HAREC on the Hacker Public Radio Podcast

A presentation for OggCamp 2024, by Ken Fallon

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Hacker or Ham ?

It's complicated

- B. Tech Production Engineering (Computer Aided Manufacturing)
- Left education, started learning
- Switched into IT
- Became a European Infrastructure Manager for the EMEA region
- Moved from IE → UK → NL
- Designing IP TV Platforms - still at it
- Found Podcasting
- Submitted shows to Today with a Techie which renamed to HPR
- Volunteered to help out in 2010
- Got my Amateur Radio License during Lockdown

HPR HACKER PUBLIC RADIO

https://HackerPublicRadio.org

THE COMMUNITY PODCAST

SHARING YOUR IDEAS, PROJECTS, OPINIONS SINCE 2005

New Episodes Every Weekday

Pocket Casts
Podchaser
Apple Podcasts
AntennaPod
Player FM
gPodder
M—XCLOUD
radio.net
LISTEN NOTES
iHeart RADIO
Overcast
amazon music
Firefox
Spotify

THE COMMUNITY PODCAST

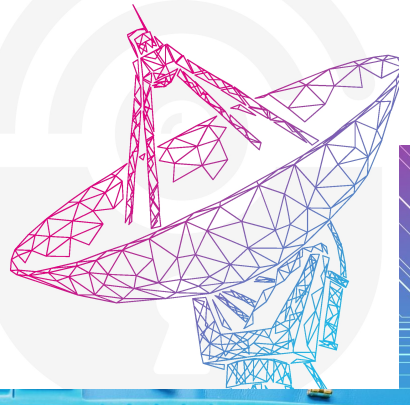
SHARING YOUR IDEAS, PROJECTS, OPINIONS SINCE 2005

New Episodes Every Weekday

- Everything is Free Culture Licensed
- 19 years, 25 days
- 2 months, 29 days, 16 hours play time
- 120,000 unique monthly subscribers
- 33,584 unique monthly downloads
- 363 people have contributed shows
- 4,560 episodes
- 6,504 unique tags
- 90 in depth series

Hackers and HAM

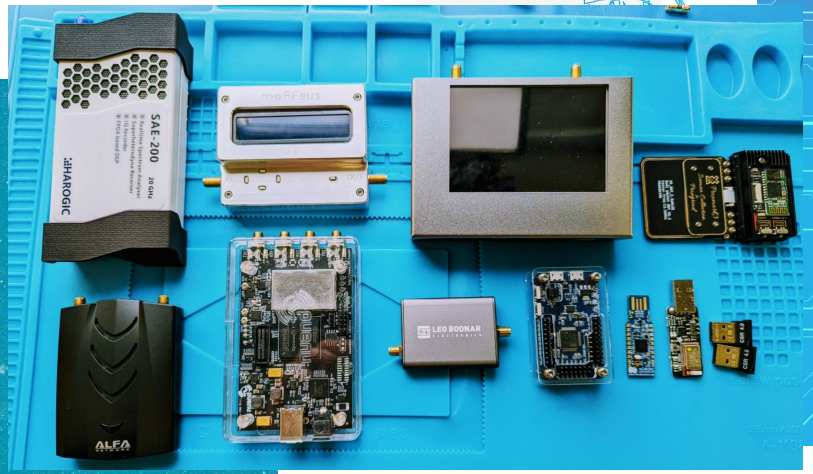
penthertz

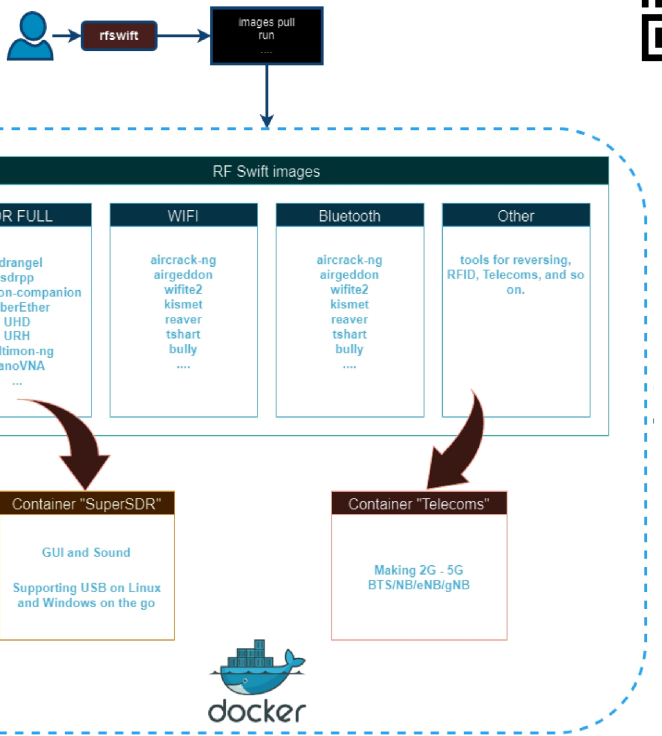


RF Swift: a swifty toolbox for all wireless assessments

By Sébastien Dudek

Spectrum 2024





contact@penthertz.com

+33 1 73 13 82 77

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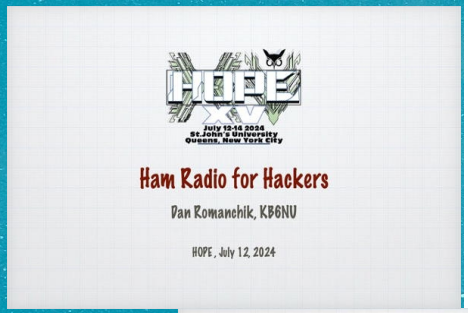
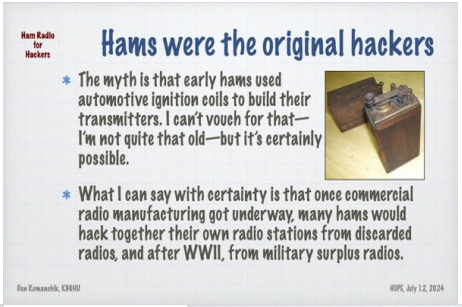
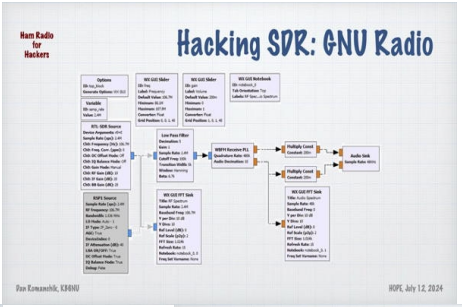
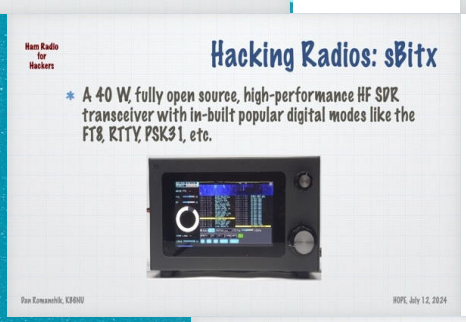
Watch us on YouTube

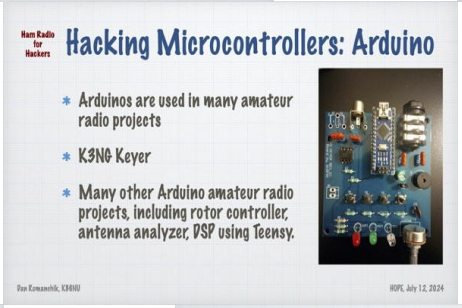
HAM and Hackers

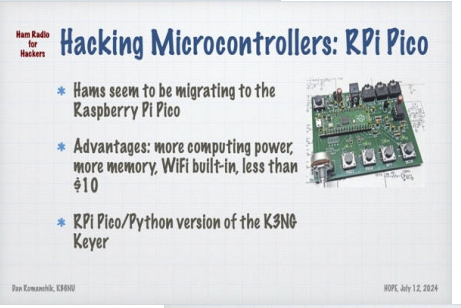


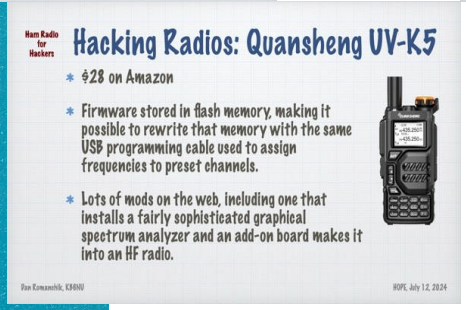


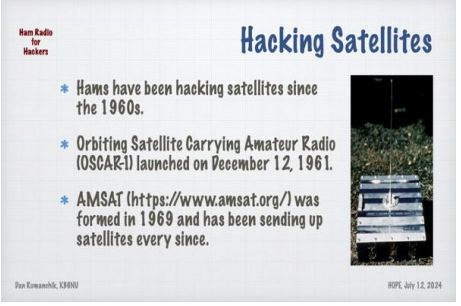


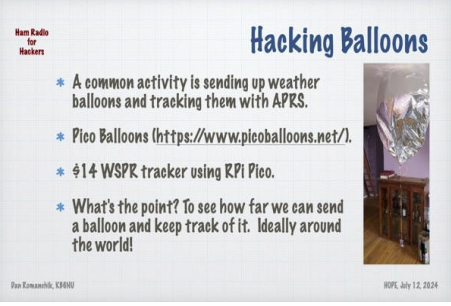












HAM Topics

All things Amateur Radio/HAM Radio

- A DX with HB9HNT
- A First Look at the Owon B35T
- Amateur Radio Round Table
- Arduino Bluetooth HOWTO
- Arduino Breadboard
- Arduino controlled Christmas lights
- Arduino IO
- Arduino Pumpkin
- Bad Caps
- Baofeng UV5R VHF/UHF Handset
- Battery
- Blinking LED
- BlinkStick
- Building a Digital Clock Kit
- building an arduino programmer
- D1 Mini Close Lid to Scan
- Electronics Calculator Kit
- Engineering Notation
- Explaining the controls on my Amateur HF Radio
- First impressions of the Odroid-go
- Fixing cloc events in GBA pokemon cartridges
- Gathering Parts
- Ham Radio testing
- International Troubleshooting
- Kickstarter Omega2 Plus first time setup walkthrough
- Little Meters
- Low Tech Fab (PCB Etching)
- Making Waves-The DSO Pocket Oscilloscope
- Multimeter Mod's
- my chicken coop
- My journey into Amateur Radio
- Phonetic alphabet
- Pinball Machine Repair Tips
- Post Apocalyptic 4s5 Battery Pack
- Practical Math - Introduction to Units
- Practical Math - Units - Distances and Area, Part 1
- Practical Math - Units - Distances and Area, Part 2
- QSK: Netcast
- Radio Thermometer
- Raspberry Pi Temperaturator
- Raspberry Pi Zero W
- Replacing backup batteries in my Kenwood HF Radio
- Silent Key
- Soldering Tips
- Some stuff I bought at a recent amateur radio rally
- Sump Minion
- The Abominable Post Apocalyptic Podcast Player
- The Conference for Creative Use of the Radio Spectrum in Open Systems
- The DSO138 Oscilloscope Kit
- The Kenwood TS940S Automatic Tuning Unit
- Tuning around the HF 40Mtr band
- Undocumented features of Baofeng UV-5R Radio
- UNI-T UT61E Review
- Video conference Push to Talk
- What's in my ham shack
- What's in the Box!
- Windmill is on the Fritz
- World of Commodore 2019
- z80 membership card

Future shows ?

Now I owe HPR a show !

- Home Cinema
- Radio-controlled clock (RCC)
- Plug-In Wall Sockets
- RF Keyboard/Mice
- Weather Stations
- Garage Door Openers
- Solar Panel, Inverters
- Car Keys
- Satellite TV
- Vibration of Passing Trains
- Noise of Passing Aircraft ADS-B
- Penetration Testing
- Traffic Message Channel (TMC)
- Zigbee
- Z-Wave
- Matter
- Thread
- Bluetooth
- Wifi
- Infrared
- 433mhz Remote Control
- Energy Meters

Why an Exam ?

The real reason why you need a license

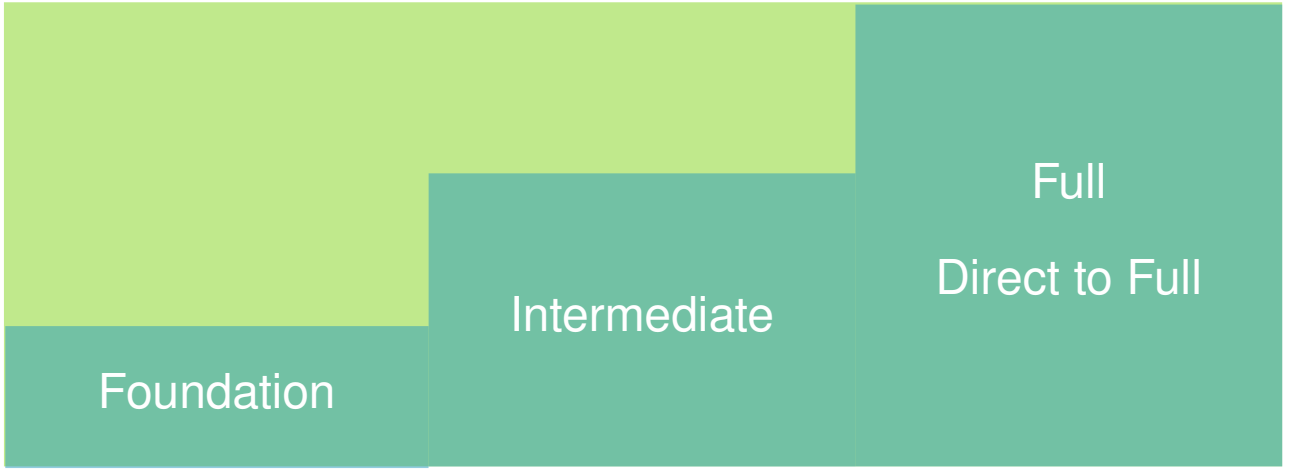
- So that you don't interfere with other users
- So they know **who you are** and so they can **shut you down**.
  - Military use Spectrum
  - Companies **pay** a lot for Spectrum
- So you won't kill yourself
- So you won't kill others
- So you don't need to have certified equipment
- So you can use more power
- So you prove that you meet the base line of knowledge that every Amateur Radio operator is expected to have to get a license. All technical discussions, documentation, etc assumes you have this level of knowledge.

Winning bidder	Spectrum won	Base price
Everything Everywhere Ltd	2 x 5 MHz of 800 MHz and 2 x 35 MHz of 2.6 GHz	£588,876,000
Hutchison 3G UK Ltd	2 x 5 MHz of 800 MHz	£225,000,000
Niche Spectrum Ventures Ltd (a subsidiary of BT Group plc)	2 x 15 MHz of 2.6 GHz and 1 x 25 MHz of 2.6 GHz (unpaired)	£186,476,000
Telefonica UK Ltd	2 x 10 MHz of 800 MHz (coverage obligation lot)	£550,000,000
Vodafone Ltd	2 x 10 MHz of 800 MHz 2 x 20 MHz of 2.6 GHz 1 x 25 MHz of 2.6 GHz (unpaired)	£790,761,000
Total		£2,341,113,000

Learning Curve

"Did you get your Ticket ?" - the RTFM of the HAM world ?

Elmer: Happy to help ! Cut the wire to length, the check the ????? and the ????? against the response of your ?????..



Noob: I would like help with this seemingly simple radio task.

HAM Series

A listeners expectations coming to the HPR HAM Series...

Personal

Everything I need to pass my exam.

HAM Series

The logical outcome of listeners expectations with a global podcast...

Personal

Everything I need to pass my exam.

Global

Material for every level, on every topic, in every language, in every exam, in every region.

HAM Series

What we need...

Personal

Everything I need to pass my exam.

Common

Topics from a common syllabus covering the majority of topics common to all exams.

Global

Material for every level, on every topic, in every language, in every exam, in every region.

Goal

Produce training material that **anyone can use** and improve upon,
without needing to pay, sign-up for, or ask **permission**,
covering **all topics** needed to pass the Amateur Radio **Exam**,
in **every region** of the World,
on **beginner**, **intermediate**, and **advanced** exam levels.

Starting as audio **podcasts** in English,
having supplemental, text, diagrams, animations, videos as required,
with the intention of supporting every language in the World.

European Conference of Postal and Telecommunications Administrations
– 46 European countries cooperating to regulate posts, radio spectrum and communications networks

HAREC

The CEPT Recommendation T/R 61-02 makes it possible for CEPT administrations to issue a Harmonised Amateur Radio Examination Certificate (HAREC). This Certificate shows proof of successfully passing an amateur radio examination that complies with the Examination Syllabus for HAREC. It facilitates the issuing of an individual licence to a radio amateur returning to his native country showing this document issued by a foreign CEPT Administration after passing an amateur radio examination in that foreign country.

Countries with CEPT Licence

International Affairs

Frequency Management

Compiled by Hans Schwarz, DK5JI

(Current as of 2024-09-03)

*** = non-CEPT country**
**** = CEPT membership suspended**

General information

The “CEPT Licence” as well as the “CEPT Novice Licence” make it possible for radio amateurs from CEPT countries to operate during short visits of up to three months in other CEPT countries without the requirement of obtaining an individual temporary licence from the visited CEPT country.

There are two CEPT recommendations for this purpose. The “**CEPT Licence**” is described in CEPT Recommendation T/R 61-01, whereas the “**CEPT Novice Licence**” follows CEPT Recommendation ECC/REC/(05)06. These recommendations have to be implemented within the national law in a country before accepting operation under the CEPT regulation.

A “Harmonized Amateur Radio Examination Certificate” (**HAREC**) according to CEPT Recommendation T/R 61-02 shows proof of successfully passing an amateur radio examination which complies with the Examination Syllabus for the HAREC. It thus facilitates the issue of an individual licence to radio amateurs who stay in a country for a longer term than that mentioned in CEPT Recommendation T/R 61-01. It also eases the issue of an individual licence to a radio amateur returning to his native country showing the “HAREC” Certificate issued by a foreign administration.

The syllabus for the “CEPT Novice Licence” is described in **ERC Report 32**, which does not have to be implemented by countries.

To facilitate the introduction of a third level, the “Entry Class”, in countries, the corresponding syllabus is described in **ECC Report 89**.

To operate under CEPT regulations, you need to have your own licence document with you. It is also advisable to carry a copy of the licensing regulations in your own country and a copy of the licensing regulations in the foreign country with you as well as a printout of the applicable CEPT recommendation.

This list has been compiled according to official documents. No responsibility is taken for the correctness of this information.

Comments and corrections are very much appreciated: dk5ji(at)darc.de.

Info

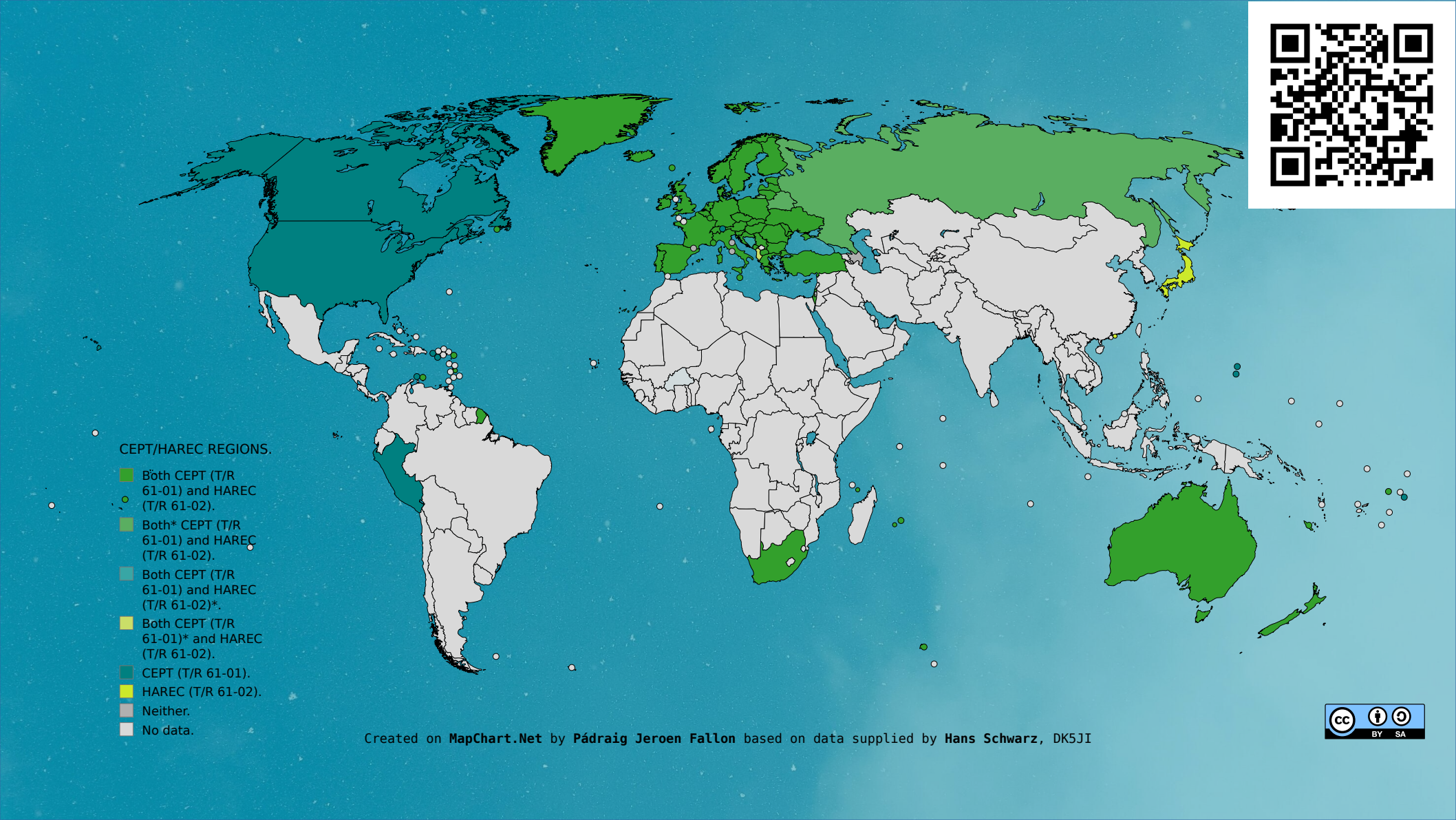
Conférence Européenne des Administrations des Postes et des Télécommunications (CEPT): *Recommendation T/R 61-01. CEPT Radio Amateur Licence*. https://docdb.cept.org/download/4422 (current as of 2024-03-01)

——: *ECC Recommendation (05)06. CEPT Novice Radio Amateur Licence*. https://docdb.cept.org/download/4413 (current as of 2024-03-01)

——: *Recommendation T/R 61-02. Harmonized Amateur Radio Examination Certificate (HAREC)*. https://docdb.cept.org/download/4424 (current as of 2024-03-01)

——: *ERC Report 32. Amateur Radio Novice Examination Syllabus and Amateur Radio Novice Examination Certificate within CEPT and Non-CEPT Countries*. https://docdb.cept.org/download/2065 (current as of 2018-10-11)

——: *ECC Report 89. A Radio Amateur Entry Level Examination and Licence*. https://docdb.cept.org/download/409 (current as of 2007-08-07)


CEPT/HAREC REGIONS.
Both CEPT (T/R 61-01) and HAREC (T/R 61-02).
Both* CEPT (T/R 61-01) and HAREC (T/R 61-02).
Both CEPT (T/R 61-01) and HAREC (T/R 61-02)*.
Both CEPT (T/R 61-01)* and HAREC (T/R 61-02).
CEPT (T/R 61-01).
HAREC (T/R 61-02).
Neither.
No data.
Created on MapChart.Net by Pádraig Jeroen Fallon based on data supplied by Hans Schwarz, DK5JI
BY SA

Why ?

HPR is dedicated to sharing knowledge.

- The joy of learning
- You know you understand it if you can teach it.
- Spread the hobby
- Paying back
- Clubs may want to produce training courses
- Not everyone can afford training
- Not having to sacrifice privacy for knowledge
- Not everyone learns the same way
- Make the material Accessible
- Support STEM classes
- Increase Diversity
- Allows translation into different languages
- Background for another course
- For those who prefer following a structured path
- For those who prefer to learn with a mix and match approach

No Why !

It's on the Internet doesn't mean that you can use it ?

Myths

- If I can right-click it, it's mine
- I am an instructional designer, educator, student, or artist
- I'll remove it if I get caught
- I'll give credit
- I'll alter it more than X%
- There's no copyright symbol
- If I don't profit from the use, I don't need permission
- No one will come after me

Breakout Session: View from the Bleachers: Applied Skills in Finding and Using Free Media Resources. Presented by Barbara Waxer, Santa Fe Community College

Cyndi Landis
Fort Hays State University

Author Note: Library Outreach Specialist, Forsyth Library, Fort Hays State University

Correspondence concerning this article should be addressed to Cyndi Landis, Library Fort Hays State University, 600 Park Street, Hays, KS 67601-4099. Contact: cllandis2@fhsu.edu, 785-628-4529

Breakout Session: View from the Bleachers: Applied Skills in Finding and Using Free Media Resources

Barbara Waxer, copyright educator, author, and instructor in the Media Arts Department at Santa Fe Community College, filled the room with her engaging visuals and quick-paced presentation that focused on the applied skills and resources needed for using copyrighted works and understanding Creative Commons licensing. Grounding her presentation on the dilemma many information consumers and content creators struggle with as they decide whether they can use copyrighted works, Waxer provided solutions to ease the decision-making process and equipped attendees with flow charts and online resources to use for copyright education and awareness.

Berne Convention

Automatic

An Author is automatically entitled to all copyrights in the work and to any derivative works.
Copyright grants to creators a bundle of exclusive rights over their creative works, which generally include, at a minimum, the right to reproduce, distribute, display, and make adaptations.
The phrase "All Rights Reserved" is often used by owners to indicate that they reserve all of the rights granted to them under the law.

Duration

The life of the author plus 50 years. The EU Copyright Duration Directive increases this to 70 years. When copyright expires, the work enters the public domain, and the rights holder can no longer stop others from engaging in those activities under copyright, with the exception of moral rights reserved to creators in some jurisdictions.

Amateur Radio Country Organizations

Written permission is required to reproduce information from these sites.

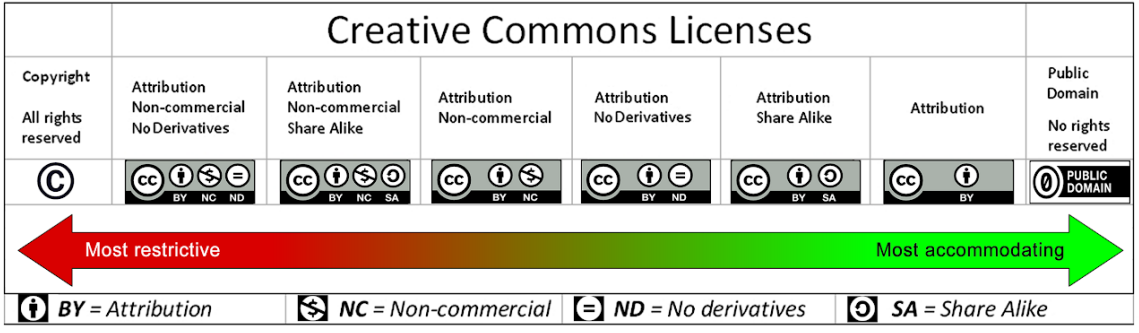
AU	https://www.oevsv.at	No assignments, Berne Convention applies. © All rights reserved.
BE	https://www.uba.be	© Copyright UBA 2024
CH	https://uska.ch/en	Copyright © USKA All rights reserved.
DE	https://www.darc.de	© DARC
FR	https://web.r-e-f.or/	© 2024
IE	https://www.irts.ie	No assignments, Berne Convention applies. © All rights reserved.
IT	https://www.ari.it	Copyright © ARI 2010 - 2024 All Rights Reserved.
NL	https://www.veron.nl	© Copyright
PT	https://www.rep.pt	No assignments, Berne Convention applies. © All rights reserved.
UK	https://rsgb.org	© 2024 Radio Society of Great Britain. All rights reserved.
US	http://arrl.org	These Terms of Use permit you to use the Services for your **personal, non-commercial use only**.

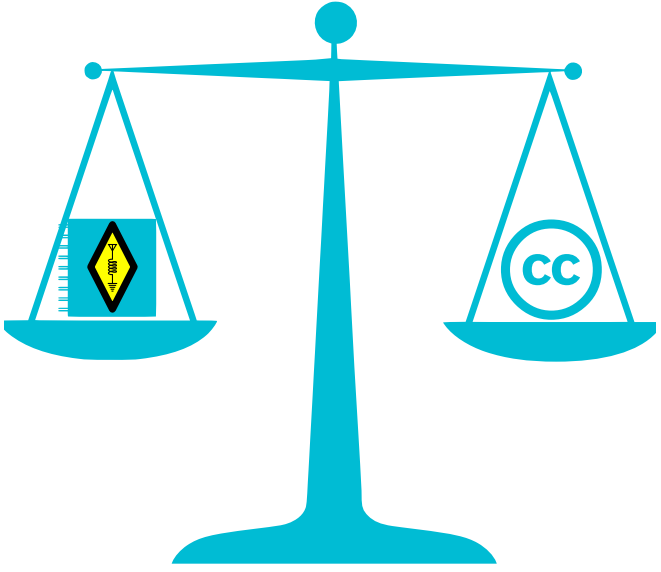
The all or nothing approach of Copyright makes it difficult for HAM Organisations to balance the goal of promoting the hobby, with the need to protect revenue generated from publications.

Creative Commons licenses

Some Rights Reserved

Creative Commons licenses offer creators a spectrum of choices between retaining all rights and relinquishing all rights (public domain), an approach called "Some Rights Reserved."





You Can Help!

- Please record a show, or a series of shows, on one of the HAREC syllabus topics.
- Contact me if you know of any existing material that covers one of the HAREC syllabus topics. Especially if you think that they might be willing to release it under the Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0) license.

CEPT ECC
Electronic Communications Committee

Recommendation T/R 61-02

Harmonised Amateur Radio Examination Certificate

Approved Chester 1990; amended Vilnius 2004

Amended Annex 2: June 2020

Amended Annex 4: October 2014

Amended Annex 6: February 2016 (updated February 2018)

https://docdb.cept.org/document/926

ANNEX 6: EXAMINATION SYLLABUS AND REQUIREMENTS FOR A HAREC

INTRODUCTION

This syllabus has been produced for the guidance of the administrations so that they may prepare their national amateur radio examinations for the CEPT Harmonised Amateur Radio Examination Certificate (HAREC).

The purpose of the examination is to set a reasonable level of knowledge required for candidate radio amateurs wishing to obtain a license for operating amateur stations.

The scope of the examination is limited to subjects relevant to tests and experiments with, and operation of amateur stations conducted by radio amateurs. These include circuits and their diagrams; questions may relate to circuits using both integrated circuits and discreet components.

a) Where quantities are referred to, candidates should know the units in which these quantities are expressed, as well as the generally used multiples and sub-multiples of these units.

b) Candidates must be familiar with the compound of the symbols.

c) Candidates must know the following mathematical concepts and operations:
   - adding, subtracting, multiplying and dividing
   - fractions
   - powers of ten, exponentials, logarithms
   - squaring
   - square roots
   - inverse values
   - interpretation of linear and non-linear graphs
   - binary number system

d) Candidates must be familiar with the formulae used in this syllabus and be able to transpose them.

CHAPTER 3

BK	Signal used to interrupt a transmission in progress
CQ	General call to all stations
CW	Continuous wave
DE	From, used to separate the call sign of the station called from that of the calling station
K	Invitation to transmit
MSG	Message
PSE	Please
RST	Readability, signal-strength, tone-report
R	Received
RX	Receiver
TX	Transmitter
UR	Your

CHAPTER 4

4. INTERNATIONAL DISTRESS SIGNS, EMERGENCY TRAFFIC AND NATURAL DISASTER COMMUNICATION

Distress signs:
- radiotelegraph ...---... [SOS]
- radiotelephone "MAYDAY"
- International use of the amateur station in the event of national disasters;
- Frequency bands allocated to the amateur service and amateur satellite service.

CHAPTER 5

5. CALL SIGNS

- Identification of the amateur station;
- Use of the call signs;
- Composition of call signs;
- National prefixes.

CHAPTER 6

6. IARU BAND PLANS

- IARU band plans;
- Purposes.

CHAPTER 7

7.1 SOCIAL RESPONSIBILITY OF RADIO AMATEUR OPERATION

- The Radio Amateur Code of Conduct;
- Self-regulation and self-discipline in Amateur Radio.

7.2 OPERATING PROCEDURES

- Starting, carrying out and ending a contact;
- Correct use of call signs and abbreviations;
- Content of transmissions;
- Checking transmission quality.

c) NATIONAL AND INTERNATIONAL REGULATIONS RELEVANT TO THE AMATEUR SERVICE AND AMATEUR SATELLITE SERVICE

CHAPTER 1

1. ITU RADIO REGULATIONS

- Definition Amateur Service and Amateur Satellite Service;
- Definition Amateur station;
- Article 25 Radio Regulations;
- Status Amateur Service and Amateur Satellite Service;
- ITU Radio Regions.

CHAPTER 2

2. CEPT REGULATIONS

- Recommendation T/R 61-01;
- Temporary use of amateur stations in CEPT countries;
- Temporary use of amateur stations in NON-CEPT countries which participate in the T/R 61-01 system.

CHAPTER 3

3. NATIONAL LAWS, REGULATIONS AND LICENCE CONDITIONS

- National laws
- Regulations and licence conditions
- Demonstrate knowledge of maintaining a log:
  - log keeping;
  - purpose;
  - recorded data.

EXAMINATION SYLLABUS FOR A HARMONISED AMATEUR RADIO EXAMINATION CERTIFICATE (HAREC)

a) TECHNICAL CONTENT

1. **ELECTRICAL, ELECTRO-MAGNETIC AND RADIO THEORY**
1.1 Conductivity;
1.2 Sources of electricity;
1.3 Electric field;
1.4 Magnetic field;
1.5 Electromagnetic field;
1.6 Sinusoidal signals;
1.7 Non-sinusoidal signals, noise;
1.8 Modulated signals;
1.9 Power and energy;
1.10 Digital signal processing (DSP).

2. **COMPONENTS**
2.1 Resistor;
2.2 Capacitor;
2.3 Coil;
2.4 Transformers application and use;
2.5 Diode;
2.6 Transistor;
2.7 Miscellaneous.

3. **CIRCUITS**
3.1 Combination of components;
3.2 Filter;
3.3 Power supply;
3.4 Amplifier;
3.5 Detector;
3.6 Oscillator;
3.7 Phase Locked Loop [PLL];
3.8 Discrete Time Signals and Systems (DSP-systems).

4. **RECEIVERS**
4.1 Types;
4.2 Block diagrams;
4.3 Operation and function of the following stages;
4.4 Receiver characteristics.

5. **TRANSMITTERS**
5.1 Types;
5.2 Block diagrams;
5.3 Operation and function of the following stages;
5.4 Transmitter characteristics.

6. **ANTENNAS AND TRANSMISSION LINES**
6.1 Antenna types;
6.2 Antenna characteristics;
6.3 Transmission lines.

7. **PROPAGATION**

8. **MEASUREMENTS**
8.1 Making measurements;
8.2 Measuring instruments.

9. **INTERFERENCE AND IMMUNITY**

9.1 Interference in electronic equipment;
9.2 Cause of interference in electronic equipment;
9.3 Measures against interference.

10. **SAFETY**

b) NATIONAL AND INTERNATIONAL OPERATING RULES AND PROCEDURES

1. Phonetic Alphabet;
2. Q-Code;
3. Operational Abbreviations;
4. International Distress Signs, Emergency traffic and natural disaster communication;
5. Call signs;
6. IARU band plans;
7. Social responsibility and operating procedures.

c) NATIONAL AND INTERNATIONAL REGULATIONS RELEVANT TO THE AMATEUR SERVICE AND AMATEUR SATELLITE SERVICE

1. ITU Radio Regulations;
2. CEPT Regulations;
3. National Laws, Regulations and Licence conditions.

DETAILED EXAMINATION SYLLABUS

a) TECHNICAL CONTENT

CHAPTER 1

1. **ELECTRICAL, ELECTRO-MAGNETIC AND RADIO THEORY**

1.1 **Conductivity**
- Conductor, semiconductor and insulator;
- Current, voltage and resistance;
- The units ampere, volt and ohm;
- Ohm's Law $[E = I \cdot R]$
- Kirchhoff's Laws;
- Electric power $[P = E \cdot I]$
- The unit watt;
- Electric energy $[W = P \cdot t]$
- The capacity of a battery [ampere-hour].

1.2 **Sources of electricity**
- Voltage source, source voltage [EMF], short circuit current, internal resistance and terminal voltage;
- Series and parallel connection of voltage sources.

1.3 **Electric field**
- Electric field strength;
- The unit volt/meter;
- Shielding of electric fields.

1.4 **Magnetic field**
- Magnetic field surrounding live conductor;
- Shielding of magnetic fields.

1.5 **Electromagnetic field**
- Radio waves as electromagnetic waves;

- Propagation velocity and its relation with frequency and wavelength $[v = f \cdot \lambda]$
- Polarisation.

1.6 **Sinusoidal signals**
- The graphic representation in time;
- Instantaneous value, amplitude [E_{max}], effective [RMS] value and average value $\left[U_{eff} = \frac{U_{max}}{\sqrt{2}}\right]$
- Period and duration of period;
- Frequency;
- The unit hertz;
- Phase difference.

1.7 **Non-sinusoidal signals**
- Audio signals;
- Square wave;
- The graphic representation in time;
- D.C. voltage component, fundamental wave and higher harmonics;
- Noise $[P_N = kTB]$ (receiver thermal noise, band noise, noise density, noise power in receiver bandwidth).

1.8 **Modulated signals**
- CW;
- Amplitude modulation;
- Phase modulation, frequency modulation and single-sideband modulation;
- Frequency deviation and modulation index $\left[m = \frac{\Delta F}{f_{mod}}\right]$
- Carrier, sidebands and bandwidth;
- Waveforms of CW, AM, SSB and FM signals (graphical presentation);
- Spectrum of CW, AM and SSB signals (graphical presentation);
- Digital modulations: FSK, 2-PSK, 4-PSK, QAM;
- Digital modulation: bit rate, symbol rate (Baud rate) and bandwidth;
- CRC and retransmissions (e.g. packet radio), forward error correction (e.g. Amtor FEC).

1.9 **Power and energy**
- The power of sinusoidal signals $\left[P = i^2 \cdot R; P = \frac{u^2}{R}; u = U_{eff}; i = I_{eff}\right]$
- Power ratios corresponding to the following dB values: 0 dB, 3 dB, 6 dB, 10 dB and 20 dB [both positive and negative];
- The input/output power ratio in dB of series-connected amplifiers and/or attenuators;
- Matching [maximum power transfer];
- The relation between power input and output and efficiency $\left[\eta = \frac{P_{out}}{P_{in}} \cdot 100\%\right]$
- Peak Envelope Power [p.e.p.].

1.10 **Digital Signal Processing (DSP)**
- sampling and quantization;
- minimum sampling rate (Nyquist frequency);
- convolution (time domain / frequency domain, graphical presentation);
- anti-aliasing filtering, reconstruction filtering;
- ADC / DAC.

CHAPTER 2

2. COMPONENTS

2.1 **Resistor**
- The unit ohm;
- Resistance;
- Current/voltage characteristic;
- Power dissipation.

2.2 **Capacitor**
- Capacitance;
- The unit farad;
- The relation between capacitance, dimensions and dielectric. (Qualitative treatment only);
- The reactance $\left[X_c = \frac{1}{2\pi f \cdot C}\right]$
- Phase relation between voltage and current.

2.3 **Coil**
- Self-inductance;
- The unit henry;
- The effect of number of turns, diameter, length and core material on inductance. (Qualitative treatment only);
- The reactance $[X_L = 2\pi f \cdot L]$
- Phase relation between current and voltage;
- Q-factor.

2.4 **Transformers application and use**
- Ideal transformer $[P_{prim} = P_{sec}]$
- The relation between turn ratio and:
  - voltage ratio $\left[\frac{u_{sec}}{u_{prim}} = \frac{n_{sec}}{n_{prim}}\right]$
  - current ratio $\left[\frac{i_{sec}}{i_{prim}} = \frac{n_{prim}}{n_{sec}}\right]$
  - impedance ratio. (Qualitative treatment only);
  - Transformers.

2.5 **Diode**
- Use and application of diodes:
  - Rectifier diode, zener diode, LED [light-emitting diode], voltage-variable and capacitor [varicap];
  - Reverse voltage and leakage current.

2.6 **Transistor**
- PNP- and NPN-transistor;
- Amplification factor;
- Field effect vs. bipolar transistor (voltage vs. current driven);
- The transistor in the:
  - common emitter [source] circuit;
  - common base [gate] circuit;
  - common collector [drain] circuit;
  - input and output impedances of the above circuits.

2.7 **Miscellaneous**
- Simple thermionic device [valve];
- Voltages and impedances in high power valve stages, impedance transformation;
- Simple integrated circuits (include opamps).

CHAPTER 3

3. CIRCUITS

3.1 Combination of components
- Series and parallel circuits of resistors, coils, capacitors, transformers and diodes;
- Current and voltage in these circuits;
- Behaviour of real (non-ideal) resistor, capacitor and inductors at high frequencies.

3.2 Filter
- Series-tuned and parallel-tuned circuit:
- Impedance;
- Frequency characteristic;
- Resonance frequency $\left[f = \frac{1}{2\pi f \sqrt{LC}} \right]$
- Quality factor of a tuned circuit $\left[Q = \frac{2\pi f \cdot L}{R_s}; Q = \frac{R_p}{2\pi f \cdot L}; Q = \frac{f_{res}}{B} \right]$
- Bandwidth;
- Band-pass filter;
- Low-pass, high-pass, band-pass and band-stop filters composed of passive elements;
- Frequency response;
- Pi filter and T filter;
- Quartz crystal;
- Effects due to real (=non-ideal) components;
- digital filters (see sections 1.10 and 3.8).

3.3 Power supply
- Circuits for half-wave and full-wave rectification and the Bridge rectifier;
- Smoothing circuits;
- Stabilisation circuits in low voltage supplies;
- Switching mode power supplies, isolation and EMC.

3.4 Amplifier
- Lf and hf amplifiers;
- Gain;
- Amplitude/frequency characteristic and bandwidth (broadband vs. tuned stages);
- Class A, A/B, B and C biasing;
- Harmonic and intermodulation distortion, overdriving amplifier stages.

3.5 Detector
- AM detectors (envelope detectors);
- Diode detector;
- Product detectors and beat oscillators;
- FM detectors.

3.6 Oscillator
- Feedback (intentional and unintentional oscillations);
- Factors affecting frequency and frequency stability conditions necessary for oscillation;
- LC oscillator;
- Crystal oscillator, overtone oscillator;
- Voltage controlled oscillator (VCO);
- Phase noise.

3.7 Phase Locked Loop [PLL]
- Control loop with phase comparator circuit;
- Frequency synthesis with a programmable divider in the feedback loop.

3.8 Digital signal processing (DSP systems)
- FIR and IIR filter topologies;
- Fourier Transformation (DFT; FFT, graphical presentation);
- Direct Digital Synthesis.

CHAPTER 4

4. RECEIVERS

4.1 Types
- Single and double superheterodyne receiver;
- Direct conversion receivers.

4.2 Block diagrams
- CW receiver [A1A];
- AM receiver [A3E]
- SSB receiver for suppressed carrier telephony [J3E];
- FM receiver [F3E].

4.3 Operation and function of the following stages (Block diagram treatment only)
- HF amplifier [with tuned or fixed band pass];
- Oscillator [fixed and variable];
- Mixer;
- Intermediate frequency amplifier;
- Limiter;
- Detector, including product detector;
- Audio amplifier;
- Automatic gain control;
- S meter;
- Squelch.

4.4 Receiver characteristics (simple description treatment)
- Adjacent-channel;
- Selectivity;
- Sensitivity, receiver noise, noise figure;
- Stability;
- Image frequency;
- Desensitization / Blocking;
- Intermodulation; cross modulation;
- Reciprocal mixing [phase noise].

CHAPTER 5

5. TRANSMITTERS

5.1 Types
- Transmitter with or without frequency translation.

5.2 Block diagrams
- CW transmitter [A1A];
- SSB transmitter with suppressed carrier telephony [J3E];
- FM transmitter with the audio signal modulating the VCO of the PLL [F3E].

5.3 Operation and functions of the following stages (Block diagram treatment only)
- Mixer;
- Oscillator;
- Buffer;
- Driver;
- Frequency multiplier;
- Power amplifier;
- Output matching;
- Output filter;
- Frequency modulator;
- SSB modulator;
- Phase modulator;
- Crystal filter.

5.4 **Transmitter characteristics (simple description)**
- Frequency stability;
- RF-bandwidth;
- Sidebands;
- Audio-frequency range;
- Non-linearity [harmonic and intermodulation distortion];
- Output impedance;
- Output power;
- Efficiency;
- Frequency deviation;
- Modulation index;
- CW key clicks and chirps;
- SSB overmodulation and splatter (agreed);
- Spurious RF radiations (agreed);
- Cabinet radiations;
- Phase noise.

CHAPTER 6

6. ANTENNAS AND TRANSMISSION LINES

6.1 **Antenna types**
- Centre fed half-wave antenna;
- End fed half-wave antenna;
- Folded dipole;
- Quarter-wave vertical antenna [ground plane];
- Antenna with parasitic elements [Yagi];
- Aperture antennas (Parabolic reflector, horn);
- Trap dipole.

6.2 **Antenna characteristics**
- Distribution of the current and voltage;
- Impedance at the feed point;
- Capacitive or inductive impedance of a non-resonant antenna;
- Polarisation;
- Antenna directivity, efficiency and gain;
- Capture area;
- Radiated power [ERP, EIRP];
- Front-to-back ratio;
- Horizontal and vertical radiation patterns.

6.3 **Transmission lines**

Parallel conductor line;
- Coaxial cable;
- Waveguide;
- Characteristic impedance [Z0];
- Velocity factor;
- Standing-wave ratio;
- Losses;
- Balun;
- Antenna tuning units (pi and T configurations only).

CHAPTER 7

7. PROPAGATION
- Signal attenuation,, signal to noise ratio;
- Line of sight propagation (free space propagation, inverse square law);
- Ionospheric layers;
- Critical frequency;
- Influence of the sun on the ionosphere;
- Maximum Usable Frequency;
- Ground wave and sky wave, angle of radiation and skip distance;
- Multipath in ionospheric propagation;
- Fading;
- Troposphere (Ducting, scattering);
- The influence of the height of antennas on the distance that can be covered [radio horizon];
- Temperature inversion;
- Sporadic E-reflection;
- Auroral scattering;
- Meteor scatter;
- Reflections from the moon;
- Atmospheric noise [distant thunderstorms];
- Galactic noise;
- Ground (thermal) noise.
- Propagation prediction basics (link budget):
  - dominant noise source, (band noise vs. receiver noise) ;
  - minimum signal to noise ratio;
  - minimum received signal power;
  - path loss;
  - antenna gains, transmission line losses;
  - minimum transmitter power.

CHAPTER 8

8. MEASUREMENTS

8.1 **Making measurements**
- Measurement of:
  - DC and AC voltages and currents;
- Measuring errors:
  - Influence of frequency;
  - Influence of waveform;
  - Influence of internal resistance of meters.
- Resistance;
- DC and RF power [average power, Peak Envelope Power];
- Voltage standing-wave ratio;
- Waveform of the envelope of an RF signal;
- Frequency;
- Resonant frequency.

8.2 **Measuring instruments**
- Making measurements using:
  - Multi range meter (digital and analog);
  - Rf-power meter;
  - Reflectometer bridge (SWR meter);
  - Signal generator;
  - Frequency counter;
  - Oscilloscope;
  - Spectrum Analyzer.

CHAPTER 9

9. **INTERFERENCE AND IMMUNITY**

9.1 **Interference in electronic equipment**
- Blocking
- Interference with the desired signal
- Intermodulation
- Detection in audio circuits

9.2 **Cause of interference in electronic equipment**
- Field strength of the transmitter
- Spurious radiation of the transmitter [parasitic radiation, harmonics]
- Undesired influence on the equipment:
  - via the antenna input [aerial voltage, input selectivity]
  - via other connected lines
  - by direct radiation

9.3 **Measures against interference**
- Measures to prevent and eliminate interference effects:
  - Filtering
  - Decoupling
  - Shielding

CHAPTER 10

10. **SAFETY**
- The human body
- Mains power supply
- High voltages
- Lightning

b) NATIONAL AND INTERNATIONAL OPERATING RULES AND PROCEDURES

CHAPTER 1

1. **PHONETIC ALPHABET**

A = Alpha	J = Juliett	S = Sierra
B = Bravo	K = Kilo	T = Tango
C = Charlie	L = Lima	U = Uniform
D = Delta	M = Mike	V = Victor
E = Echo	N = November	W = Whiskey
F = Foxtrot	O = Oscar	X = X-ray
G = Golf	P = Papa	Y = Yankee
H = Hotel	Q = Quebec	Z = Zulu
I = India	R = Romeo	

CHAPTER 2

2. **Q-CODE**

Code	Question	Answer
QRK	What is the readability of my signals?	The readability of your signals is ...
QRM	Are you being interfered with?	I am being interfered with ...
QRN	Are you troubled by static?	I am troubled by static
QRO	Shall I increase transmitter power?	Increase transmitter power
QRP	Shall I decrease transmitter power?	Decrease transmitter power
QRT	Shall I stop sending?	Stop sending
QRZ	Who is calling me?	You are being called by ...
QRV	Are you ready?	I am ready
QSB	Are my signals fading?	Your signals are fading
QSL	Can you acknowledge receipt?	I am acknowledging receipt
QSO	Can you communicate with ... direct?	I can communicate ... direct
QSY	Shall I change to transmission on another frequency?	Change transmission to another frequency
QRX	When will you call again?	I will call you again at ... hours on ... kHz (or MHz)
QTH	What is your position in latitude and longitude (or according to any other indication)?	My position is ... latitude, ... longitude (or according to any other indication)

Questions ?

Why "HAM" Radio ?

Wired Telegraphy - the first global network.

1816 Sir Francis Ronalds transmitted electrical signals over 8 miles in Hammersmith.

1832 The Schilling telegraph was an early needle telegraph invented by Baron Schilling Von CanstatU+0074

1833 First operative electric telegraph by Gauss and Weber connected Göttingen Observatory to the Institute of Physics 1km away

1837 Patents Morse (1 Wire) and for Cooke & Wheatstone (5 wire)

1839 Cooke & Wheatstone (5 wire) implemented on Paddington to West Drayton

1842 West Drayton to Slough extended as 2 wire requiring the **first professional** telegraph operator, and **open to the Public**

1844 Morse paper system connected Baltimore to Washington. **Operators learned the code** making paper machines unnecessary.

1847 William Siemens laid the first successful underwater cable across the Rhine between Deutz and Cologne.

1849 → 1865, a series of bilateral and regional agreements among Western European states attempted to **standardize** international communications.

1861 the west coast of the US continent was connected to the east coast

1865 The **International Telegraph Union**, the predecessor to the modern **ITU, was founded**. International Morse Code becomes standard for continental European telegraphy

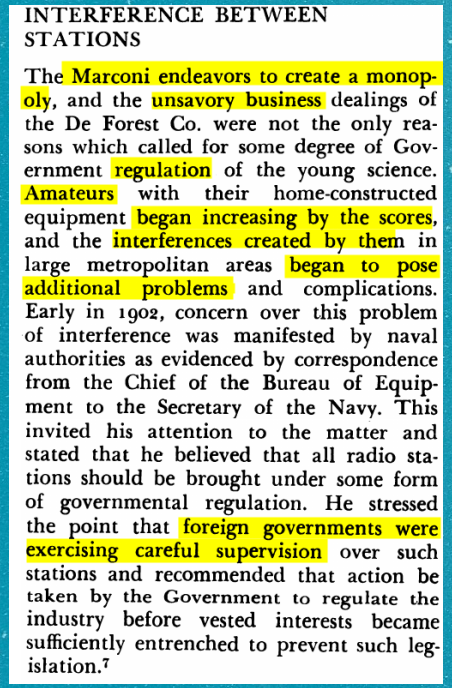
1872 Loomis was granted first wireless U.S. Patent for "Improvement in Telegraphing,"

1897 Marconi had transmitted wireless Morse code signals over a distance of about 6 km across Salisbury Plain

1810 1820 1830 1840 1850 1860 1870 1880 1890 1900

First Exams

WirelessBros, Grifters, Monopolies, DDOS, and LOLs



INTERFERENCE BETWEEN STATIONS

The Marconi endeavors to create a monopoly, and the unsavory business dealings of the De Forest Co. were not the only reasons which called for some degree of Government regulation of the young science. Amateurs with their home-constructed equipment began increasing by the scores, and the interferences created by them in large metropolitan areas began to pose additional problems and complications. Early in 1902, concern over this problem of interference was manifested by naval authorities as evidenced by correspondence from the Chief of the Bureau of Equipment to the Secretary of the Navy. This invited his attention to the matter and stated that he believed that all radio stations should be brought under some form of governmental regulation. He stressed the point that foreign governments were exercising careful supervision over such stations and recommended that action be taken by the Government to regulate the industry before vested interests became sufficiently entrenched to prevent such legislation.[7]

- 1900 Marconi tried to establish a worldwide monopoly in radio telegraphy
- 1901 DDOS Marconi and De Forest mobile stations reporting of international yacht races
- 1902 Deutschland incident refusal of Marconi to communicate with competing companies
- 1903 Questionable Stock offerings, Patent Wars, Wireless Telegraph Bros.
- 1904 Navy managed wireless in the US
- 1906 International Radiotelegraph Convention called for countries to license their station
- 1909 Formation of Junior Wireless Club (Radio Club of America)
- 1910 First National organisation Amateurs of Australia formed
- 1910 US Navy issues "certificates of skill in radio communication"
- 1910 - 1911 US Navy fails to pass bills to outlaw amateur operations.
- 1912 Titanic sinks. The closest ship turned off wireless due to been rebuked earlier by the Titanic
- 1912 Required call signs "to order radio stations off the air in the event of war", restriction to "useless" 200m, power restrictions, licences were required to transmit
- 1913 London Wireless Club (RSGB) is formed

Credits

Hacker Public Radio HAM Series	https://hackerpublicradio.org/series/0043.html
CEPT Radio Amateurs	https://cept.org/ecc/topics/radio-amateurs
File:CEPT logo.svg	https://en.wikipedia.org/wiki/File:CEPT_logo.svg
Recommendation T/R 61-01	https://docdb.cept.org/download/2ae38a89-e58a/TR6101.pdf
Recommendation T/R 61-02	https://docdb.cept.org/document/926
Icons	https://svgsilh.com
LibreOffice Impress	https://www.libreoffice.org/
LibreOffice Impress Template	https://lumbung.libreoffice.id/templat/freshes-by-risyad-rafsanjani/
Inkscape Vector Graphic Editor	https://inkscape.org/
Fedora LXQt Operating System	https://fedoraproject.org/spins/lxqt/

Credits

ImageMagick CLI Image Editor	https://imagemagick.org/
Gwenview image viewer	https://apps.kde.org/gwenview/
Kate Text Editor	https://kate-editor.org/
KolourPaint paint program	http://www.kolourpaint.org/
QR Code Generator	https://fukuchi.org/works/qrencode/
Custom Map	https://www.mapchart.net
CEPT Countries Hans Schwarz DK5JI	https://files.darc.de/index.php/s/CKT38kZP6miK7xf
Ham Radio For Hackers Dan Romanchik, KB6NU	https://www.kb6nu.com/there-is-hope-for-amateur-radio/
Berne Convention signatories	https://commons.wikimedia.org/wiki/File:Berne_Convention_signatories.svg
EU Copyright Duration Directive	https://en.wikipedia.org/wiki/Copyright_Duration_Directive

Credits

File:Berne Convention signatories.svg	https://commons.wikimedia.org/wiki/File:Berne_Convention_signatories.svg
About Copyright and CC Licenses	https://creativecommons.org
The Creative Commons License Spectrum	https://www.barbarawaxer.com/quick-ref-downloads
Creative commons license spectrum.svg	https://commons.wikimedia.org/wiki/File:Creative_commons_license_spectrum.svg
View from the Bleachers	https://journals.ku.edu/jcel/article/download/6612/6504/0
HPR Logo Richard Querin (CC-BY-SA)	https://hackerpublicradio.org/media/images/
CEPT Spectrum Management	https://docdb.cept.org/document/926
Time from NPL (MSF)	https://en.wikipedia.org/wiki/Time_from_NPL_(MSF)
The First Regulations	http://w2pa.net/HRH/the-first-regulations/

Credits

Ally Lublin	http://allsstelecommunications.weebly.com/telegraph.html
The Electric Telegraph	https://archive.org/details/bub_gb_6SstLNS-s1gC
History of Communications	https://archive.org/details/historyofcommuni00howe
RF Swift	https://hackerpublicradio.org/eps/hpr4214/hpr4214/Penthertz-Spectrum24-RF_Swift.pdf
History of Radio	https://en.wikipedia.org/wiki/History_of_radio
NIST and the Titanic	https://www.nist.gov/blogs/taking-measure/nist-and-titanic-how-sinking-ship-improved-wireless-communications-navigating
Building a poor man's quarter-wave 433MHz antenna: Antenna's construction	https://community.element14.com/challenges-projects/project14/rf/b/blog/posts/building-a-poor-man-s-quarter-wave-433mhz-antenna-antenna-s-construction

Thank You

The End

HAREC on the Hacker Public Radio Podcast

A presentation for OggCamp 2024, by Ken Fallon

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