the signals coming earth-bound tend to be clockwise or anti-clockwise twisted due to effects that include the Faraday and Doppler effects. Employing this type of antenna in space communications is supposed to provide a smooth transition of signal response when the predominant of horizontal and vertical polarization exchanges. In practice, the helical antenna is perhaps one of the most recognisable example of the circular polarized family.

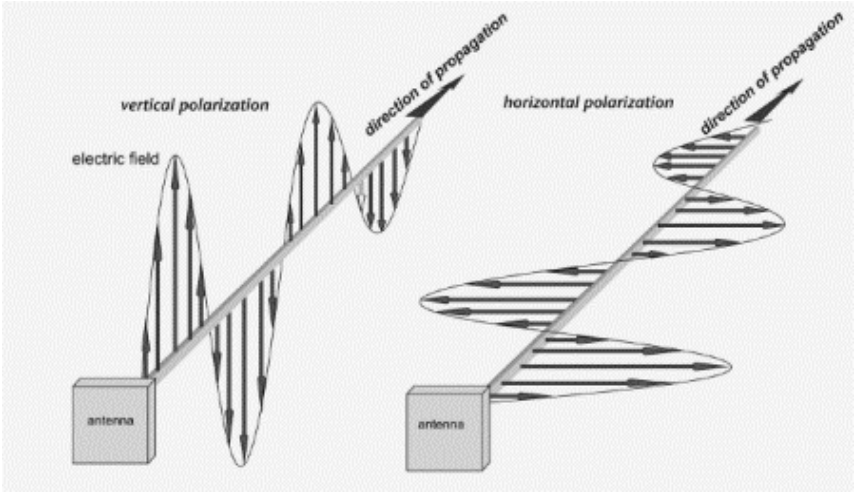

Figure 3.1 : Antenna polarization

Propagation Beacons

Propagation beacons are used to observe possible band openings and to determine if a certain path is open or not. Generally, if one can receive the beacon successfully, due to reciprocity, two way contact with stations to and from the area where the beacon is located should be possible.

Most beacons operate in CW mode with varying power levels. Some operates 24 hours a day while others operate on a pre-defined schedule. Therefore, it is important to check the latest beacon operating status and schedule first before attempting to listen for a beacon.

Lately the weak signal propagation reporter network (WSPRnet) has been gaining popularity. This network that uses JT mode allows beacon stations to be setup to transmit their beacons at random intervals and receive other beacons at other times. The result is uploaded into the WSPRnet database which is accessible via the Internet. This allows DXers to get a live view of band openings as well as recall history of when the bands are open.

VHF and UHF Propagation Types

VHF and UHF long distance contact can take places via many forms of propagation types.

1. Tropospheric ducting

A phenomenon known as tropospheric ducting that happens at times allows VHF and UHF signals to travel over hundreds and sometimes even thousands of kilometers. During this phenomenon, signals are bended in the atmosphere's tropospheric. Ducting effects occur due to the temperature inversions at a height up to 3000m above the earth. Generally, SSB and CW operators are the first to spot these opening since most weak signal operations take places using these modes.

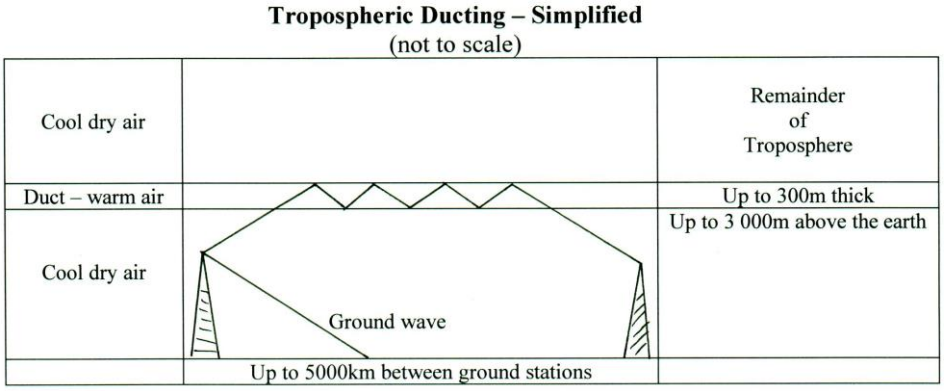

Figure 3.2 Tropospheric ducting

In order to avoid losing the chance to finish the contact especially during short band openings, contacts are made using this and other weak signal modes generally only involve a brief exchange of signal report and the amateur's grid square location (known as the Maidenheads Locator System). When band condition improves, longer contacts are possible. FM mode and contacts using moderate power and/or small lower gain antennas are also possible during favourable band conditions.

2. Sporadic E

The phenomenon where radio signals get reflected back to earth by highly ionized segments in the ionosphere is known as Sporadic E. Usually, signals are strong two way during Sporadic E opening, and generally high power and high gain antennas are not necessary as compared to other long distance propagation modes. Although it is usually rare, when it happens, contacts in excess of 1000km are possible. Sporadic E openings can range from a matter of seconds to a few minutes to several hours at rare occasions.

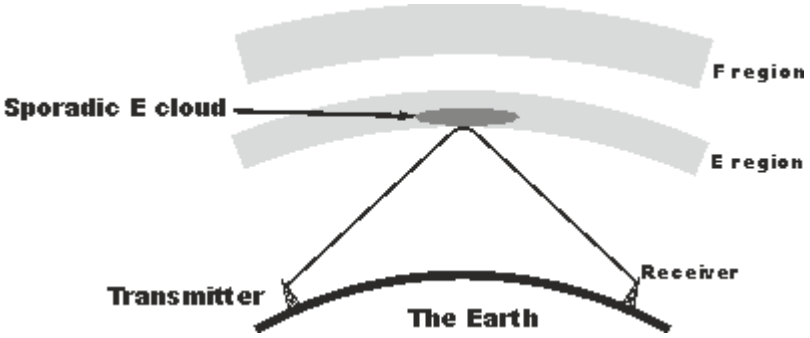

Figure 3.3 : Sporadic E

3. Transequatorial propagation

Transequatorial propagation, which is commonly known as TEP, occurs normally during the daytime on the 2m band. It happens over equatorial regions and it is common in temperate latitudes in early summer, late spring and to a lesser temperature degree in early winter. Equatorial E-skip can be expected on most day throughout the year for receiving stations that are located within ±20 degrees of the geomagnetic equator, peaking around midday local time. TEP supports communications over distances between 2500 and 5000 km.

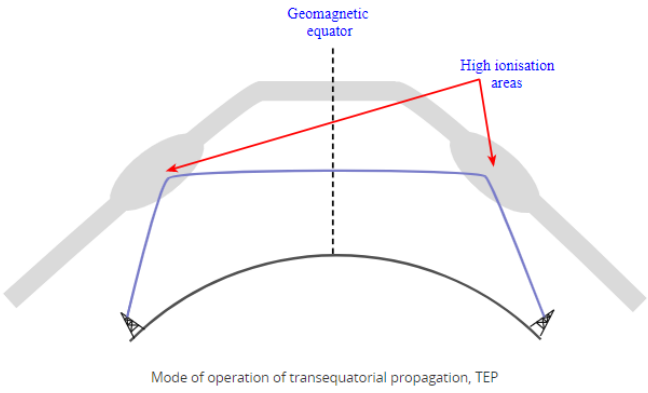

Figure 3.4 : Mode of operation of TEP

4. Meteor Scatter

Traditionally, Meteor Scatter was carried out by recording Morse Code on analog tapes, playing them at very high speed to be bounced off the ionized gas trail of meteors during meteor showers. They are then recorded on the receiving end and played back at slow speed and subsequently decoded.

Nowadays this process has been made easier with the advancement of digital modes such as JT6M and FSK441 that transmits high-speed burst of digital data off the meteors instead.

Using digital modes, one computer will send a request for contact and if successfully received by a distance station, a reply (usually with RST and Grid locator) will be sent back. If no reply was received, a new request is transmitted and the above process is carried out again until no contact can be made. The use of high speed digital modes allows a full two way contact to be completed in a matter of a few seconds and of course makes the overall process much simpler and more reachable to more amateurs.

Multiple contacts from multiple stations can be made off the same meteor trail depending on its intensity until the trail dissipates and can no longer reflect VHF signals with the required minimum signal strength. Often called burst transmission, this can yield communications distances similar to sporadic E.

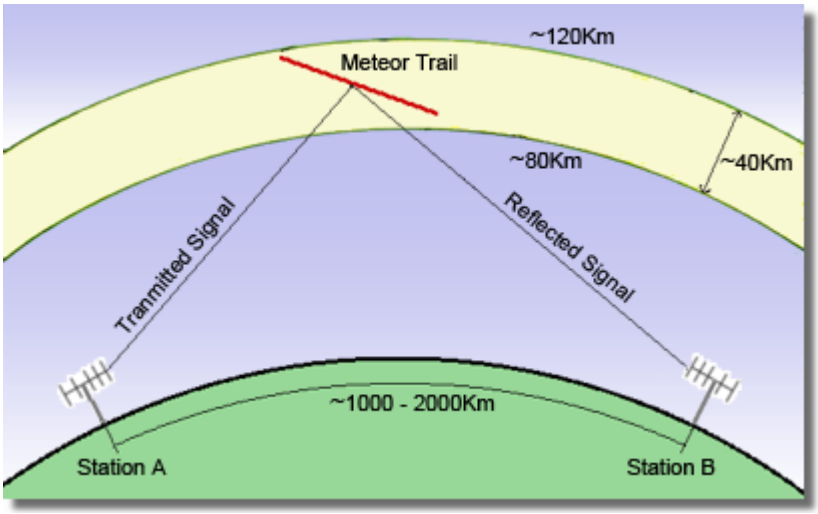

Figure 3.5 : Meteor scatter

5. Auroral propagation

Auroras is another phenomenon that produces upper atmosphere ionization that makes DXing possible. Voice modulated radio signals may be used sometimes because the ionization persists much longer as compared to meteor

trails. However, as the ionized gas constantly moves, it often leads to heavy distortion of the signals which result in the audio sounding “ghostly” and/or whispered.

On the 2m band, voice communications is typically unintelligible and amateurs must resort to CW mode to complete the contact. CW signals returning from an auroral reflection simply sounds like swishing or whooshing noise and have no distinct sound or tone. On the 6m band however, due to its frequency is significantly lower than the 2m band, voice communications is often readable (with varying degrees of difficulty) and more often takes places here.

Therefore, generally when using an auroral event as a radio signal reflector, the reflected signal intelligibility and strength decreased as the frequency increases.

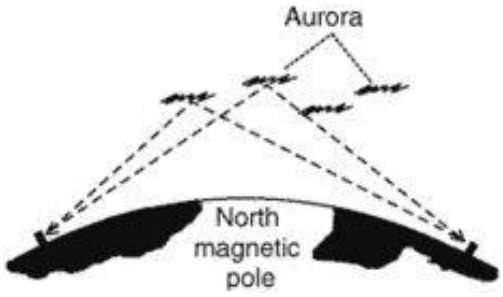

Figure 3.6 : Auroral propagation

Further VHF and UHF applications

Three numbers of usages of 2m communications are further listed in the followings.

1. Automatic Packet Reporting System

The application of Automatic Packet Reporting System (APRS) whereby one current location is identified has already been covered in other relevant section of this manual.

2. Moonbounce

Amateurs have successfully communicated over long distances and across continents by using moonbounce, commonly known as EME (Earth-Moon-Earth).

As VHF signals normally escape the earth's atmosphere, it is possible to perform EME communications on the VHF bands and above. EME works by using the moon as a passive reflector. Signals from earth are bounced off the surface of the moon and back to earth. The average distance between Earth-Moon is 384,400km and loss in signal occurs along the forward and return path. Antenna of relative high gain is necessary to overcome such path loss and other inherited losses. Under nominal conditions, Table 17.2 from "The ARRL Antenna Book" 23rd Edition actually suggests an antenna system that is able to deliver a gain of 21.0 dBi at 144 MHz to be used for CW EME work.

Further compensation for signal losses comes the need to use high transmission power and high gain antennas that are steerable in azimuth and elevation. On the reception end, low noise pre-amplifiers and a receiver with high stability is also important for successful EME communications.

Amateurs should also take note that the long distance that the signal needs to travel from earth to the moon and back to earth actually causes an inevitable delay of about 2 second. It is therefore possible to hear the brief moment of one's own transmission which is known as "echoes", returning after unkeying the transmitter and returning back to receive mode.

Previously, amateurs used CW for EME communications but with the recent technological advancement in digital mode, JT mode are gaining popularity, allowing smaller stations to attempt EME communications. The sensitivity of JT mode allows reception of signals that are buried deep in the noise floor and generally not audible to the human's ear. On the microwave bands, with the right amount of EIRP and under favourable conditions, SSB mode is also possible.

Figure 3.7 & 3.8 shows a QSL card between 9W2QC and PI9CAM using only 50 Watts of power. It should however be noted that such low power EME communications can only be done with the help of a really huge EME station on the other end.

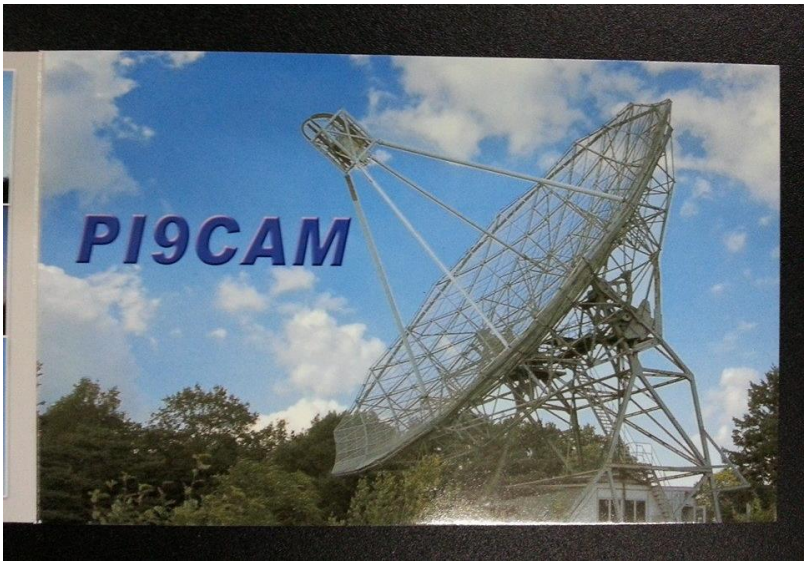

Figure 3.7: A QSL card for EME QSO PI9CAM

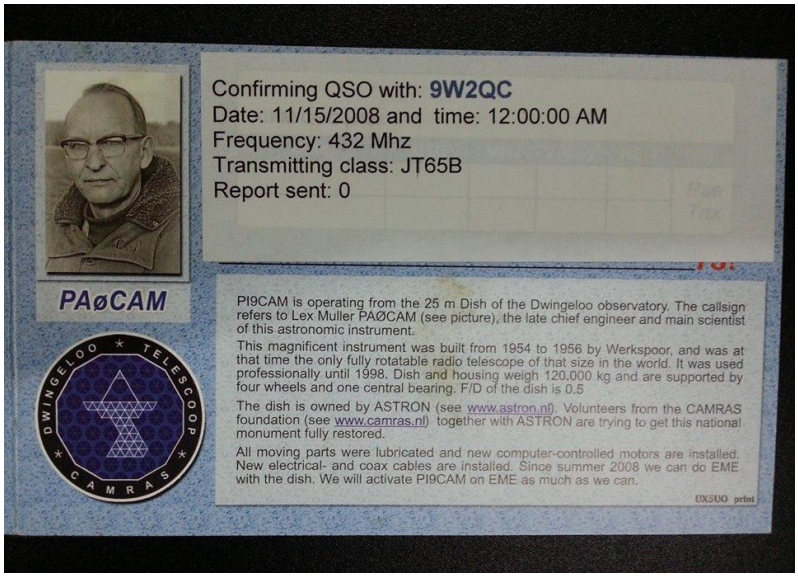

Figure 3.8 : A QSL card for EME QSO 9W2QC

3. Satellite Communications

Various portions of the amateur radio band are allocated exclusively for amateur radio satellite operations. The most commonly used bands are the 2m VHF band and the 70cm UHF band. However, there are also satellite allocations in the 10m and various microwave bands too.

Satellites usually have their uplink and downlink frequency pairs in different bands with the exception of simplex packet radio satellites that do not require full duplex operation.

The satellite's assigned mission control station is usually the one who defines what mode or band is in use at any particular time by commanding the on-board software and computers. They will also be responsible for general housekeeping of the satellite such as verifying its telemetry and making necessary changes to keep the satellite healthy.

As the scheduling, mode and band in use might vary from time to time, amateurs are advised to check the schedule published by the satellite's operator in order to know which mode is in use at a particular period of time.

Most amateur satellite are in Low Earth Orbit (LEO) which is generally about 700km above the earth although there are a few in High Elliptical Orbit (HEO) which is around 50,000km above the earth. Satellites are basically like orbiting repeaters although it takes more work and effort to work with them as compared to normal terrestrial based repeaters. More information on satellite operation can be found in the relevant satellite chapter in this manual.

CHAPTER 4 : DISASTER, PUBLIC SERVICE AND EMERGENCY COMMUNICATIONS

Emergency and Disaster Communications

In the event of any disaster or emergency, communications between the Emergency Operations Centre and all the front line first-responders become vitally important. Ideally, some terrestrial microwave, cellular or landline services remain available, as there will be very heavy reliance on them for disaster management, rescue and evacuation operations planning and execution, among others. However, in many natural disaster event or emergencies, whether it was a major earthquake or severe flooding event, most if not all of the normal communications infrastructure will be unusable due to some equipment or network damage or due to tower collapses and the loss of power thereby putting them out of service.

Each of the served agencies like Jabatan Pertahanan Awam Malaysia (JPAM), Jabatan Bomba dan Penyelamat Malaysia (JBPM) , Malaysia Red Crescent (MRC), and Polis Diraja Malaysia (PDRM), when attending to disasters and emergencies will no doubt be equipped with their own communications but these dedicated communications do not allow all these different groups to inter-communicate, making co-ordination of any search and rescue or recovery works more complicated.

The satellite based communications service such as satellite phones and rapid deployed Very Small Aperture Terminals (VSAT), can provide telephony, data, intranet and even internet service. This communications service also can be useful to be used during emergencies. However, this type of communications service is high cost, require some technical skills to set up properly and they remain a point-to-point communications system which are more suited to EOC and SC use. The urgent requirement is more for a point-to-multipoint so that crucial and important information may be easily disseminated and quickly shared among all services.

This is exactly where amateur radio societies and clubs fits in, a purely volunteer service during such disaster or emergency events, and based on either VHF or UHF simplex on 6m, 2m or 70 cm, amateur radio repeater links, or on the reliable HF amateur band radios, have been playing an increasing role in providing emergency communications worldwide. Ideally suited for rapid deployment, a core of dedicated amateur radio operators in Malaysia have been demonstrating to the regulatory authority as well as to the emergency service agencies, the coverage attainable and efficient communications available using the amateur radio bands and their digital modes of communications. Many amateur radio societies and clubs worldwide have produced their own emergency communications handbook.

In Malaysia, the national society also has a small manual covering the basic "Do's and Don'ts" for radio amateurs during emergencies and disasters called the EMCOMMS Handbook published by Radio Amateur Civil Emergency Service (RACES)[1].

When assigned for actual participation in any disaster or emergency, radio amateur societies and clubs take these responsibilities seriously and will quickly set up their stations, one at a nearby location to the EOC while other amateur volunteers will accompany the various first-responder teams to their affected sites, assigned to assist SC's on site. Sometimes, local amateurs in the vicinity of these affected areas may be called in to assist with these requirements, usually organised and coordinated by amateur radio clubs and societies.

These radio amateurs will also quickly set up their stations and establish communications with their emergency communications headquarters near the EOC and at all affected sites either beside the SC or accompanying the first responders around affected sites. It is not unusual for these teams to use tactical callsigns for this sort of operations. This is to ensure that the

[1] RACES is an Organization of Federal Communication Commission (FCC) licensed amateur radio operators who volunteer to provide radio communications for state and local governments during times of emergency

communications from headquarters to something like “Sierra 1, 2 or 3, etc.,” will remain properly identified despite a change in operator as, during an extended operation, relief operators may be sent to operate these sites in rotation until the operation is wound down. In each station’s log however, there will be notations of the various individual operators’ callsigns as to when he or she takes over that particular station. This practice properly identifies the responsible operator during any period of time during the operations for post event audit and accountability purposes. If individual callsigns were used, from the EOC, there may be confusion as to which operator is at which site and the constant over-the-air query of “9W2CCC – which site are you at now?” or similar queries throughout the operations.

Examples of the untold efforts of the Malaysian radio amateurs include volunteer works done during the Highland Towers Condominium collapse in 1993, where many radio amateurs responded and were on site around the clock in shifts to provide support communications for the transfer of casualties and recovery of fatalities to the hospitals assigned to attend to this disaster. This relay of information assisted the hospital to prepare in advance for the incoming casualty.

Figure 4.1 : Highland Tower incident

Another instance of the radio amateurs' valuable assistance was during the December 2014 flooding of the East coast areas. Many communications links were down due to flood water damage and there were also numerous power outages. Radio amateurs were able to assist in providing vital communications via HF and VHF amateur repeater network.

Figure 4.2 : Flood in Kelantan

The 2015 earthquake in Sabah involving Mount Kinabalu was yet another example of the amateurs' unselfish response when the radio amateurs participated in providing a whole week's VHF simplex communications link between the Park Headquarters with many volunteer amateurs who went to several locations on the mountain coordinating the search and rescue and also recovery efforts.

Figure 4.3 : Earthquake in Mount Kinabalu

While voice communications remain important, it has been convincingly demonstrated that with digital modes like PSK31 and a few others, and the now standard amateur emergency message handling form based on the NTS telegram format, effective and accountable message handling with a traceable paper trial works well when all else fails. Another popular method is to use FLDigi, which is a multi-mode digital application and has features suited particularly for EMCOMMS whether in VHF, UHF or HF bands.

MESSAGE

NUMBER	PRECEDENCE (tick one) ☐ Routine ☐ Priority ☐ Emergency	STATION OF ORIGIN	WORD COUNT (CHECK)	PLACE OF ORIGIN	FILING TIME	FILING DATE

To: (BLOCK LETTERS):

From: (BLOCK LETTERS):

For radio operator use only:

RECEIVED FROM	DATE	TIME	SENT TO	DATE	TIME

Figure 4.4 : The NTS message handling form – widely adopted for EMCOMMS use

Compared with normal analog voice transmissions, all digital modes offer a first level of protection from eavesdroppers which they sound like a buzzing noise and are not decipherable by the human ear. They do not require very high transmitting power nor occupy very much bandwidth and are therefore imminently suitable for a highly transportable emergency communications backpack where batteries may be the only power source available.

In Malaysia where much of the rural area is heavily forested with varying densities of trees and foliage creating severe attenuation to line of sight, space wave communications, unless VHF and UHF repeaters are available for the affected area, provide a rather limited range of coverage. The battery-powered HF radios, used at low power with simple wire dipole antennas set up for NVIS (near Vertical Incidence Sky wave) mode on either 40 meters, 60 meters or 80 meters will quickly become the main means of reliable communications between the affected areas and the emergency operations centre as, without the need for a repeater, the radio waves from an NVIS station will radiate at high angles (nearly 90^{o}) upwards to the ionosphere and reflect back at a similar

angle thus create a circle of highly concentrated signal of about 30~400 miles within which very clear and reliable communications are obtained. These stations, in the hands of skilled amateur radio operators, can easily provide the necessary and reliable link between the affected areas and the emergency operations centre, changing to other bands with changing propagation during the day and night.

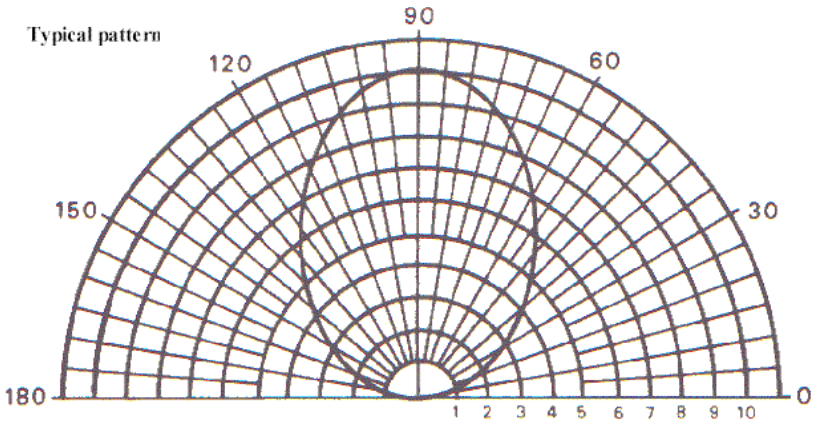

Figure 4.5 : Typical NVIS radiation pattern

In the most basic setup and under dire circumstances, with a small amateur band HF radio, a small battery, some coaxial cable, some lengths of wires and ropes, plastic pieces for insulators and a wire cutter, a skilled radio amateur will be able to quickly get on the air.

Some of them, if adequately prepared, can even complete a station setup sometimes within five minutes and communicate effectively with as little as five watts! Skilled amateurs, knowing their approximate distance from the EOC, and with foreknowledge of the availability or non-availability of amateur repeaters, are able at a glance to decide on site with which band in their amateur spectrum they can best communicate back to the EOC.

It is also quite common nowadays to see that the Emergency operations management are left in the hands of the affected community (like the District Officer). This has helped tremendously as the operations room will at least have some people with knowledge of the terrain, the topography and layout of the

affected areas which, with additional supporting details from the first-responders, will most certainly present a very clear picture of the affected area and the extent, scale and seriousness of the disaster for all following operations planning purposes. Although strictly a volunteer effort now, EMCOMMS by amateur radio operators are ideally suited for a communications role in first-responder teams as amateurs have the skills and the ability to adapt to any situation, always able to establish contact among themselves and are thus able to provide situational updates, convey request for medical evacuations, and generally provide first-responders with a channel to quickly receive EOC directives, and receive timely and crucial information with which to avoid developing dangers detected at EOC for their front line locations.

The National Amateur Radio societies and clubs in Malaysia have been responding to requests from agencies like Jabatan Bomba dan Penyelamat Malaysia (JBPM) and Jabatan Pertahanan Awam Malaysia (JPAM) to jointly conduct several EMCOMM exercises using amateur radio as their fall back communications when their own communications are unable to provide them the clear channel or the coverage they require. In yearly mock exercises, the National Amateur Radio societies and clubs have conducted EMCOMMS drills and exercises of varying difficulties to train all interested new radio amateurs and sharpen the skills of the core amateur radio EMCOMM volunteers to constantly improve their communications skills and to encourage their continued volunteerism during any real disaster or emergencies.

With skilled and responsible amateurs at the helm at both ends, the communications requirements in any disaster or emergency scenarios can be swiftly met as has been demonstrated time and again. In addition to the skilled amateurs who are all volunteers sacrificing their time and expending their skills to provide assistance, the amateur radio SOP they use shows a high degree of professionalism in all their work. Having message forms that are properly signed and authorized for transmission by the sender, they conduct all third-party traffic no matter how sensitive or private, as communications operators with the permission of the regulatory authority and under their Oath of Secrecy.

In addition to this, their practice of logging all communications, amateurs can, when called upon to do so by the regulatory authority, also provide a detailed journal of all radio traffic carried on or through their station throughout the duration of their station's operation. Although many volunteer radio amateurs may have other professional qualifications for instance, engineer, mechanic and pharmacist, or be members of some uniformed corps such as Malaysian Red Crescent, Jabatan Pertahanan Awam Malaysia (JPAM) and Scouts Association of Malaysia, it must be understood that when they are officially carrying out the duties of an assigned EMCOMMS volunteer in any disaster or emergency, they will carry out their duty only as communications operators and nothing else.

Amateur Radio operators will always be proud to be able to serve their country and their community or, as and when required, provide their voluntary services for any part of the nation when called upon to do so and they carry out their responsibilities to the best of their abilities irrespective of race or religion or political persuasions.

CHAPTER 5 : TRAFFIC HANDLING

Beginning

Traffic / Message handling beginning is as old as amateur radio itself. During ham radio's early days, most households in elsewhere throughout the world were without any type of communications devices that people take for granted today. Even to this day, some homes are still without telephones and communications relied upon friendly neighbours who would relay information to another community member who was without a telephone but thankfully as Malaysia progresses, this phenomenon is getting to be rare.

Amateurs in the earlier days felt compelled to be public servants due to their unique talents. They were willing to deliver messages to and from other members of the community. Then, radios had only a range of a few hundred miles due to frequency and equipment. Messages were relayed between numerous stations before reaching their intended recipient.

Traffic Handling

In Malaysia today, there are various NETS throughout the country and they are constantly evolving. There are now various NETS of Linking Repeaters utilising both VHF & UHF bands. Also, there are smaller NETS as well as standalone repeaters.

All these NETS often have a fixed time / day for "Checking In" by Amateurs. Signal Reports are exchanged along with whatever information to be relayed or conveyed. These NETS also serve as a "standby backbone" for communications in times of Disaster Relief as well as Emergency Communications should the common day communications infrastructure suffer a breakdown for whatever reason.

Apart from VHF & UHF bands, 40m band is also used in areas where the shorter wavelengths do not cover as when greater distances of transmission /

reception is required. 40m band NETS are also conducted in almost a similar fashion as the VHF & UHF NETS. Voice in SSB mode and other modes like CW are used and NETS for these modes are held on different times & days.

Most of digital modes are slowly gaining popularity and NETS are also being carried out. The more popular operation modes include PSK31 and RTTY amongst others. In time, these modes may be the mainstream of emergency communications as they are able to overcome interference as well as utilise lower power consumption thus prolonging the endurance of battery operated radios.

NETS & Repeaters

Currently, there are NETS are being carried out by various societies in Malaysia. The major ones are operated through the Linking Repeaters (UHF & VHF) on certain days.

Most of the amateur radio clubs has their own Linking Repeater Network and Local Repeaters across Peninsular Malaysia, Sabah & Sarawak. Each of club has published their live repeaters list on their website, however please note that the data shown on the club's website may not be the latest. It is advised to refer MCMC website for most updated live amateur radio repeaters list.

Who Owns the Frequency?

NETS do encounter difficulties when the time comes for checking in as there may be a rag-chew on-going on the published NET Frequency. What can one do when this happens? One way would be to break-in on the rag-chew and politely ask if the parties could relinquish the frequency. If they refuse, the NET has no more right to the frequency than the parties currently occupying the said frequency. The parties rag-chewing on the frequency has as much right to occupy the said frequency as the next person.

The alternative would be to call the NET near but not directly on the published frequency. The new frequency used should be far enough so as not to cause interference to the parties occupying the published frequency but not too far that the NET stations can't find the NET.

It is possible that the entire band is occupied and loaded with QSOs and the NET cannot be carried out in a conducive manner. This happens locally on the 40m band due to the proximity to Malaysian neighbouring country which has a large ham populace means that the said band is almost always occupied to the fullest.

Helpful Hints When Sending and Receiving Traffic

Traffic handlers or NCS use a variety of materials for message handling. Some use official message pads although it's not a requirement. Some just use scraps of paper. Many just buy inexpensive notepads from stationery shops.

Don't say "QSL" or "Roger" unless you have received the contents of the message 100%. There is no shame in asking for repeats of part of the message. It's not a "QSL" or "Roger" until you have gotten the message in entirety. SSB / Voice or CW operates in pretty much the same way.

Correct message handling via phone can be as efficient as it is via other modes. A few rules need to be followed in order to achieve such efficiency.

1. If it's not part of the message, do not say it.
2. Do not spell it unless the spelling is out of the ordinary.
3. Unless it's a letter group or a mixed group, or the receiving station didn't get it when you spelled it alphabetically, do not spell it phonetically.

Unless you know the capabilities of the receiving station, do not speak at full speed but rather at half speed bearing in mind that the receiving station needs time to write down the message that you are conveying.

In the case of message handling using CW mode, few rules or common practice are employed.

1. You need not send preamble words such as “PRECEDENCE” etc. as the operator is usually familiar with handling traffic.
2. When sending the date, the first three letters of the month is sufficient to be used.
3. Always spell out words such as “ROUTE” and “STREET” for addresses.
4. For telephone numbers, just send the numbers omitting out the dashes.
5. Always spell out words in full. Abbreviation is OK only for rag chewing and not message handling.
6. It’s good to alert the receiving party when you get to the penultimate message by sending $\overline{\mathbf{AR}}\mathbf{1}$ to the receiving party.

It does take time to be proficient in CW and sending traffic on this mode may be difficult at first but over time and once the basics are mastered, it’ll be second nature.

Message delivery is another aspect of message handling. Hams may be at ease rag chewing on the air for hours but when it comes to message delivery, many are at a loss over what to do. Here are a few steps and pointers.

1. Introduce yourself when the other party picks up the phone. Make a good impression of yourself.
2. Ask to speak to the person named in the message. If the person is not available, ask the person answering if they could take a message for the recipient.
3. Inform who is the sender of the message before you deliver the contents of the message.

A good way to start off a delivery is something like this :

“Hello Sir/Madam/Miss <name>, I’m Abu Amateur. I’ve received a message via Amateur Radio for you from <sender name>.

This usually gain you some credibility with the recipient. When delivering the message, skip all the preambles and just deliver the text of the message. Once the message is delivered, ask if the recipient would like to send a return message. Explain that it's absolutely free and that you would be most happy to send a reply for the recipient if they wish.

Notices of death or serious injuries should only be treated as emergency communications between relief agencies and government agencies like Police etc. This is to be done as a last resort in the absence of alternative communications. Radio Amateurs should never ever be tasked with notifying anyone of deaths or serious injuries. This should always be handled through relevant relief agencies.

Net Control Station

It is essential to remember that net regulars are the net. Without them, there is no net. A Net Control Station (NCS) has a duty to preside over the net to ensure that the net is conducted in the most efficient and orderly way so that all participants can complete their duties and move on to other things. There are a few things to remember when one is appointed as an NCS.

1. The NCS's job is to be the Boss BUT not be bossy. Discipline on the net has to be maintained to ensure order and efficiency. The NCS is the absolute boss on the net but it pays not to be a tyrant when one is the NCS.
2. Punctuality is very important. Many net members may have other commitments apart from the net so it's important to start the net promptly at the appointed time.
3. It is important for the NCS to know his / her territory well. It's also important to remember where each member is located as then as NCS, traffic can be directed to the correct net members.
4. The NCS has to ensure that his equipment is in tip top condition. Antennas and radios need to be in good operating condition. As NCS,

you must have a good signal – not necessarily the loudest signal but you do need to be heard by all stations.

5. The NCS establishes the net frequency. This however, does not give the NCS rights over the said frequency. If the said frequency is in use, the NCS has no right to the said frequency. In this case, a nearby frequency may be used (close enough that the other net members can find the NCS). QRM is a normal occurrence especially in crowded and narrow bands.
6. Keep a log of all net sessions. You never know when you need the information recorded in the log.
7. Keep the net's message handling as smooth as possible. Certain net members may move to another adjacent frequency to convey messages to one another while the NCS clears other traffic. The net members that moved on to the adjacent frequency may re-join the net once they have finished exchanging their traffic. This enables the net to be more efficient and the net need not drag on unnecessarily.

Even though net members who are not normally the NCS for a particular net, there may come a time when they are called upon to be the NCS for unforeseen reasons. It is important that all net members familiarise themselves with the net and the participating net members as one day the appointed NCS may be unavailable for whatever reason and thus one of the net members may have to stand in to become the NCS.

In a Nutshell

This chapter is just a brief touch on traffic handling. It is by no means an exhaustive guide on this subject. However, it should be enough to serve as a meaningful reference for both Elmers and newbies alike. You have now been interested in message handling and if that is so, find a net that suits you. You may find that over time, you'll make many acquaintances over the air.

The origins of traffic handling goes way back in the history of Amateur Radio and today, it branches out into many aspects. Some may be on various

interests, other maybe be purely for message forwarding. There may be yet others that are geographically orientated. Whatever it is, in times of emergency, all nets may galvanise into one big net with the sole purpose of forwarding messages and assisting relief agencies. That is when you will find it all worthwhile and rewarding in more ways than one.

CHAPTER 6 : DXING

The term ‘DXing’ as defined in Wikipedia, is all about making radio contacts with rare stations usually at considerable distance and sometimes not so distant, but stations that are considerably difficult to come across mostly due to lack of propagation or having a very, very, small radio amateur population hence having a very rare presence on the HF bands. For amateurs in Malaysia, most countries in Europe, USA, Australia and Japan will not really count as a true DX station for seasoned amateurs although it will certainly thrill the newcomer amateurs to no end! When used in the context of the VHF and UHF amateur bands, DX will also qualify for stations well beyond the line of sight whether due to atmospheric inversions, tropospheric ducting or some other strange and unusual propagation phenomena.

Today, through the amateur Satellites, or even using the moon as a signal reflector, DXing has become much more easily attainable for VHF and UHF enthusiasts. Here the amateurs whose their interests are only in these bands and in these modes of communications, have developed much in the area of weak signal reception as well as in the area of new digital modes which technology allows signals as much as 20dB into the noise floor to be fully readable! One cannot help but compare this with how it was in the earlier days when a SW receiver could be built from a simple crystal radio kit – It would be hard to believe if it was told that no batteries were needed at all. With this, one could tune through a limited portion of the shortwave bands by moving the wiper on a copper wire coil and as if by magic, one will be able to hear some station on the air.

A contact with the International Space Station, which is floating around in space continuously and having an amateur station manned by a few radio amateur astronauts, may qualify as a DX contact of sorts, perhaps in a special category as in terms of distance, they are only around 250 kilometres above the earth but they are an object moving at very high speed in near space above the ionosphere!

On the HF bands, DXing activities become a natural progression for all hams after they acquire their licence, most probably at a time when these newcomer-amateurs go through the usual experimentation phase, trying antennas from simple dipoles to elaborate beam antennas, each depending on the amateur's financial standing and his willingness to invest in them. All these amateurs will and do resort to DX chasing which usually takes the form of testing out the effectiveness of his equipment and antennas. Typically, on the air together with another station, they will set about to find a station as distant as possible then both will make contact and compare signal reports to see who has the better report which they will equate to who has a better station, setup or the better antenna that made the difference even though it may have been only a single 'S point' difference in the reception report obtained.

As a newly licensed radio amateur, operators are advised to scan the HF bands after turning on the HF radios. Most of operators will not be able to resist joining any net activity especially if they are from a faraway country. A popular net was the W7PHO family hour net (a US net) on 14.226 MHz, which also happens to be the same frequency being used by the Southern Cross Net: an Australian amateur net. These nets share the same frequency but at 00:00 GMT (8:00pm local time here), the Southern Cross Net would hand over the frequency to the Family Hour Net due to the Sun's position in the sky, propagation will have changed from one part of the world to the other.

Many amateurs gather here under the control of better-equipped net controllers who may sometimes be from different parts of the US. Between the two net controllers, and with at least one of them having a better reception on faraway stations, they run this net with the objective of helping all these "smaller" or newcomer stations on the net to make contact with the foreign stations that these net controllers manage to catch. This was their way of helping their net participants more interested in amateur radio and also to achieve their targeted awards like Worked all Countries (WAC) and DXCC.

During those days in the late 80's to the 90's, the radio proved to be much more interesting and captivating than watching popular TV programmes of that time.

With just this little HF transceiver and even only a small homebrewed beam antenna, amateurs from one part of the world could talk to amateurs in the USA, getting reports of 59 or even 10dB over 59.

These armchair travels became the backbone of many radio amateurs' interest in amateur radio. They can now "travel" by radio to faraway places and making friends with strangers, learning about exciting places which at that time, they may have never been to. Imagine the excitement as pictures formed in their mind's eye when these people were describing their city, town, or state and how much they can truly enjoy these experiences. This is what DXing is all about to many amateurs, armchair travelling by amateur radio, even to this day, many amateurs, especially newcomers to this hobby, will feel the same way.

There are several aspects to DXing in amateur radio. Merely making a DX contact with a station that was on the air is only one aspect of this fascinating hobby but there are also many dedicated amateurs who add to this experience by meticulously selecting and actually make a trip to a 'rare' country, obtain the necessary licences, and set up a station to make available to all the amateurs worldwide this relatively 'rare' country. This is called as 'DXpeditioning'; an expedition by radio amateurs to put a rare country on the air.

The work involved in the planning, financing and paperwork for such an endeavour is tremendously difficult and fraught with legal, technical and logistics problems and not forgetting the financial undertaking it would require to make it all happen. All amateurs owe a huge debt of gratitude and appreciation towards these brave and dedicated adventurers who have sacrificed much of their own time and even took some risks to their lives to make it possible for amateurs to obtain that rare callsign in amateurs' logbook

To be successful in acquiring more DX contacts, an amateur today has to operate smarter. A thorough study of the propagation predictions in many amateur magazines will be of help and use as will be some good knowledge of the performances and design specifications of operator's equipment, especially antennas. For example, where one has the space, a vertical antenna with very

good ground plane will present a low angle of radiation from the station. When used on a band like 80 meters during the sunset or sunrise hours, this will excite the chordal hop mode making the 80-meter signals, normally absorbed by the D layer in the ionosphere during daylight hours, travel very much further thereby increasing the probability of an otherwise difficult to obtain DX contact on this difficult band.

On all bands, one also has to consider the level of atmospheric noise. Today the radio spectrum has a much higher noise floor than thirty years ago. On this globalisation eras, the RF spectrum has been bombarded with RF energy from television and cellular telephone stations, terrestrial microwave transmissions, and as people use many modern domestic appliances which all of them contribute electrical noises in the spectrum. With the improved sensitivity of the modern receivers or transceivers, it makes the reception of weak DX stations much more challenging.

In spite of all these difficulties the persevering amateur, even if with a humble low cost transceiver with only an inverted V or a wire dipole, diligently scanning the ham bands for activity and willing to put up with making many calls to a DX station, may sometimes be rewarded with a response from that station and one can imagine the pride this amateur will have in making this score.

There are so many special interest avenues in amateur radio that it would be impossible, in the span of a few pages to cover them all, let’s just say that in the past two or three decades in amateur radio, it can be seen that equipment improve from valve type radios to ultra-modern Software Defined Radios, antennas that have become so well developed that it can even self-tune to any frequency within its bandwidth that is set on your radio dial.

Of course one can be proud of one’s super contest-station with all the fantastic radio, amplifiers, antennas, and towers all purchased with a small fortune but what can make one more proud that being able to say, “I built those antennas myself” or “I built the amplifier myself”. Intimate knowledge of one’s equipment especially in antennas and the proper selection of a particular antenna for a

particular direction and knowing what is the difference between a knowledgeable amateur and an ignorant one especially when the supposedly knowledgeable amateur simply blasts the spectrum QRO whether it is for local or Dx. One tip to share with you readers is that many stations give priority to stations that operate QRP so do try to operate with 5~10 watts and see if you can make a WAC or WAS on QRP – that's an open challenge to all Hams.

So, with this part of the necessary construction skill set covered, one then moves into using this station with proper and well-rehearsed practices and styles that boost this into a super-efficient station that can easily make contacts with anything one can hear on the band. Here too, knowledge helps no end – knowing the best bands at certain times of the day, certain months of the year and time in the sunspot cycle will ensure that you do not make CQ calls to the void.

Finally, to all newcomers to this hobby, you are encouraged to get to know some of the older amateurs who have put up a good station. Spend some coffee time with them, put up with their reminiscing about their "good old days", learn from them as much as you can and then develop your own unique approach to this hobby but not necessary by imitating everything they do, or the way they do it. Use your own judgement, your common sense and understanding and in turn, teach others so that this knowledge does not get lost or die with you – it must be passed on to help many more who perhaps did not have the opportunities like you had in your time!

Let us hope this little chapter will inspire you to use your radio and listen attentively to whatever is on the band – there is such a thing as a one-way propagation. You could be sitting on a frequency that stays utterly silent and you hear absolutely nothing. Then you make your "CQ DX CQ DX" call forgetting to make the necessary initial "Is this frequency in use?" inquiring call.

All of a sudden you get a loud booming signal calling you telling you in a rather admonishing voice that this frequency is in use, please QSY – really embarrassing but this is a rather common mistake.

CHAPTER 7 : CONTESTING

Introduction

This chapter is not meant to be like a contesting handbook, it is only intended to shed some light on this popular activity in amateur radio. Interested parties can easily find many articles on the internet and also many books written to fully explain the many contests in detail.

So what is amateur radio contesting all about? How does one learn about it or even participate in it? Amateur radio contesting is to some, the best activity in amateur radio, challenging in that it does demand the very best from every serious participant. Every contest has its own set of rules and regulations, most featuring a few and some a wide variety of categories.

As mentioned earlier, a contest will comprise of a few key elements, which may include:

1. The date and duration of the contest
2. Contest Categories (high or low power, single or multi-band, single operator or multi-operator)
3. The mode of the contest (whether this contest is for SSB or CW or one of the digital modes)
4. Contest rules (required information to be exchanged and whether there are compulsory rest periods)
5. Contest Log format and Submission
6. Contest scores and any penalties for mistakes for non-conformity.

In amateur radio, the operators are able to participate in many contests throughout the year. Some of them are small simple contests like “SEANET 201X” either for CW or SSB contests and some of them are quite popular and heavily participated contests like the WPX (Worked All Prefix) contest both in SSB and CW. Perhaps the most popular contests of all will be the CQ WW SSB and CW contests. In keeping with the code of conduct in Amateur Radio, there

is no actual financial reward in winning these contests other than a certificate or a plaque, and a mention in some of the more popular Amateur Radio magazines.

Why do Operator contest?

Initiated in the earlier days as a means of challenging all amateurs to sharpen their skills for the rapid dissemination of information, which is of particular importance for medium and large scale emergencies, today it has become more of a sport than anything else. Some contest may specify a duration of forty-eight hours with no compulsory rest periods while others may specify compulsory rest periods and yet some others may be of a shorter duration.
Many amateurs are quite proud of their station, be it a superior antenna setup or some elaborate phasing of amplifiers and antennas, perhaps an antenna farm – in layman's terms, it's a large open property with a lot of towers and antennas. It is not inconceivable that some may even be sporting rhombic antennas for worldwide coverage.

This merely goes to show that these people take this hobby seriously enough to invest a lot of money, time, and technical knowhow to achieve their ultimate station so, their pride is certainly justified and their taking part in contests are merely a way for them to affirm their station's superior performance. In doing so, they also acquire other benefits like improvement in making quick and efficient contacts and logging and a 'looser tongue' for faster speech.

This challenging activity in amateur radio has also spawned many contest clubs, some of whom also set up elaborate stations for multi-operators, with a wide selection of radios, antennas, and amplifiers. Over the years, these clubs have successfully trained many "green" operators using the "sports" platform in this hobby to sharpen their skills in the art of contesting while at the same time, learn optimal methods of equipment selection with all the practical works in antenna installation testing and tuning, all without having to bear the entire burden of financing an elaborate station personally but rather collectively.

Remembering that a good contest station will also work excellently for emergency communications, this training in station setup, radio equipment and antenna selection and good operating practices reaps more benefits than simply just in contesting. Armed with the knowledge of when propagation will be good for which band, which information can be obtained from amateur radio magazines or websites providing propagation forecasts based on solar activity and magnetic flux indices. This contester-amateur will be able to make excellent decisions of when to operate where and indeed many known contesters are also found to be quite involved in emergency communications with all their skills, gained from contesting, put to good use for a most worthwhile public service during disasters and emergencies.

A contest QSO usually starts with a station calling several times:

"CQ Contest, CQ Contest, CQ Contest, 9M8XX (in phonetics – Nine Mike Eight X-Ray X-ray) calling CQ Contest and listening"

If operating in a Simplex mode or " listening 5 up" meaning the station calling CQ Contest will be operating in split mode and he will be listening for responses to his call 5kHz above his calling frequency.
This example given is quite typical but some may be only slightly different like

"Nine Mike Eight X-ray X-ray Contest, Nine Mike Eight X-ray X-ray Contest".

Typically, responses to the CQ Call will be by responding stations calling out the suffix of one's call like ***"Alpha Bravo Charlie"*** or ***"Yangkee Zulu"*** once or twice and if the calling station hears and picks you up, he will respond with your Suffice :
"Station Alpha Bravo Charlie?" or ***"Yangkee Zulu?"*** to which ***"Alpha Bravo Charlie"*** or ***Yangkee Zulu"***
will quickly respond with his or her complete callsign, the signal reports and other contest-defined requirements.

Obviously if one's station gets out very well (whether this is due to the output power level of the stations, the antennas in use or simply that both stations happen to have excellent propagation to each other at that time), the likelihood of the calling station picking you up from a "pile-up" or a crowd of amateurs all calling in response, greatly increases. Another observation here is that female contesters are often more quickly responded to than their male counterparts.

As mentioned earlier, information exchanged for each contest contact may also vary. Some contests require only a serial number to be added to the QSO which usually consist of callsign, a signal report and a serial number. For example, 9M8XX, this is 9M6ABC, you are 5 and 9 and your number 004. In the CQ WW series however, one is required to state one's CQ Zone number. For example 9M8XX, you are 5 and 9, 28. One of the more exciting contest is the Islands On The Air (IOTA) contest and this contest actually encourages a contester to make a trip to a known island (definitions of recognized islands are given in the contest rules and regulations), with two types of stations (Island station and World station) and the usual single band or multi-band, single operator whether assisted or unassisted, or multi-operator, high or low power categories.

This contest spreads the spirit of adventure in the amateurs participating as one has to carefully prepare sometimes up to a year ahead of time, not only to meet all the different licensing requirements in whichever country or part of the world he or the contest team is visiting but the demands of good logistics planning for all the necessary equipment as well with all the special arrangements and permits from the Customs department and also the regulatory authorities for that country.

For the more general contests, there are usually also several categories in the contest, from a simple single operator QRP (low power – not more than 10 Watts PEP) station to a QRO (full legal power – a one kilowatt) multi-radio, multi-operator station. Since the advent of the internet, stations may now participate either in an "assisted" or an "unassisted" category (assisted being

using the internet with the DX cluster webpages to “advertise” the band and frequency being used by the “assisted” station).

Other categories of contests may be whether you are participating in a single band category or on all bands – here, “all bands” only include all the non-WARC HF bands meaning the classic 160, 80, 40, 20, 15 and 10 meter band and, by a “gentleman’s agreement”, no contests will be held on the WARC bands and on this matter, some IARU regions have even gone as far as to include this “restriction” in their handbook to “officialise” it.

One obvious thing learnt from watching “over the shoulder” during contests is that people who are seasoned contesters definitely have also mastered the art of “rapid speech” and also have a distinctly sharper hearing.

Over the years, contesters have become very demanding and somewhat impatient, perhaps due to the pressure of the contest or simply having little patience for beginners or nervous and slow stations, some of these amateurs have resorted to rather rude remarks on the air. An example is, perhaps due to a lower proficiency in the English language, some stations failed to quickly catch on when the other station responded with a “Dupe” response meaning “Duplicate” or a contact on that band has already been established earlier. If the “slower” station continues and persists in responding, it may irk the calling station and so earn himself/herself a telling off on the air.

Today, the use of computer logging software in any contest is almost the rule rather than the exception as manual logging will cost too much time and in computer logging software (usually package designed and prepared for all the popular contests) having all the required fields on screen, with a “Dupe checker” and an “Advisor” to tell the contester whether a particular callsign he just entered is a duplicate, a required multiplier or a new contact. A running Contacts per Minute Counter and score counter are usually incorporated to tell the contester how he is doing overall and all these aids certainly help the contester operate much more efficiently during contests.

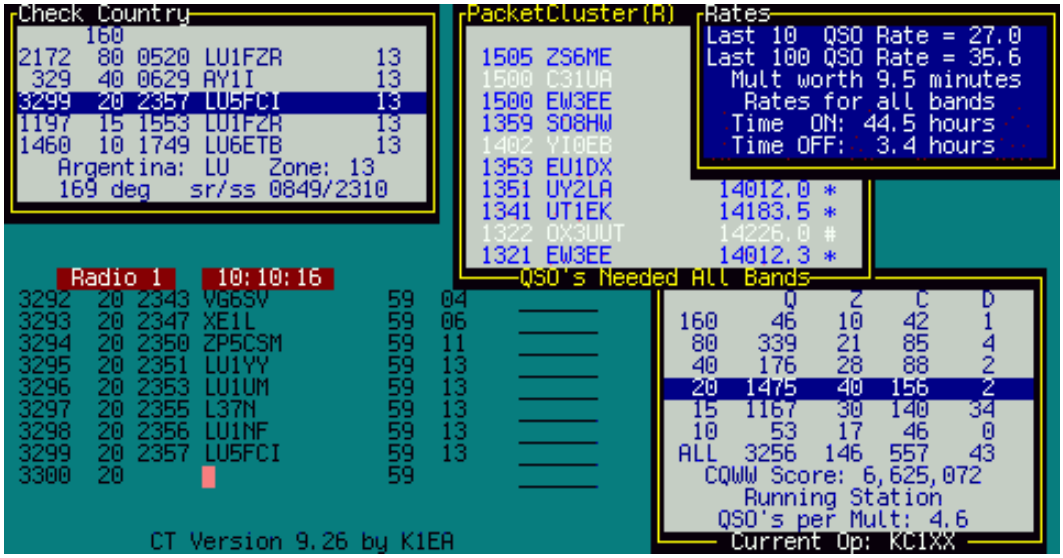

Figure 7.1 : The most popular contest logging software, the classic CT by K1EA.

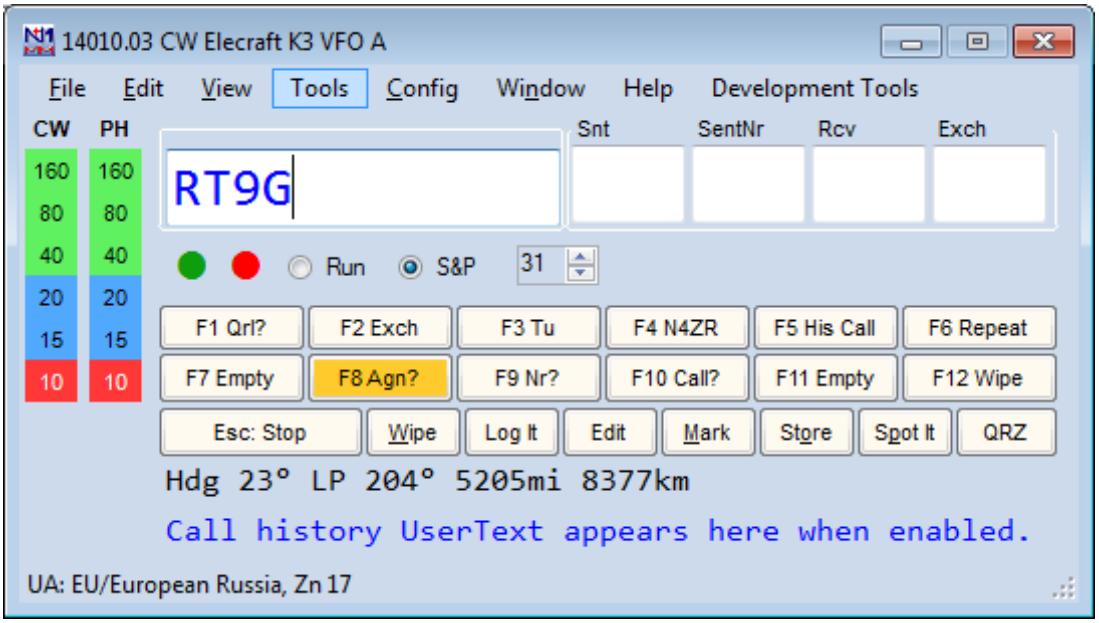

Figure 7.2 : N1NM logging software

Figure 7.2 shows a screenshot of the popular N1NM logging software. This software is not only usable for regular logging for all kinds of contests, all modes, digital modes are also supported and also with interfacing support for all the popular radio models in use today and with has rapidly grown in popularity.

If one listens in on any contest, from the different signal levels heard from all the stations on the air, some near and some very far (or two or more may even

be from the same country and locality), it will be quite obvious from the very strong signals from some stations that these amateurs have “bigger stations” and have invested quite heavily in their station equipment and setup, using really good and expensive radios, and having antennas on multiple tall towers, some even having phased antennas and phased amplifiers with stacked phased antennas like a “4 over 4 over 4” (meaning a stack of three phased 4 element antennas) and using a rotating tower, all of which will cost megabucks.

In amateur radio, it is really up to the individual how much he is willing (or able) to spend on his or her station but that does not mean that humble and more basic stations are unable to compete. The ionosphere can sometimes be a good leveller of the playing field and sometimes, operating smart may even put one in strong competition with bigger and better equipped stations.

Addressing the simpler needs of the new amateur, some contests feature a QRP category. The portable and even mobile HF stations have been heard. Indeed when even a “superstation” contester hears or picks up a QRP contact, he usually courteously gives this QRP station priority and also usually, the pileup stations upon hearing that he is in contact with a QRP station will quietly wait for their contact to be over before all start piling up again. With the exception of a few inconsiderate operators, this courtesy of giving way to a “small” contester is in keeping with the best tradition in amateur radio.

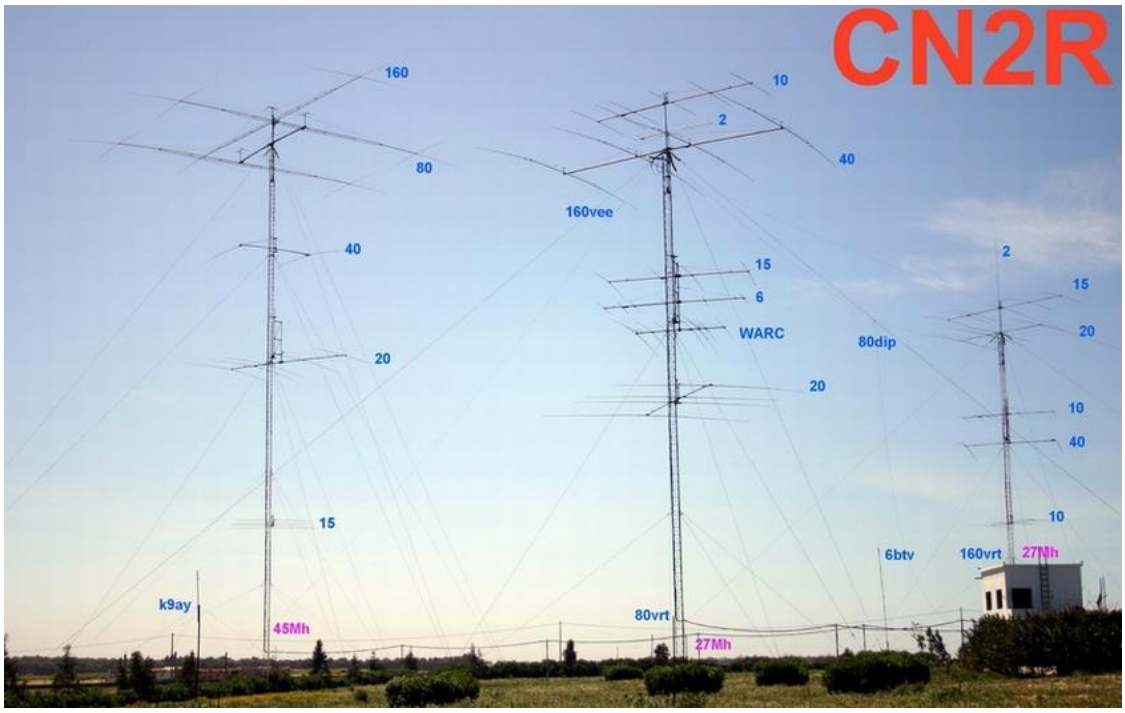

Figure 7.3 : Contest station

Figure 7.3 shows a serious contest station capable of all the CQ WW DX contest categories. Setup in Morocco by Jim Sullivan (W7EJ, also CN2R and 9M8R).

Ultimately, a contester will win his or her “15 minutes of fame” when placed top among over half a million contesters worldwide in one or the other category. But to be fair, it should also be considered how much money was invested in equipment for the station and how ‘smart’ the contester has used the propagation paths, the contest hours, and contest tricks for making quick contacts and scoring points. No matter what position was won, any contester would have done well all things considered, having to learn to balance the number of hours spent on the contest, the hours of rest, how one has used his or her skill to gain contacts quickly and then how the station was set up, with whatever equipment and how the best possible performance has been squeezed out of every last one of them.

The most important point is that the contester enjoyed the contest, enjoyed the sport and sportsmanship, maintained a high standard of operating proficiency,

and polished his or her skill of how to quickly establish a contact, accurately exchange the essential information and also logging the contact.

Contesting is definitely an activity in amateur radio that every operator must try at least once just for the fun of it whether alone or in a club. Although some may later choose not to actively participate ever again, there will be no denying that the experience, even though only once, will stand him in very good stead in his entire amateur lifetime.

CHAPTER 8 : HF DIGITAL COMMUNICATIONS

Introduction

In radio communications, the use of digital mode is not really new. One of the earliest digital modes is Morse Code in CW mode. It has been used since the birth of radio. In the 1950s, with the end of World War II, there were a lot of surplus equipment such as a mechanical teletype machine available. Radio Teletype (RTTY) was introduced and become popular for amateur radio use. Prior to this, the RTTY were pretty much confined in the commercial and military usage only. This teletype would be connected to the transceiver via a Terminal Unit (TU) as an interface.

With the introduction of affordable microprocessor technology in the late 1970s and personal computer in the early 1980s, there were many newer digital modes gained their popularity among the amateur radio operators and in commercial usage too. The PC mostly act like a dumb terminal and connected to a standalone TU or multimode controller. These multimode controllers are functioning as modulators/demodulators (MODEM), converting data to modulated audio signals and converting the audio signals back to data.

With the rise of Internet usage in the early 1990s, and the availability of much more capable PC with sound card, more modes were introduced to the amateur radio operators. The sound card with the right software replaces the more expensive multimode controller as a modem. The only thing that is necessary to make this work is a simple interface that allows the audio signals to be sent/received from/to PC to the transceiver and vice-versa and a simple circuit to switch the mode from receive to transmit.

There are many reasons an amateur radio operator decides to work on digital modes. Extending the station's range without investing more on new antennas or increasing output power is one of the reasons. A mode like JT-65 which intended for extremely weak signals can decode signals in many decibels

below the noise floor and often allow successful exchanges without the signals being audible to human ears.

To be able to work on digital modes, an amateur radio operator requires the following equipment:

1. An HF transceiver
2. A PC capable of running the specific software
3. A PC to transceiver interface

The High Frequency Transceiver

To be able to operate in the digital mode, there are not many things needed for the transceiver. Most existing transceivers should work well in a digital mode including probably a 20-years-old SSB transceiver. For older transceivers, the following two things should be considered; first is the stability, the old transceiver, especially those using tubes might tend to drift. And the second thing, the transmit/Receiving switching speed. Some modes might require a fast switching. An example of the mode that requires fast switching is PACTOR.

Nowadays, most modern transceivers come with a built-in USB sound card in them. There is nothing much needed other than the USB cable connecting the transceiver and the PC. Some recent high-end transceivers have the capability to work on certain digital modes such as PSK, RTTY and CW without any PC required.

For a bit older transceivers, most of them should come with data or accessory ports. They’re mostly designed to be interfaced to some external devices such as PC. Typically, the manufacturers use 13-pin DIN port as standard but for much older transceivers, they are varying.

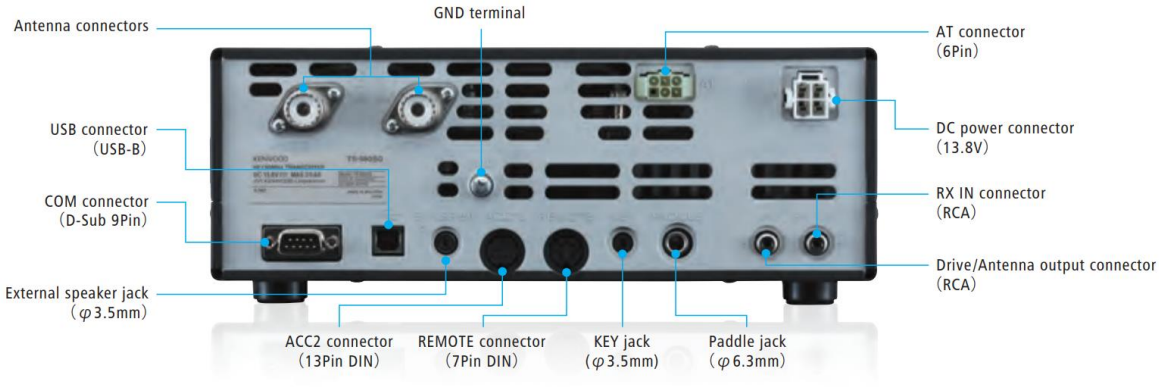

Figure 8.1 : Example of transceiver

Figure 8.1 above shows an example of the rear of a modern transceiver with both 13-pin DIN accessory and USB ports.

For older transceivers that do not have the accessory or data ports, the microphone and speaker jacks could be used. A simple interface could be used to do the automatic switching between the transmit and receive.

And probably if else failed, the manual way. On some digital mode which doesn't require fast switching like SSTV, a manual interface will do. Manually putting the transceiver microphone near your PC speaker and pressing the PTT button during the transmit and putting a PC microphone near your transceiver speaker during receive.

The PC

Depending on the software chosen, the hardware requirements might vary too. The older PC based software might only run on Windows XP and some might be able to run on the latest Windows 10. On platforms such as Linux and Mac OSX, there are not many choices up till now to work on such platforms. Some of the software are available for a multiplatform environment but such software is hard to be found and probably will not work for all digital modes.

Basic requirements for PC:

1. Windows XP and above
2. USB and/or RS-232 serial ports
3. Sound card
4. 1GHz CPU speed
5. Memory requirement depending on the OS and should be able to run the software smoothly
6. Enough storage to install the OS and most of the software, 40GB HD might be enough when running Windows XP but bigger size needed for latest OS
7. Internet connectivity for software logging and update

When building or buying up a new PC, bear in mind that most basic PC sold right now will be a good enough. Do not choose a very high-end PC just to work on digital modes.

With the recent introduction of cheap tablet PCs, operators could operate in a portable environment without a need to bring a bulky PC. Some of these tablet PCs could run a full Windows 8 or Windows 10 OS and could certainly cater for most demanding software too. The battery could last for few hours which is better for a short outdoor DX trips.

For older PC, choosing the right sound card is critical when working with digital modes. But for newer PC, the built-in sound card is quite good enough. With some interfaces, operators might be able to drop the sound card requirement from the list altogether, though with an extra investment needed to buy them.

The Software

For the PC environment, choosing the right software for you is quite easy. Most of the available software that can be used to work on digital modes are available for free or as a shareware. Some are available only as a commercial software.

The most commonly used software available:

1. Ham Radio Deluxe 6 – Commercial – comes with 12-month support and upgrade is available for free. A full featured suite which not only supports digital communications but also equipment control and logging. The DM-780 software is capable of supporting most digital modes too. The older free version 5 is available on the internet too though with no support and no updates.
2. MMTTY – Freeware – supports only Windows and RTTY mode.
3. MultiPSK – Freeware – supports Windows and many PSK modes including BPSK, QPSK, HFDL, Packet, PACTOR 1, AMTOR and many more.
4. MixW – Commercial – a multi-mode software running on Windows and capable of logging and contesting. Able to run on Windows 95 and above.
5. FLDigi – Freeware - a multiplatform software that runs on Windows, Mac OSX or Linux. FLDigi is multi-mode software and capable of supporting many popular modes such as PSK31, MFSK31, DominoEX, and RTTY.
6. Digipan – Freeware – able to work on PC running Windows 95 and above and requires a smaller footprint. Digipan hasn't been updated for quite some time and it only supports PSK31 and PSK63 only.
7. MultiPan (ex DigiPan 32) – Freeware – a multiplatform software runs on Windows, Mac OSX or Linux.
8. Hamscope – Freeware – multi-mode software running on PC and able to support PSK31, RTTY, MFSK, Packet and CW
9. BlackCat Multimode – Commercial – a multi-mode software running on Mac OS X and supports most popular digital modes including RTTY, PSK, SSTV, CW, FAX
10. JT65-HF-HB9HQX – Freeware – only support JT65/JT9 mode
11. WSJT/WSJT-X – Freeware – supports JT65/JT9 for weak signal communications

For contesting, the following software are available:

1. N1MM – Freeware - with additional interface to Fldigi, supports RTTY and PSK31
2. WriteLog – Commercial – supports RTTY and PSK31

Software that run only on Android/iOS phones or tablets:

1. DroidPSK, DroidRTTY – PSK and RTTY for Android devices
2. DroidSSTV – SSTV for Android devices
3. PortablePSK – PSK for iOS devices

Standalone Device

There are few purpose-built devices that let radio operators work without a need for a PC. One of the products is by NUE-PSK called NUE-PSK Digital Modem. This device is portable, runs on battery, capable of working in PSK-31, RTTY, and CW modes. The only thing required other than the transceiver is a PC keyboard.

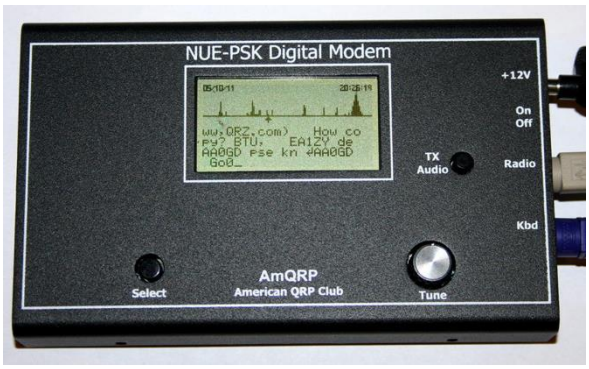

Figure 8.2 : PSK digital modem

The Interface

On some HF transceivers that do not have the USB sound card built in, a sound card interface is needed. The primary function of this sound card interface is to

allow your PC to switch the transceiver between receive and transmit along with isolating the two equipment.

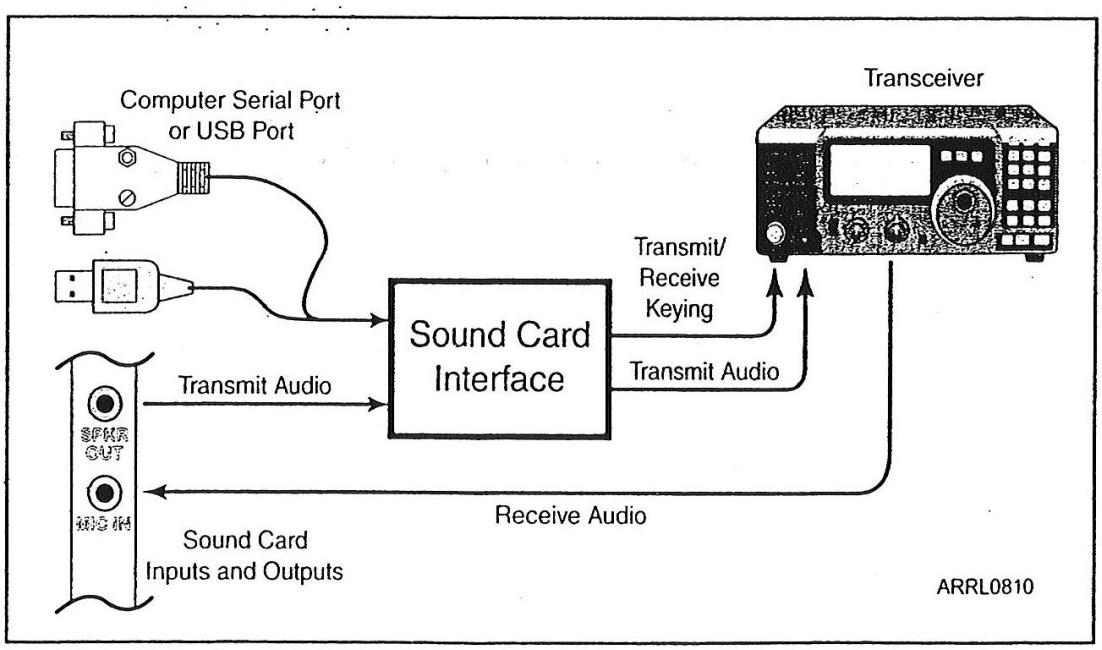

Figure 8.3 : Connectivity interface setup[2]

The cheapest solution is to fabricate own interface which for people with skills will be an easy thing to do. The cost to build the interface is quite cheap and the parts are easily available especially from either online sellers or from local electronics shops.

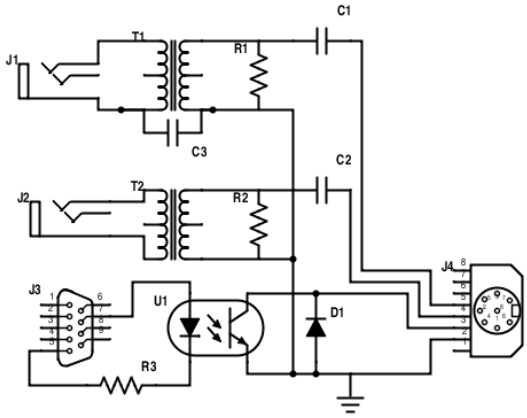

Figure 8.4 : Example of a schematic for the interface

[2] Image source from ARRL Operating Manual

Figure 8.4 is an example of a schematic for the interface. Few interface designs can be found on the internet with almost similar parts. The main parts are the T1 & T2 isolation transformers and U1, a 4N25 opto-isolator.

A number of manufacturers have come up with a commercial solution that simplifies station setup including adding up USB sound card built into the interface.

There are few advantages when buying the commercial interfaces. Some of the interfaces are built not only for digital operations but also for controlling the transceiver with added independent audio level controls, extra microphone input, and built-in USB sound card. The cost of this commercially sold interfaces varies according to the features.

Figure 8.5 : Sample of USB sound card[3]

Popular HF Frequencies for Digital Modes:

Band (Meters)	Frequencies (MHz)
10	28.070 – 28.080
12	24.920 – 24.930
15	21.070 – 21.080
17	18.100 – 18.110

[3] *Image source from DX Engineering website*

20	14.070 – 14.080
30	10.130 – 10.140
40	7.080 – 7.125
80	3.570 – 3.600
160	1.800 – 1.810

Table 8-1 Popular HF frequencies for digital modes

Available Digital Modes

Out of many available modes, there are few modes that are being used regularly by amateur radio operators, either during normal conversation (QSO) or during a contest. The most common ones are the RTTY, PSK31, MFSK16, and JT65/JT65-HF. Some of the digital modes are used in specific requirements, conditions or environments and rarely can be seen on the air for normal QSO.

Radio Teletype

Radio Teletype (RTTY) is not only the oldest but it is also one the most popular digital mode. It is still used in weather broadcast especially in Western Europe and throughout the Mediterranean. In amateur radio, this mode is used for normal QSO, DX or contesting. Before the PC era, a mechanical teletype terminal or printer was used for communication but now, this mode is mainly done by PC and soundcard combination.

In RTTY transmission, there is no amplitude modulation, only a pure carrier which shift frequency. There are two frequencies used and conventionally, it is called mark and space. The lower RF frequency is known as the space frequency and the upper one is known as mark frequency. The different between these two frequencies is known as shift. The standard shift for amateur radio is 170Hz.

Figure 8.6 : Example of teletype machine

Depending on the transceiver or the interface used, one can either use an Audio Frequency Shift Keying (AFSK) or a Frequency Shift Keying (FSK) modulations to transmit RTTY. In AFSK, the audio tones for mark and space are generated by the PC or by the interface. When AFSK is used, make sure the transceiver is set to use a lower side band (LSB) to follow the RTTY convention.

Some transceivers have a port called DATA or RTTY which is a preferred way of operating due to the availability of narrow IF filters that can be used to remove interferences. In FSK, the audio tones for mark and space are generated by the transceiver instead of the PC.

Popular software that supported RTTY includes HRD's DM780, MMTTY, HamScope, MultiPSK and few others. N1MM with Fldigi interface is suitable for contesting.

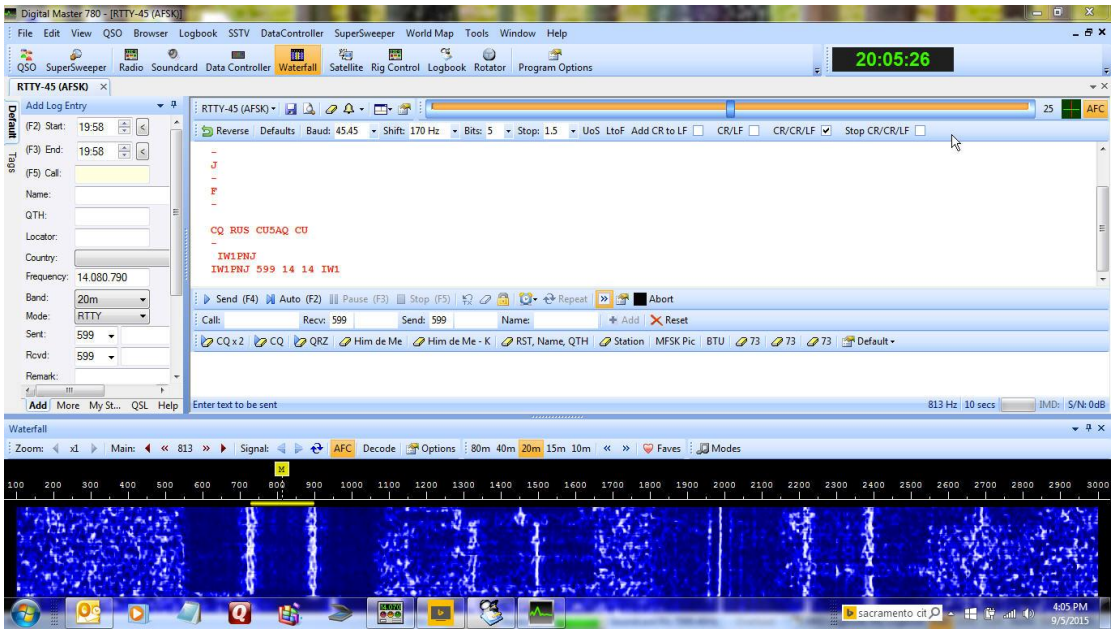

Figure 8.7 : A sample QSO with waterfall display for RTTY signals.

Phase Shift Keying 31

Phase Shift Keying 31 (PSK31) has become the most popular mode of HF digital communications today. It was developed by Peter Martinez (G3PLX) and made available to the amateur radio community in late 1998. PSK31 has been widely accepted since then and most casual conversations in digital mode today are done using PSK31.

PSK31 stands for Phase Shift Keying, the modulation method and the 31 is the bit rate. Unlike the RTTY, the characters are formed by changing the phase of the sound wave and not using different tones. To a normal ear, PSK31 signal sounds like a single tone but with a slight wobble.

PSK31 is a highly efficient data mode that lets the operator work a long distance on a low power and it has become a favourite for QRP operation. Like some other digital modes, it can often overcome interference and work on poor propagation conditions where voice or other methods of communications fail.

Since PSK31 uses narrowband, this mode is suitable in a crowded frequency. PSK31 contacts can be conducted in less than 100Hz separation and at least 20 simultaneous PSK31 QSOs at a time in the 2.5KHz regularly required for SSB voice QSO.

There are many software that support PSK31 and the choice depends largely on personal preference. For those who prefer to have a single familiar interface for working in digital modes, HRD’s DM780 probably the best choice. Others such as DigiPan, Fldigi and WinWrabler might be suitable for casual usage too. For contesting, as for RTTY, a combination of Fldigi and N1MM might be used.

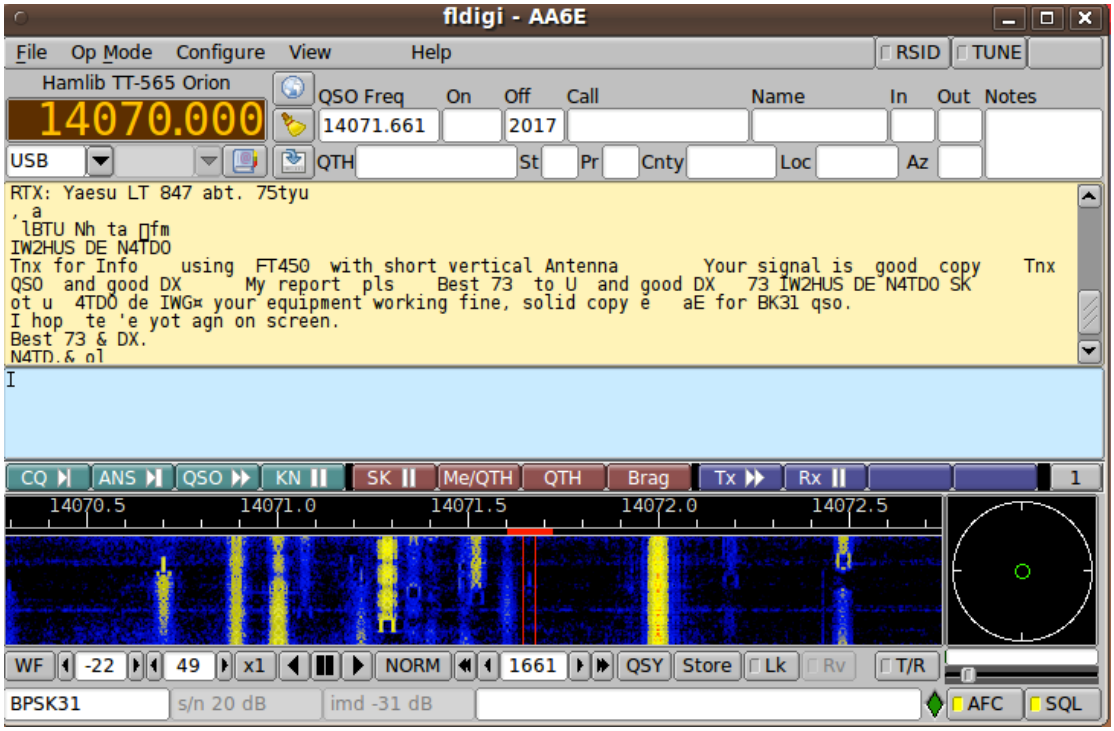

Figure 8.8 : A sample of QSO on PSK31

Multiple Frequency-Shift Keying and Related Modes

Multiple Frequency-Shift Keying (MFSK) is not new but rather late in gaining acceptance by amateur radio operators. MFSK had been predominantly used in diplomatic services and military and the electromechanical equipment used were very expensive. Thanks to the availability of inexpensive PC and sound card combination, this mode has been made practical to be reused for amateur radio usage.

Early MFSK systems were designed for high communications reliability. This electromechanical equipment provided very good performance, robust, sensitive, and reliable with good results in poor propagation conditions without requiring error correction. MFSK was used by British Foreign Office, Belgian and French military among others. There are some military MFSK systems that have similar nature still being used now.

MFSK stands for Multiple Frequency-Shift Keying and it is a variation of Frequency-Shift Keying (FSK) that uses more than two frequencies. MFSK

signal modulation technique involves discrete audio tone bursts of different frequencies, which deliver data.

MFSK works by using comparing narrow tone spacing. This helps to achieve significant data rates for a given bandwidth.

MFSK16 was the first mode that gets revitalized based on MFSK and it was designed by Murray ZL1BPU and first coded by Nino IZ8BLY. The software was first made available in late 1999. MFSK16 has full-time error correction and was designed for a long path DX. It seems to be the best mode for this role till today.

DominoEX was developed to counter the general limitation of MFSK by Murray ZL1BPU and first coded by Con ZL2AFP in 2004. To avoid tuning problems, IFK (Incremental Frequency Keying) is used and data is represented by the frequency difference between one tone to the next, an equivalent to differential PSK. An additional technique called IFK+ (Offset Incremental Frequency Keying) is used to manage the tone sequence in order to counter inter-symbol interference caused by a multi-path reception. This gives this mode a greater improvement and robustness.

Other MFSK modes that have been further developed are Olivia (by Pawel SP9VRC), THOR (by Dave W1HJK), EXChat and FSQ.

Examples of multi-modes software that have MFSK modes built-in are HRD's DM780, MultiPSK and Fldigi. THROB2, HELL-MT63-MFSK, and some others however, are meant to work for a very specific MFSK modes.

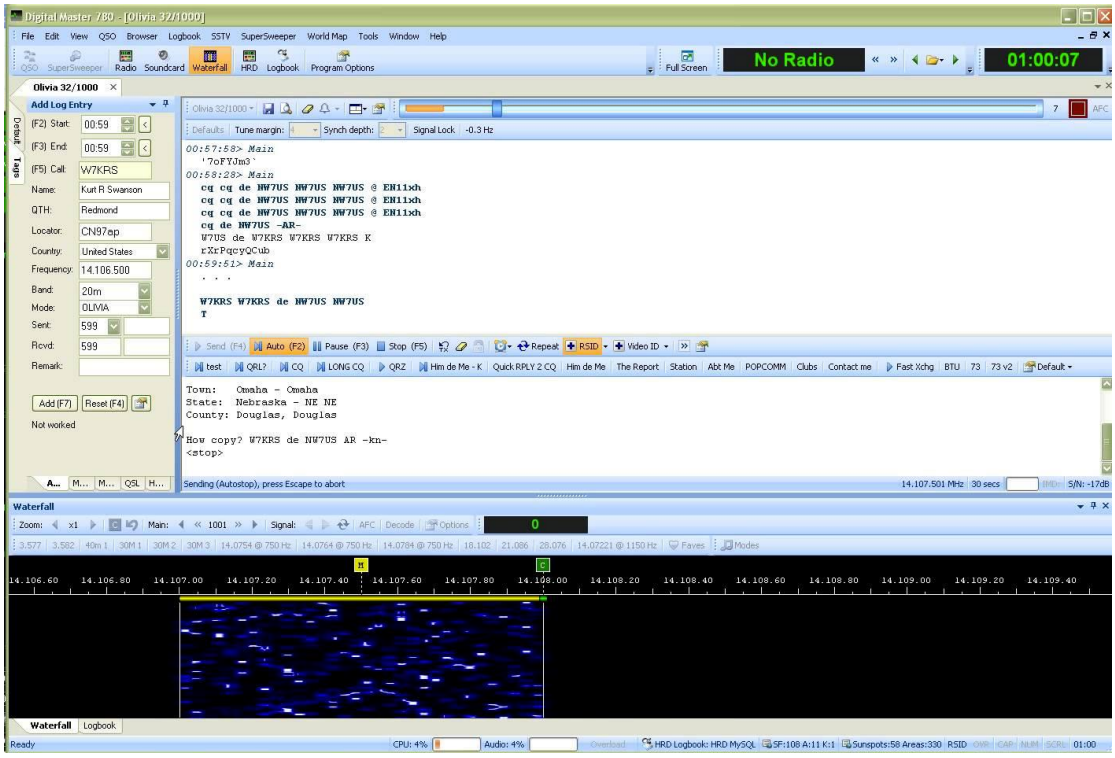

Figure 8.9 : A sample QSO using Olivia32

PACTOR

PACTOR is a new form of data communications mode that combines two earlier digital modes, packet radio, and AMTOR (Amateur Teleprinting Over Radio). PACTOR is used by some amateur radio bulletin boards. It is also commonly used for transferring data, including emails from marine stations.

PACTOR combines the bandwidth efficiency of packet radio with error correction (CRC) and automatic repeat request (ARQ) of AMTOR. PACTOR operates over half-duplex links and uses an ARQ protocol, acknowledging each individual data packet with a short signal. To optimize the data transmission, PACTOR also uses online data compression. Depending on the PACTOR version and the propagation conditions, PACTOR transmission speeds range from 20 to 5200 bits per second.

Various updated PACTOR versions include PACTOR-1, PACTOR-2, PACTOR-3, and PACTOR-4. PACTOR-1 is an open technology and the modems are commercially available. PACTOR-2, PACTOR-3, and PACTOR-4

are the enhanced versions, much faster but are proprietary. The enhanced versions are proprietary, the price is usually out of range for amateur radio operator and only available from SCS only. The enhanced versions also utilize a proprietary data compression technology and without buying a specialized modem, the data transmitted are unreadable.

Most of the multimode software has support for PACTOR but to be able to make full use of the PACTOR and the enhanced version's features, a specialized software is needed. In the year 2000, a gateway system called WINLINK 2000 was developed to be an Internet-to-HF gateway. WINLINK 2000 is a network of participating stations running a client software called such as AirMail and RMS Express which is also known as WinLink Express. The stations are connected to a central server (CMBO) which is the ‘hub' for the Internet connectivity to Internet email and position reporting. Currently, RMS Express is the preferred email client and actively developed by Winlink Development Team. WINLINK 2000 plays a central role in emergency communications messaging too.

Figure 8.10 : SCS PYC-III USB

To be able to access the WINLINK 2000 network, other than the transceiver, one need to get a multimode controller that is capable of using any of the PACTOR versions. For now, this is only available from SCS and its participating dealers around the world.

JT65/JT65-HF

For a normal ear, this mode sounds the most melodic among the rest. Some amateur radio operators even thought that this might be an illegal musical transmission on amateur bands. The tune marches to the beat of a different drummer some may say and it comes in almost a whole minute, stopped for a while and continues again. For someone who gets used to the constant warbling tones of PSK31 or multi-tone music of RTTY or MFSK16, the sound will be pretty strange to their ears.

JT65A was introduced as a weak-signal digital mode which allows the operator to get a contact under the noise of the high-frequency spectrum. The JT65A was conceived by Prof Joe Taylor (K1JT) from Princeton University. JT65A is actually a sub-mode of the original JT65 protocol that was introduced by K1JT and designed to optimized EME contacts on the HF and VHF bands. JT65 includes error-correcting features that make it robust.

JT65-HF is an adaptation of JT65A protocol with emphasis on the usage in the high frequency (HF) amateur bands to facilitate weak signal communications and experimentation.

This mode uses a precisely timed transmit-receive sequences. The transmission should be done in either odd or even minute and takes precisely at one second after the UTC minute. A PC must be synced with an Internet Time server before it can be used for this mode. Software like the JT65-HF HB9HQX has a time synchronization built in and the PC needs to be connected to the Internet for this to work.

A bit different from the rest of the digital modes, JT65A is not a conversational mode like RTTY or PSK31. It is more on exchanges of basic information between two stations.

List of common JT65A frequencies:

Frequency (kHz)	Sideband	Note
28076.0	USB	
24920.0	USB	
21076.0	USB	
18102.0	USB	
14076.0	USB	
10139.0	USB	
7036.0	USB	International
7039.0	USB	Typically Europe
7076.0	USB	USA
3576.0	USB	
1838.0	USB	
1805.0	USB	

Table 8-2 Common JT65A frequencies

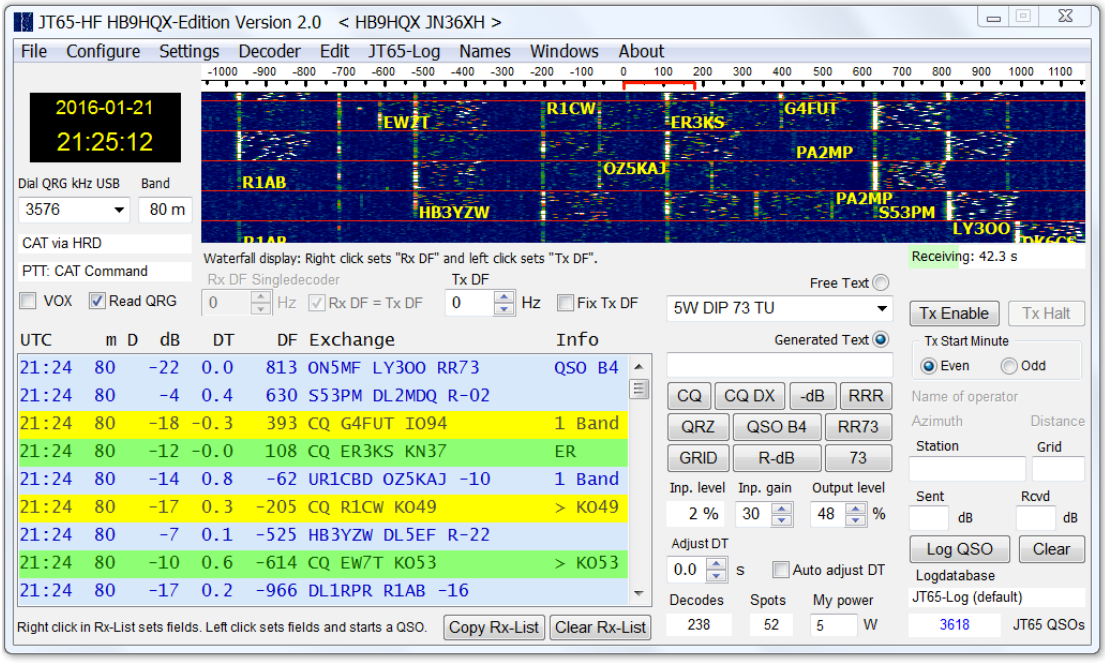

Figure 8.11 : Sample software and ongoing QSO for JT65-HF

Conversation in Digital Modes

The conversation in digital modes is pretty much the same as having a conversation in CW mode. For international operators who are English is not their main language or having difficulties in conversing in full English, most of them will just follow the pre-programmed scripts. Please do not put off when you're not being correctly answered when you ask a question. Using the same abbreviations as used in CW mode will surely helpful most of the time.

Some said, most of the contacts done on digital modes tend to be "rubber stamp" QSOs. As such, some software like HRD's DM780 and Fldigi come with sample scripts and macros which can be used or modified to suit the operator. HRD's DM780 has a quick and simple QSO scripts for sending information like name and location also a long one which includes the working condition of the operator's station. This includes the transceiver, antenna, and power transmitted. They might also have some sample scripts for contesting too.

1. Sample of a quick QSO in digital modes (except for JT65):

1. Calling CQ:

   CQ CQ CQ CQ CQ CQ DE 9M2TST 9M2TST PSE K

2. Answering CQ:

   9M2TST 9M2TST 9M2TST DE 9M2TXT 9M2TXT K

3. Caller replying back with signal report:

   9M2TXT UR RST 599 599 NAME ABU ABU QTH KUALA LUMPUR KUALA LUMPUR HW CPY 9M2TXT DE 9M2TST K

4. Answerer giving back the signal report and end QSO:

   9M2TST UR RST 599 599 NAME CHONG CHONG QTH IPOH IPOH TKS FER QSO 73 CUL 9M2TST DE 9M2TXT SK

5. Caller ending QSO:

   73 CHONG CUL DE 9M2TST SK

2. Sample of a proper sequence of JT65 QSO:

1. Calling CQ with grid location:
   CQ 9M2TST OJ04

2. Answering CQ:
   9M2TST 9M2TXT OJ40

3. Giving signal report (signal report should be automatically given by software):
   9M2TXT 9M2TST -01

4. Giving signal report to caller and end QSO:
   9M2TST 9M2TXT R-01

5. Acknowledge report:
   9M2TXT 9M2TST RRR

6. Answerer ending QSO:
   9M2TST 9M2TXT 73

7. Caller ending QSO:
   9M2TXT 9M2TST 73

3. Sample of a contest QSO in digital modes:

1. Calling CQ:
   9M2TST 9M2TST TEST

2. Answering CQ with just call sign:
   9M2TXT

3. Caler giving signal report and serial number:
   9M2TXT 599 001

4. Answerer giving back report and serial number to caller:
   599 012

5. Caller ending QSO:
   TU 9M2TST TEST

Note: For contesting, the text after the signal report can be a serial number or anything that is defined for each contest rules. Please refer to contesting section for further information.

Tips in Operating Digital Modes

The following tips might help you getting most when operating in digital modes:

1. Do not run more than 20 Watt on the transceiver. Digital modes excel in low power and using more than required might causes interference to others on the band.

2. Regulate the output power using the microphone gain and keep the PC audio output at maximum. Use the line-level output from the PC, amplified output will cause distortion and splatter on the band. The cleanest signal transmitted with lower microphone gain and higher line level output volume from the PC.

3. Do not use speech processing and make sure the ALC is close to 0 while operating in digital modes. Most newer transceivers have DATA mode switchable using DATA button which will disable any speech processing or ALC setting.

4. Make sure that there is no RF coming back into the audio chain as this will cause spurs and interference.

CHAPTER 9 : AMATEUR SATELLITES

Amateur Radio Satellites

An amateur radio satellite is an artificial satellite that is designed, built and used by amateur radio operators for amateur-satellite radio communications service. The satellite can be a dedicated spacecraft for amateur satellite mission, or it can be secondary payload sharing a spacecraft with primary mission which might be commercial, research or educational.

There are many satellites that operate in the amateur radio satellite service. Some are one-way (downlink only) satellite that transmits its telemetry and other mission data, while some are two-way (uplink and downlink) permitting amateurs to communicate with the spacecraft's computers or other amateurs within its footprint in various modes.

Most amateur satellites that fulfil the criteria are assigned with an OSCAR (Orbiting Satellite Carrying Amateur Radio) designation. This designation is issued by AMSAT, which is an organization that promotes the development and launch of amateur radio satellites. Because of this amateur radio satellites are very often referred as OSCARs.

Amateur radio satellites may be used by licensed amateur radio operators for voice (FM, SSB) and data communications.

Types of Orbits

Satellites operate in various types of orbits namely Low Earth Orbit (LEO), Medium Earth Orbit (MEO), Geosynchronous Orbit (GEO) and High Earth Orbit (HEO). Most amateur radio satellites are in LEO and MEO but a few have been launched before in HEO. The differences of these orbits are discussed below:

A satellite in LEO orbits the earth with an altitude between 160 to 2,000 kilometers. Each orbit around the earth takes about 90 - 120 minutes, depending on its altitude.

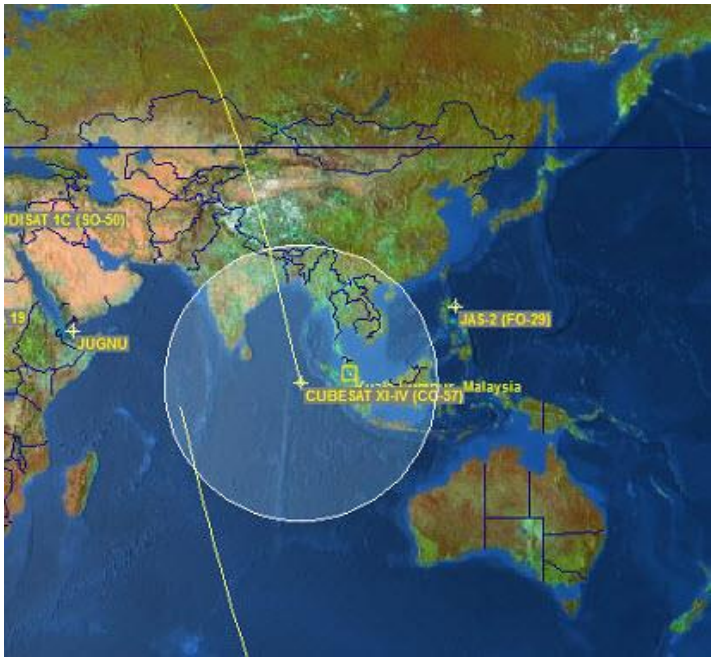

Figure 9.1: LEO satellite footprint sample

A satellite in MEO is defined as those operating above the LEO's altitude of 2,000 kilometers but below that of geostationary orbit of 35,786 kilometers. It is sometimes being called Intermediate Circular Orbit (ICO). Generally, a MEO satellite has a larger footprint and longer pass duration as compared to a LEO satellite.

A GEO satellite is a satellite that orbits the earth at the same speed of the earth's rotation. It is generally positioned at an altitude of 35,786km. This synchronization of rotation and orbital period will make the satellite appear to be exactly at the same position in the sky all the time.

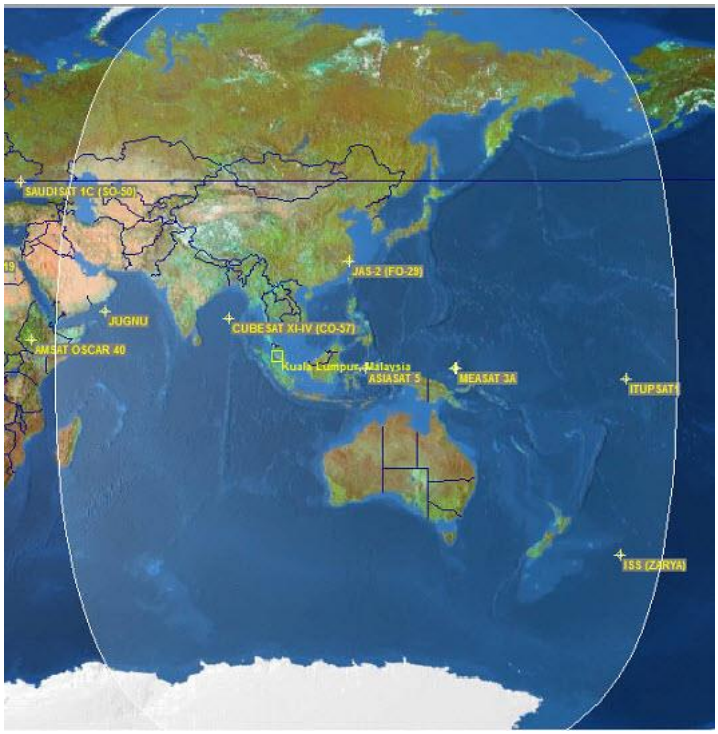

Figure 9.2: GEO satellite footprint sample

HEO is one that operates above the geosynchronous orbit altitude of 35,786 km. Its orbital periods are usually more than 24 hours and to an earth observer, the satellites are moving slower as compared to a LEO. HEOs are more challenging to work due to its distance from earth but can provide longer QSO duration and a much larger footprint that moves between continents.

Figure 9.3: HEO satellite footprint sample

Doppler Shift

Doppler shift is a common effect that must be taken into consideration and be compensated when operating with amateur radio satellites. This is especially for LEO satellites due to its high orbital speed. You can relate Doppler shift to the shift in audio frequency when an ambulance with its siren-on passed you at high speed when you are stationary.

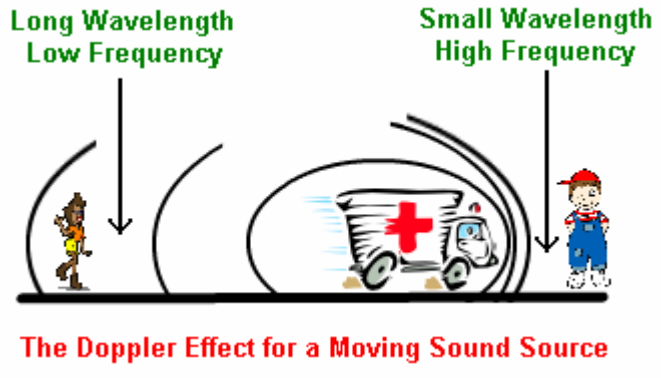

Figure 9.4 : Doppler shift effect

Doppler shift causes the uplink and downlink frequencies of the satellite to vary as it passes over the ground station. Generally, the downlink frequency will start higher from Acquisition Of Signal (AOS) and end lower at Loss of Signal (LOS), while the uplink frequency will start lower from AOS and end higher at LOS. At Time of Closest Approach (TCA), the frequency will be exactly as the published frequency.

It is important for operators to compensate for Doppler shift especially on 70cm and higher bands in order to successfully communicate with the orbiting amateur radio satellites. Doppler shift is generally about +/- 3 KHz on the 2m VHF band, +/- 10 KHz on the 70cm UHF band, +/- 25 KHz on the 1268 MHz band and +/- 50 KHz on the 2401 MHz band.

Operating Modes on Amateur Radio Satellite

Amateur radio satellites operate in various voice as well as data modes. Amateurs as well as research institutes are experimenting with new modes all

the time and therefore, it would be impossible to cover all the modes available. This section would cover the commonly used modes available to get one started on amateur radio satellites.

FM Voice Repeater

FM Voice Repeater is very similar to a traditional ground based terrestrial repeater. Think of it like a moving repeater. It has an uplink frequency in one band and downlink on another. Some requires a PL tone on the uplink to activate and access the repeater. The advantage of this form of transponder is that amateurs with simple FM equipment can work them, and Doppler shift on FM is not as sensitive as compared to linear based transponders.

The disadvantage is that, only one QSO can take place at a particular time. If there are many users, normally only their grid square and callsign are exchanged together with a signal report. It is recommended that users should operate in full duplex mode in order to avoid stepping on top of other transmissions. Operating in full duplex mode will also let you know if you are getting into the satellite or not and how well does the satellite receive your signal.

Linear Transponder

A linear transponder is different from an FM voice repeater type transponder as it allows multiple QSO to be carried out simultaneously over a range of frequencies. Although a linear transponder passes all modes, only SSB & CW or narrow band data modes are allowed to conserve power and for fairness among all users. The use of FM on a linear transponder is strictly forbidden due to its bandwidth and power requirements. The total transponder power allocated is shared among all users of the transponder.

Generally, one should also monitor their own downlink signal when operating through a linear transponder and ensure that their downlink signal is not louder than the available beacon’s signal strength. The downlink signal is propitiated

to the uplink power level of all users of the transponder. Most satellites use a linear inverted transponder which means they need to uplink in Lower Sideband (LSB) and the downlink will be inverted to Upper Sideband (USB).

It is recommended that for an amateur to try out and familiars himself with FM repeater type transponder first before attempting to operate through a linear transponder. A lot of publication is available from AMSAT on how to operate properly through a linear transponder-based satellite. It is recommended for amateurs who are interested to operate through a linear transponder satellite to read up on these document to understand the techniques and procedures for proper operation.

Packet Radio Satellites

There are various satellites that utilize packet radio too. For example, NO-84 and the International Space Station (ISS) feature a UI-Digipeater at 1200 bps which allows amateurs to digipeat APRS formatted AX.25 packets through it. Their function is similar like a standard ground based APRS digipeater.

Previously, there are also satellites that operate the PACSAT Store-and-Forward protocol. They also use packet radio with baud rates of 1200, 9600 and 38,400 bps. Amateurs can uplink and store messages on the satellites and download messages stored by other amateurs. Some satellites also include images from its onboard camera or whole orbit telemetry data.

As the scope of this is too wide and changes all the time, it is recommended for amateurs who are interested in packet radio satellites stay up-to-date with the latest development by joining the AMSAT's Bulletin Board (AMSAT-BB) which is a mailing list reflector by AMSAT, and check out the AMSAT's website.

Ground Station Requirements

The following software and hardware requirements should be taken into consideration in setting up an amateur radio satellite ground station. While many LEO satellites can be operated with a simple arrow antenna that covers the VHF and UHF band, a handheld transceiver and a tablet to track the satellite's orbit. However, the following are items that need serious consideration for a full fledge amateur satellite ground station.

The diagram below shows a block diagram of the various components that make up a satellite ground station that would be discussed.

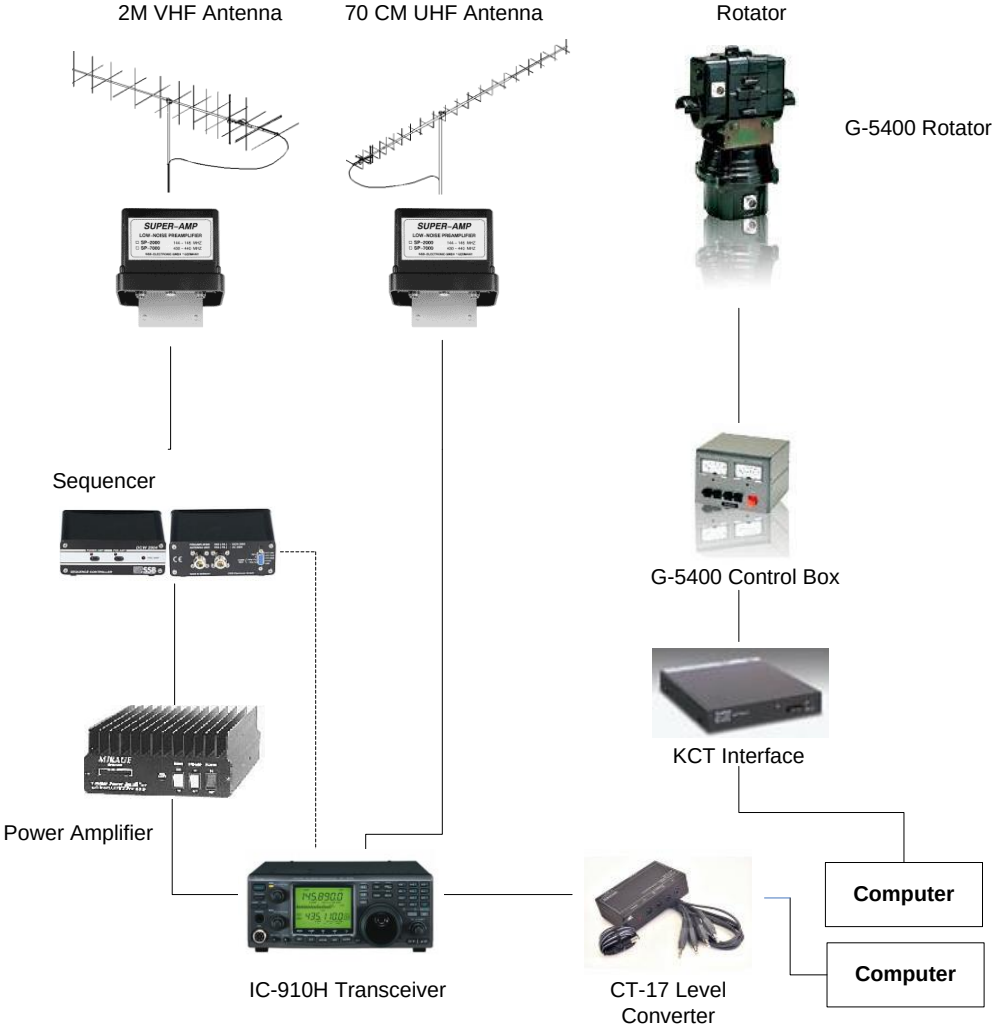

Figure 9.5:Typical amateur radio satellite ground station setup

Software

Software that can predict the path of the satellites of interest is the heart of any satellite ground station. They track the path of any satellite based on the Keplerian elements of the satellite that are fed into the software. At any time, a satellite tracking software is able to provide the azimuth, elevation, next Acquisition of Signal (AOS) and Loss of Signal (LOS) time, its orbit number, and its illumination.

Keplerian needs to be updated often and this is important to get the most accurate orbit prediction. An example of a 2-line Keplerian element for the ISS is shown below:

ISS
1 25544U 98067A 04127.92349537 .00017095 00000-0 14786-3 0 7232
2 25544 51.6276 176.0525 0011067 106.0444 249.6038 15.69246258311835

Satellite tracking software can also provide a list of next passes and plot the coverage footprint of the satellite. Knowing the footprint of the satellite is important as this determines the places that can be reached via the satellite during the particular pass.

There are many satellites tracking software on the Internet, some of which need to be paid after its evaluation period while some are free of charge for amateur use. When selecting a satellite tracking software, one should consider its ability to track the antenna in azimuth and elevation, its ability to compensate the radio for Doppler Shift and the availability of graphical orbit plotting options.

Among the commonly used software are Orbitron, Nova, WISP and SATPC32.

Antennas

As satellites are usually spinning, circular polarization antennas are usually being used for satellite operation. At the time of writing, most LEOs require RHCP (right hand circular polarity) although there are a few that requires LHCP (left hand circular polarity). Getting the correct polarization is important as a difference in polarization can result in more than 20db loss which might result to completely loose the signal.

Example of circularly polarized antennas are the cross Yagi, QFH, eggbeater, satellite dish with patch feed and the helix antenna. The QFH or eggbeater are omni directional circular polarized antennas which work well with the LEOs.

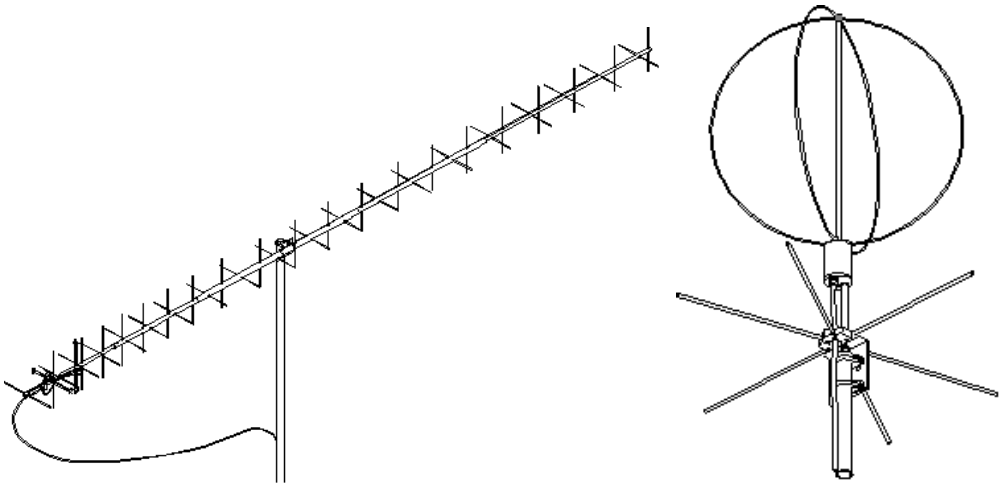

Figure 9.6 : Example of antenna

The commonly used linear polarized antennas can also be used for satellites. In this case, regardless of whether the satellite is transmitting LHCP or RHCP, the user will lose 3db of gain. For a compromise setup, this is somehow acceptable and would still yield reasonable results especially when working with the LEOs. However, the use of circular polarity is highly recommended for serious satellite work, working with HEOs and deep space probes which are launched from time to time.

Transceivers

Although there are many bands with amateur satellite allocation, the most commonly used one are the 10m, 2m, 70cm, 23cm and 13cm bands. With the exception of 13cm, all of these bands can be directly worked with a typical amateur radio transceiver without the need of additional upconverters, downconverters or transverters.

Although commonly used mobile or handheld FM transceivers can be used to work with amateur radio satellites, particularly the FM LEO satellites, satellite-ready radios usually have additional features as below to make satellite operation easier:

1. 10 Hz or less tuning steps – this is important for precise Doppler tracking especially when working with narrow band data signals
2. Normal/Reverse Tracking – the ability to track the downlink and uplink frequency in normal or reverse order when working with linear transponder type of satellites
3. Built in bias-tee for powering mast-mounted pre-amplifiers via the coaxial cable
4. Separate antenna connectors for each band that eliminate the need to use external diplexers when connecting the 2m, 70cm and 23cm antennas.
5. Wide variety of modes such as FM, SSB and CW which allows access to FM repeater type, linear transponder and data satellites.
6. Ability to work full duplex – the ability to transmit (uplink) on one band and listen to your own downlink signal on the other band is very important to avoid causing QRM to existing users and to gauge whetherhow well you are getting into the satellite.
7. The ability to connect to a computer for the automatic compensation of Doppler shift.

Rotators

Rotators installed for use in an amateur radio satellite ground station must be capable of rotation in both azimuth (horizontally) and elevation (vertically). Although amateur have reported success with azimuth only rotation at fixed elevation angles, full azimuth and elevation rotation is recommended in order to take advantage of the full satellite pass from AOS to LOS.

Figure 9.7 :Sample of rotators

When purchasing a rotator for amateur radio satellite use, one should consider a model that is capable to integrate with a computer. This is important so that a computer can be used to track the satellite automatically when it passes over one's QTH. Some rotators can be directly interfaced to a computer using a USB or Serial connection, while others require an external interface.

Pre-Amplifiers

Downlinks from satellites especially Cubesats with low power budget can be weak. Despite the satellite being in line of sight with the ground station most of the time, due to the distance (which can be more than 1000km at times) path loss can be high and this increases as frequency increases. Coaxial cable loss also increases as frequency increases, and this is particularly noticeable on 70cm and above.

Although the best practice states that the coaxial cable should be as short as possible, this is sometimes not practical. High quality, low loss cables could also be costly and difficult to acquire. This is where a mast-mounted preamplifier comes into place.

A mast-mounted preamplifier as its name implies, is an amplifier that is mounted directly underneath the antenna (or as close to the antenna as possible). The main purpose is to boost the incoming signal in order to compensate the coaxial cable loss. It is important that the preamplifier should be mounted on the mast, as close to the antenna as practically possible and not in the shack as a preamp in the shack will amplify not only the incoming signal but also noise picked up between the cable run from the antenna to the shack. One should not assume that a pre-amplifier could be used to compensate low gain antennas or system imperfection.

When selecting a preamplifier, one should take into consideration the ability for the preamplifier to be brought out of the RF patch in case you wish to transmit on that band. Famous models like the SSB SP-2000 and SSB SP-7000 has a RF-VOX feature. These preamplifiers will automatically detect the presence of transmitted RF power and switch the relays offline when you key the transmitter. Other preamplifiers that are capable of higher power handling and those with lower noise figures generally do not have RF-VOX feature built in. It is therefore necessary to employ sequencing to ensure that they are properly bypassed before the transmitter is keyed.

Figure 9.8 : Sample of SSB SP-2000 preamp

Figure 9.9 : Internal of SSB SP-2000

Downconverters

Downconverters are devices used to convert an incoming frequency to a lower frequency. For example 2400-2402 MHz is down converted to 144-146 MHz.

In amateur radio satellite applications, it is mainly used on the 13cm band and higher to convert these high range of frequencies to something that fall in 10m, 2m or 70cm bands. The use of downconverters are useful on the higher band where in case you do not have transceivers or receivers that are capable of receiving these high frequencies directly or when the high cable cost and loss make it impractical to carry these signals directly down to the shack.

A low noise preamplifier is usually integrated with a low noise downconverter in one package, and this should be mast-mounted to take advantage of its usefulness to compensate the points discussed above. Unlike a mast-mounted preamplifier, downconverter does not allow transmitted RF power to pass through them, so prevention should be taken to avoid accidental transmitting into a downconverter if they are connected to a transceiver.

A commonly used downconverter that converts 13cm to 2m and cover the 2400-2402 MHz amateur satellite allocation is the SSB UEK-3000.

CHAPTER 10 : LEGALLY, SAFELY AND APPROPRIATELY

The 3 main keywords that allow each radio amateur to enjoy their on-the-air experience – **Legally, Safely and Appropriately**.
Each radio amateur has a responsibility to operate their station within the rules and regulations that govern the Amateur Radio Service **(Legally)**. They are also required to ensure that the activities carried out will not pose harm to themselves and others **(Safely)**. Finally, each radio amateur is required to ensure that their on-the-air activities are in keeping with the operating standards set by the rules of the country as well as the standards developed within the amateur radio community over time **(Appropriately)**.

The Amateur Radio Spectrum

The electromagnetic spectrum is a finite resource that fortunately cannot be depleted. It will be restored to normal once the use of it is stopped. Changes to the use of radio spectrum are possible and it is not static. Its usage may change according to changes in needs. These changes evolve with technological innovation and advances. There can be changes in frequency bands allocated to the amateur radio service. There can also be changes in how these bands are used.

Amateur Radio in Malaysia is endowed with a wide range of bands from 0.135MHz and up to 250GHz. However, please note that the use of radio amateur frequency in Malaysia is subject to MCMC's approval. Operators will enjoy a wide range of bands with propagation of every type. To operator's benefit, radio propagation determines the distance a signal can travel. Some frequencies may be reused many times around the world.

International Regulation of the Spectrum

Amateur Radio frequency band allocation doesn't happen overnight. Band allocation proposals must go through a myriad of steps from national agencies (i.e. MCMC) to international bodies (i.e. IARU Region 1/2/3) and International

Telecommunication Union (ITU) before being agreed upon and accepted into a Regional Band Plan.

Nations sign treaties and agreements amongst themselves and within the United Nations framework. ITU was founded in Paris in 1865 by the first International Telegraph Convention, which agreed upon conventions and regulations to be used for Telegraph. ITU holds Plenipotentiary Conferences once every four years that is empowered to determine the following:

1. Determine general policies of the Union
2. Revise the Convention if required
3. Elect Members of the Union to serve on ITU Council
4. Elect a Secretary General, Deputy Secretary General, Directors of the Bureaus and Members of the Radio Regulations Board

Apart from Plenipotentiary Conferences, ITU World Radiocommunication Conferences (WRCs) are held every few years. Agendas are agreed at the previous WRC and confirmed by the ITU Council. Many issues are contemplated at these conferences. Examples include the creation of 30m, 17m and 12m Bands in 1979, 7MHz – 7.2MHz worldwide allocation in 2003 amongst others.

Telecommunications Regulation within Malaysia

In Malaysia, all telecommunications and related regulations are governed by the Malaysian Communications and Multimedia Commission (MCMC). MCMC is the regulator with regards to telecommunications (radio and otherwise) in Malaysia. The Law of Malaysia that governs communications and multimedia industries is referred to as **Communications and Multimedia Act 1998 (Act 588) and Communications and Multimedia (Spectrum) Regulations 2000.**

Amateur Radio Operator's Certificate (AROC) in Malaysia

There are 3 Classes of AROC available – ***Class C, Class B and Class A***. One begins with a Class C, progresses on to Class B and ultimately Class A. Examinations are administered each step of the way as a requirement to obtain the AROC. All examinations Radio Amateur Examinations (RAE) are administered by MCMC. For more information, please refer to the latest **Guidelines for Amateur Radio Services in Malaysia.**

Upon passing the RAE examinations, you can then apply for Apparatus Assignment (AA) in order to obtain callsign corresponding to the examination that operator has passed. Guidelines for AA and Callsign are published in MCMC website namely, **Guidelines for Apparatus Assignment** and **Guideline on the Allocation of Call Sign to the Amateur Radio Service** respectively.

MCMC maintains AA information in a centralised database. AA holders can check their AA information online via MCMC website.

Call Sign Structure

The International Telecommunication Union (ITU) is an organisation that sets the standards for prefixes and formation of Callsigns on the various radio services worldwide. According to the ITU Radio Regulations, an amateur radio callsign must start with one or two letters as a prefix (sometimes the first or second character might be a number – as in 9M & 9W is for Malaysia). The prefix is followed by a number indicating a callsign district or area and then a suffix of not more than 3 letters. The allocation of international call sign series can be referred to Appendix-42 of the Radio Regulations.

In Malaysia, Class A amateurs have callsigns starting with 9M whilst Class B & Class C amateurs have callsigns starting with 9W. Please refer to the **Guidelines for Amateur Radio Service in Malaysia** on allocation of callsign for Amateur Radio Service.

Should an amateur radio operator travel from one region to another, they can still use their callsign with a prefix of current location in front of their home callsign. For example, 9M8/9M2 for a call area 2 amateur transmitting in a 9M8 area.

Station Operating Standards

The licence is not the most important piece of paper you receive in Amateur Radio. The most important is your first QSL Card where it has a written confirmation from another station that you have completed a two-way transmission or contact with them.

The first QSL Card shows that not only have you learned what is required to pass the examinations for a licence BUT that you have put the knowledge that you have learnt into use, got on the air and participated. This is important and critical in pursuing Amateur Radio legally, safely and appropriately.

The latest **Guidelines for Amateur Radio Service in Malaysia** published by Malaysian Communications and Multimedia Commission lays out the responsibilities of each amateur licensee. Each amateur station is required to be operated in accordance with good engineering and good amateur practice. This means that each amateur radio operator must learn how to conduct himself or herself in a proper manner, cooperate with fellow amateurs and treat each and every operator with respect and decorum.

One of the most common problems that operators experience is congestion on the air. Trying to find a clear frequency on 20m SSB or 40m SSB on a busy night or weekend can be a real challenge. Likewise, finding a clear VHF frequency on 2m in places such as Kuala Lumpur and its surrounding areas can be a challenge. Effective use of the spectrum requires the cooperation of each and every operator. This is equally true during years of low solar activity when poor high band propagation drives everyone to the lower bands or during

years of high solar activity where the bands are filled with amateurs coming out of the woodwork to enjoy and take advantage of the good conditions.

Please note that no one individual or group is assigned a frequency for exclusive use. As such, the orderly sharing of frequencies have emerged. Known as voluntary band plans, these are not hard and fast rules but rather guidelines for what type of amateur activity should take place in various parts of the spectrum.

Band plans vary from region to region especially on the VHF and higher band. Taking the time to find out and following the band plan for activities and modes that interest you may be worthwhile. When there is cooperation and guidelines / band plans are followed and adhered to, it allows for all amateurs to have a more enjoyable time on air.

One of the least observed and most overlooked areas of good practice is that Amateur Stations must use the minimum transmitter power necessary to carry out the desired communications. Following this rule operator will be able to conduct the QSO without emitting unnecessary interference to others on crowded bands. Please be considerate.

Interference

Interference between amateur stations can be reduced but not eliminated completely through voluntary restrictions. There are other types of interference but this section is referring to interference between one amateur station and another and it is not interference to consumer electronic devices or to non-amateur intruders into exclusive ham radio bands.

Except when it involves and concerns emergency communications, amateur to amateur interference is permissible. Every amateur radio station has an equal right to operate irrespective if you have used the same frequency every certain time of a day for a certain long period of time. You do not have a legal right to

the frequency to it than the person who have just received their licence recently. The rules specifically prohibit malicious interference.

Radio amateurs have the privilege and right to pursue legitimate objectives that are within the privilege granted to them by their licence. They also have the obligation to minimise inconvenience and loss of enjoyment to other radio amateurs.

Reciprocal Operating Within Malaysia

Under certain circumstances, it is legal for a foreign licensed radio amateur to operate while visiting Malaysia if reciprocal arrangement exists. In Malaysia, MCMC may issue the appropriate reciprocal assignment (reciprocal license) to the foreign amateur radio operator if the operator meets all the requirements and conditions. The class of the assignment will be equivalent to the foreign license class issued by the authority in the operators original home country.

For more information, please refer to the latest **Guidelines for Amateur Radio Service in Malaysia** published by MCMC**.**

Station Identification

The simple reason why stations must transmit their callsign is so that people will know whom they are talking to. In addition, unidentified transmissions are prohibited. The rules are very straightforward in this area. Furthermore, callsigns should be use once every 10 minutes for simplex transmission and once every 3 minutes for transmissions through a repeater. In addition, callsign should be use at the beginning and at the end of a QSO.

Additional rules that need to be followed :

1. You should transmit your station ID using the same mode in which you are communicating.

2. When conducting an international third party contact, you must give both your callsign and the callsign of the station with whom you are communicating with.
3. If you are transmitting the station ID of an automatically controlled station using CW, the speed should not exceed 20 WPM.

Frequency Bands

Frequency bands are allocated for use by Amateur Radio Service in Malaysia either on a primary or secondary service basis. Please refer to Spectrum Plan in MCMC website.

Band plan development is an ongoing process and it requires research and feedback from amateurs before arriving at something that will serve the need of the diverse amateur community and a band plan is adopted. This process may take years on both national level and at International Amateur Radio Union (IARU). Nonetheless, new modes or the popularity of existing ones can render a recently adopted band plan looking outdated or obsolete.

Changes in new digital modes have taken place at a fast pace necessitates that national Amateur Radio societies and regulators, MCMC and IARU to monitor and keep abreast with the advances in technology.

Providing Emergency Communications

One of the basic purposes of Amateur Radio Service is to provide emergency communications. Due to its importance, radio clubs and associations worldwide as well as regulatory agencies for instance MCMC in Malaysia, frequently hold ENCOMM simulations exercises, GoBox competition and other related activities.

Internationally, it is widely accepted that in the event of an emergency where life or property are at risk, there is no restriction that prevents the licensee from using Amateur Radio to try to obtain assistance or relief required. A station in

distress should use any means at its disposal to attract attention, make known its condition and location, and obtain assistance.

This however, is not a complete freedom to do anything that you may want to do. You still have a responsibility to act in a responsible manner irrespective. There are records of enforcement actions imposed worldwide involving stations that *"cried wolf"* or made false claims. The regulators have placed great trust in amateurs by allowing them great latitude during emergencies. This does not mean one can act as one wishes during these situations.

Summary

The wide variety of bands, modes and activities in Amateur Radio available can be overwhelming. At all times you have to ensure that you are operating your station legally, safely and appropriately. This in itself is no small nor simple task. While the regulations can seem daunting, answers to all this can be found in documents published by MCMC.

This chapter is not meant to provide an elaborate nor exhaustive detail or each and every rule and regulation. It's intended to address the most commonly asked questions. Each amateur is encouraged and recommended to have a copy of the latest **Guidelines for Amateur Radio Service in Malaysia** and ensure that you understand what is written in it.

CHAPTER 11 : OPERATING AWARDS

Making contacts over the air and the subsequent exchange of QSL cards is one of the highlights of amateur radio operations. Resulting from the exchange of QSL cards, the hunting for Awards furthers the reward of Amateur Radio operations. It is one of the major motivating forces behind many contacts that occur through Amateur Radio each day. To qualify for and be rewarded with a certificate or plaque that signifies one's achievement and have it hanging from one's radio shack wall takes perseverance and some skills. It also makes receiving such awards very gratifying and offers a sense of achievement.

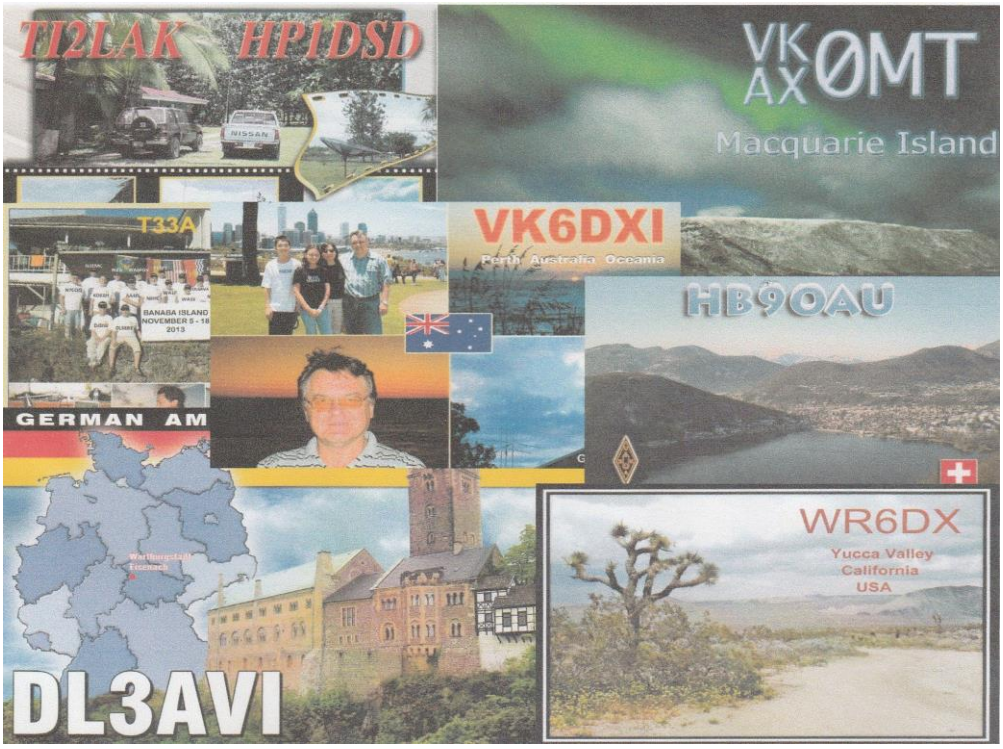

Figure 11.1 : A variety of QSL Cards from around the world received by the author

Almost every country offers awards and chasing the various awards on offer by the many organisations / countries that offer them also expands the knowledge of geography, history and political structure of countries around the world. This chapter serves to highlight the various awards on offer in Malaysia as well as some of the more interesting awards on offer throughout the World.

Application for Awards

To apply for awards, one needs to make an application to the body that offers the award. Forms are normally available through the website of the body offering the award. Fees may be applicable to cover for printing as well as postage. If none is mentioned, it is good practice to enclose an Self-Addressed Stamped Envelope (SASE) for the return postage of the award certificate or in the case of foreign countries, a self-addressed envelope with International Reply Coupon (IRC) which is available from your local post office. Most Award Managers are volunteers so be patient as they may take some time to reply.

Should QSL cards be required with your application, send them in the safest possible way and include sufficient postage for their return. With advances in technology, scanned copies are accepted these days. Always send QSL cards that contain your callsign and other information that substantiates your QSO. Do not send cards that have been altered, have information marked over or crossed out even if this is done by the originating amateur radio operator. These cards are normally not acceptable for awards purposes. Secure a replacement card should they occur. These are helpful tips to ensure there are no delays in receiving awards applied for and in no way meant as a hindrance.

Malaysia Awards

To make Amateur Radio QSOs interesting and more enjoyable, Malaysia Amateur Radio Transmitters' Society (MARTS) as a member of IARU Region 3, issues the following awards to amateur radio operators worldwide:

1. Worked All Malaysia Award
2. Malaysia Century Club Award
3. Malaysia Worked All States Award

These awards are meant to encourage amateur radio operators worldwide to make contact with Malaysian amateur radio operators and also to promote

Malaysia to the world. The awards are also meant to educate amateur radio operators from other countries about Malaysia and its' political structure and also geography and history. These awards are further elaborated in later sections. Application for these awards is to be made to MARTS and application forms and fees payable may be obtained through MARTS website.

1. Worked All Malaysia Award

The Worked All Malaysia Award is available to all amateurs worldwide who submits proof of having QSOs with at least two the following:

1. 9M2 (Peninsular Malaysia Class A)
2. 9W2 (Peninsular Malaysia Class B)
3. 9M6 (Sabah Class A)
4. 9W6 (Sabah Class B)
5. 9M8 (Sarawak Class A)
6. 9W8 (Sarawak Class B)

2. Malaysia Century Club Award

The Malaysia Century Club Award is available to all amateurs worldwide who submits proof of having QSOs with the following:

1. 9M2 (Peninsular Malaysia Class A) – 20 QSOs
2. 9W2 (Peninsular Malaysia Class B) – 30 QSOs
3. 9M6 (Sabah Class A) – 10 QSOs
4. 9W6 (Sabah Class B) – 15 QSOs
5. 9M8 (Sarawak Class A) – 10 QSOs
6. 9W8 (Sarawak Class B) – 15 QSOs

3. Malaysia Worked All States Award

The Malaysia Worked All States Award is available to all amateurs worldwide who submits proof of having QSOs with all Class A & Class B amateur operators (9M & 9W) from all 13 states and 3 Federal Territories in Malaysia.

The states are Perlis, Kedah, Pulau Pinang, Perak, Selangor, Negeri Sembilan, Melaka, Johor, Kelantan, Terengganu, Pahang, Sabah & Sarawak. The Federal Territories are Kuala Lumpur, Putrajaya & Labuan.

Award Conditions & Eligibility

These 3 awards include endorsements for various modes and bands.

To earn the basic award, establish two-way communications on the amateur bands with the six different geographical and classes of amateurs in Malaysia. There is no minimum signal report required and any or all modes and amateur bands may be used for the general award.

Contacts must all be made from the same geographical location. Club Station applicants must include the club name and callsign of the club. There is no time limit on the period of contacts made. Scanned copies of QSL cards may be submitted provided all information on both sides of the QSL card are scanned.

Endorsements to be included in the award must be made at the time of application or else a general award will be issued. Endorsements that are currently offered include CW, QRP, Packet, EME and any single band or mode. QRP is defined as 5W PEP output as used by the applicant and is affirmed by signature of the applicant on the award application. Contacts made through “repeater” devices or any other relay method is not acceptable for award confirmation. A separate award is available for satellite contacts. All station contacts must be “land stations”. Contact with ships (maritime mobile) docked or otherwise and aircraft (aeronautical mobile) cannot be counted. Exceptions

are given for permanently docked exhibition ships as they are considered land based in the state where they are permanently docked.

MARTS reserves the right to “spot call” for inspection of QSL cards at MARTS expense. This serves not to question the integrity of any individual, but to ensure the overall integrity of the award program.

False statements on the award application or submission of forged or altered QSO cards may result in the rejection of the award applied. MARTS will not attempt to determine the person responsible for the alteration of any QSL cards. Please do not submit altered cards. The decision of the MARTS Awards Committee in such cases is final.

American Radio Relay League Awards

American Radio Relay League (ARRL) is the national association for amateur radio in the United State of America (USA). Founded in 1914, they offer many awards to be attained by amateur radio operators throughout the world. Amongst the more recognisable and prestigious awards offered by ARRL are as follows:

1. Worked All States Award
2. Worked All Continents Award
3. DX Century Club Award
4. DXCC Challenge
5. 5 Band DXCC Award
6. QRP DXCC Awards

Figure 11.2 : A selection of Awards from ARRL

There are many more awards on offer by ARRL currently. The above are the more prestigious and sought-after awards by amateurs in the USA and worldwide alike.

RSGB Islands On The Air – IOTA

Islands On The Air (IOTA) was created by Geoff Watts in the mid-1960s and subsequently taken over by RSGB (Radio Society of Great Britain) in 1985. The IOTA Program consists of 21 separate awards and can be claimed by any licensed radio amateur eligible under the General Rules.

The basic award is for working stations located on 100 islands / groups. Subsequent higher achievements for working 200, 300, 400, 500, 600, 700, 800, 900 and 1000 islands / groups are available. There are also seven continental awards including Antarctica and three regional awards: Artic Islands, British Isles and West Indies, for contacting a specified number of islands / groups in each area.

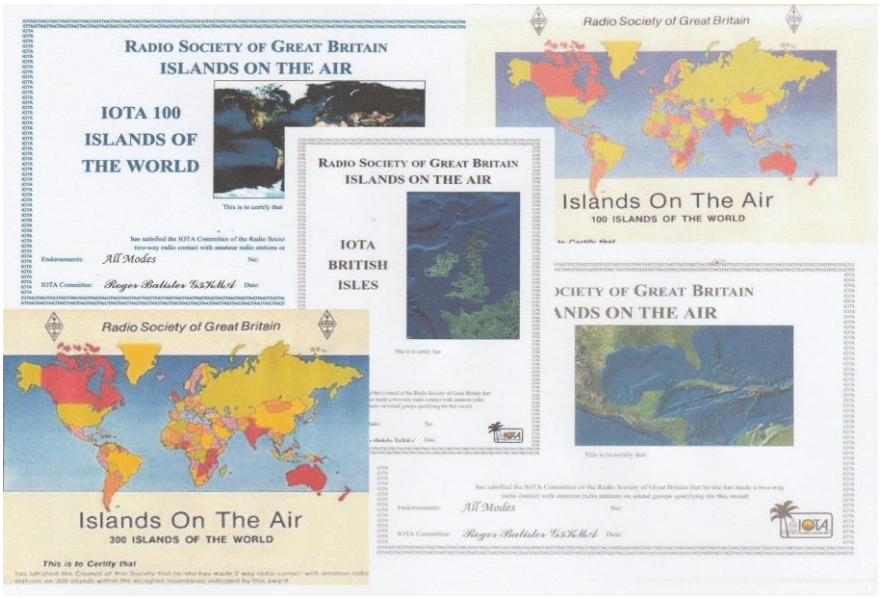

Figure 11.3 : Selection of Awards given by RSGB IOTA

CQ Magazine Awards

CQ Magazine is one of the world's leading amateur radio magazine, with an emphasis on operating, DXing, contesting, propagation, public service amongst others. In addition, *CQ* Magazine sponsors a wide variety of operating awards and on-air contests, and publishes a broad range of amateur radio books, CDs, DVDs and other products for the amateur radio community. Amongst the many awards sponsored by CQ Magazine, the more popular awards are as follows:

1. Worked All Zones (WAZ) Award
2. CQ DX Awards Program

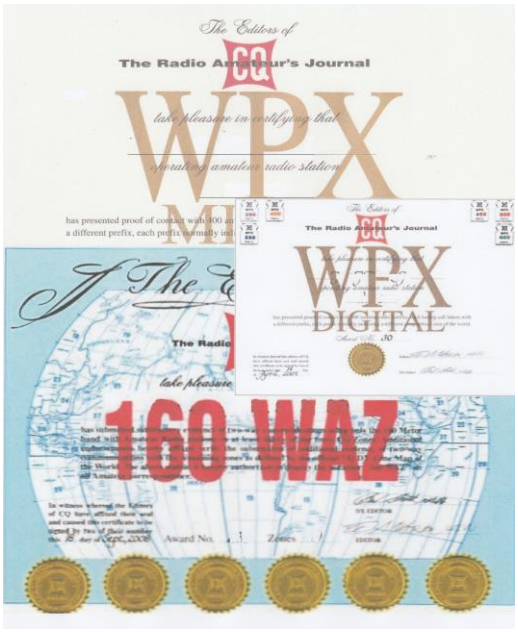

Figure 11.4 : Selection of Awards issued by CQ Magazine

Conclusion

Collection and chasing for awards remains one of the activities participated by most amateur radio operators worldwide and while the mechanics of applying for the awards remain largely unchanged, the advances in technology have meant that some processes are now done on-line instead of via post. Apart from chasing awards, there is also the hobby of chasing DXCCs. Ultimately, the chasing of DXCCs relates back to one of the awards mention in earlier parts of this chapter.

Malaysia is one of the more unique countries in the world of amateur radio. The country is split into two regions which are West Malaysia (ASIA) and East Malaysia (OCEANIA). What this means is that Malaysia has 2 DXCC in one country. This is indeed unique and though Malaysia is not the only country to have this phenomenon, there are very few countries in this world that this phenomenon occurs.

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