



IBERRADIO ÁVILA 2019 - EA4CYQ SATELLITES Juan Antonio Fernández Montaña



- 1.- WHY WE HAVE TO IMPROVE
- 2.- WHAT IS A CUBESAT?
- 3.- TECHNICAL IMPROVEMENTS OF A FIXED STATION
- 4.- TECHNICAL IMPROVEMENTS OF A PORTABLE STATION
- 5.- GENERAL OPERATING CRITERIA

5.1 THE SINGULARITY 5.2 LISTEN TO FIND OUT THE SINGULARITY 5.3 WHAT LANGUAGE YOU SPEAK 5.4 WHAT DATA WE EXCHANGE 5.5 HELP TO HIGHLIGHT THE SINGULARITY

INDEX

6.- WORKING FM SATELLITES

6.1 LISTEN - LISTEN - LISTEN
6.2 TRANSPONDER ON/OFF
6.3 HOW TO CALL
6.4 TAKE ADVANTAGE OF THE FADING!

7.- WORKING SSB SATELLITES

7.1 SOME TIPS ON SSB 7.2 THE POWER ON SSB 7.3 A SPECIAL CASE: AO-7

8.- PLANNED EXTREME QSOs

1.- WHY WE HAVE TO IMPROVE

- A LEO SATELLITE IS A "DEVICE" WITH MANY CONSTRAINTS
- VERY SHORT DURATION PASSES
- LARGE AND CHANGING COVERAGE
- QUICK CHANGES OF FREQUENCY, POLARIZATION AND HEADING
- MANY PEOPLE TRYING TO ACCESS

SOLUTION:

- INCREASE THE EFFECTIVENESS OF OUR STATION
- THE OPERATIONAL SKILL BECOMES ESSENTIAL

2.- WHAT IS A CUBESAT



10x10x10 cm Dimensions of a CubeSat

> 1.3 kg Mass of a CubeSat

Without spin control

Most with negative gain antennas



AO-73

SO-50







- MEO
- HEO
- GEO
- INCLINATION
 - EQUATORIAL
 - POLAR
- ECCENTRICITY

2.- WHAT IS A CUBESAT?

CONTROL OF THE POLARITY (APTITUDE)

WITHOUT STABILIZERS

WITH STABILIZERS



2.- WHAT IS A CUBESAT?

CONTROL OF THE POLARITY (APTITUDE)

SINGLE AXIS

TWO-AXIS



2.- WHAT IS A CUBESAT?

- IT DOES NOT HAVE ACTITUDE CONTROL
- SPIN, ITSELF ROTATION, IS HARD TO REDUCE
- THE POLARIZATION CHANGES:
 - ABOUT ITSELF
 - ABOUT US



- THE IONOSPHERE RANDOMLY MODIFIES THE POLARITY DEPENDING ON THE FREQUENCY
 - 144MHz WITHIN 10' AND 2 HOURS
 - 435 MHz WITHIN 3' AND 24 HOURS
- THE IONOSPHERE RESHAPES THE CIRCULAR POLARITY TOWARDS AN ELLIPTICAL ONE WHERE A LINEAR POLARITY PREVAILS

2.- WHAT IS A CUBESAT

THE MOST IMPORTANT TECHNICAL CHALLENGES TO OVERCOME ARE:

- ORIENTATION
- WEAK SIGNALS
- UNKNOWN & RANDOM POLARIZATION AND BETWEEN ONE POLARIZATION AND BETWEEN ONE POLARIZATION MORE THE OPPOSITE ONE THERE IS NOT THE OPPOSITE IIII

- ANTENNAS WITH AZIMUTH AND ELEVATION
- ROTATOR CONTROL AND AUTOMATIC TRACKING
- AUTOMATIC CONTROL OF FREQUENCIES (CAT)
- MANDATORY TO SWITCH BETWEEN THE TWO LINEAR POLARITIES ON EACH BAND UP/DW
- LOSS REDUCTION ON RECEPTION (LNA)



3.-<u>TECHNICAL IMPROVEMENTS OF A</u> FIXED STATION



- THINK ABOUT A LONG-TERM INSTALLATION



- EVERY SINGLE STEP SHOULD BE THE DEFINITIVE ONE
- PREPARE AN OVERALL BUDGET:

	BRAND NEW	HOME-MADE
		USED
V/U CROSSED-POL. ANTENNAS	200€	100€
AZIMUTH/ELEVATION ROTATORS	7 <i>00</i> €	400€
POLARIZATION CHANGE RELAYS	120€	40€
LNA WITH VOX V + U	160€	120€
ROTATORS CONTROL INTERFACE	200€	60€
CAT INTERFACE	30€	20€
INSTALLATION+COAXIAL CABLES	200€	100€
TOTAL	1610€	840€

- ALWAYS BEGIN AS PORTABLE, **<u>IT IS CHEAPER!</u>**
- BUDGET IS NOT NEEDED
- GET USED TO THE ORIENTATION
- PRACTICE WITH THE POLARITY CHANGES
- IMPROVE YOUR HANDY (HT) MEMORIES
- BE AWARE OF THE PASS PATH (EAST OR WEST)
- PEOPLE AROUND AND YOUR OWN SAFETY IS THE FIRST



RECOMMENDATIONS

- PLAN SAT PASSES IN ADVANCE
- TAKE REFERENCES OF DIRECTION FOR AOS, LOS AND MAXIMUM HEIGHT. IF YOU DO NOT HAVE IT CLEAR MARK THEM ON THE GROUND
- WRITE DOWN AOS, LOS AND MAXIMUM HEIGHT TIMETABLE AND HAVE A CLOCK IN FRONT OF YOU

SO-50 PASS BY THE WEST, 10', MAX. ELEV. 30°

AOS	170°	13,15
CENTRE	230°	13,20
LOS	290°	13,25



EA4CYQ - Juan A. Fernández Montaña 2019

RECOMMENDATIONS :

- THE ORIENTATION IS ALWAYS A REFERENCE. THE HAND IS VERY FAST, IN LOWER HEIGTHS TRY TO AIM AT THE GROUND IN ORDER TO USE IT AS REFLECTOR
- I HAVE HAD SUCCESS IN VALLEYS AIMING AT THE OPPOSITE SLOPE USING IT AS A MIRROR



DO NOT LOOK FOR THE MAXIMUM RX SIGNAL IN THE TRANSMISSION, IT IS A MISTAKE, RELY ON THE AUDIO LOOKING FOR A NICE UPLINK, ALTHOUGH THE RX SIGNAL WERE WEAK, THE AUDIO QUALITY IS THE BEST INDICATOR.

RECOMMENDATIONS :

- WELL-ORGANIZE MEMORIES INCLUDING THE NAME AND ITS FUNCTION (TX SO-50/ON, TX SO-50,RX SO-50/1...)



- SAVE MEMORIES OF CENTRAL FREQUENCIES AND BEACONS IN LINEAR SATELLITES
- ALWAYS CARRY A FULL-CHARGED REPLACEMENT BATTERY
- HAVE AVAILABLE A COAXIAL CABLE AND A GAS SOLDERING IRON
- BUILT A MICROPHONE HEADSET AND TAKE CARE OF THE CONNECTIONS

RECOMMENDATIONS:

 LOOK FOR THE WAY TO RECORD THE RECEPTION AUDIO FROM A CABLE, IT IS A VALUABLE HELP.
 YOU WILL NOT NEED A HAND FOR WRITING DOWN AND YOU WILL BE ABLE TO REVIEW THE PASS LATER ON.



- IF YOU USE A TRIPOD, THE LAST SECTION SHOULD BE MADE OF A NON-CONDUCTING MATERIAL, OR HOLD THE ANTENA FROM BEHIND, IF NOT YOU WILL ABSOLUTELY DEFORM THE RADIATION LOBES
- IF YOU WORK LINEAR SATELLITES, TRY TO FIT A PTT BUTTON IN THE ANTENNA HANDLE AND USE A MICROPHONE HEADSET, THAT WAY YOU WILL HAVE YOUR HANDS AVAILABLES FOR OTHERS TASKS.
- PREPARE CASES OR BOXES WHICH FIT WITH YOUR CAR TRUNK VOLUME, BACKPACK, ...

RECOMMENDATIONS:

- LEAVE A RAINCOAT OR UMBRELLA AS A LOST THING, JUST IN CASE YOU ARE WITH SOMEONE ELSE
- DO NOT BE SLOPPY, THERE IS NOT MARGIN OF ERROR AS PORTABLE, FAR AWAY FROM HOME
- DO NOT BE LAZY, ALWAYS HAVE A LIST CLOSE TO YOU WHERE YOU INCLUDE THINGS TO IMPROVE



5.- GENERAL OPERATING CRITERIA

A SATELLITE PASS IS UNIQUE AND UNREPEATABLE, IF OPERATORS DO NOT TAKE ADVANTAGE OF THAT WITH EFFICIENCY, ALL OF US WILL WASTE TIME AND EFFORTS TILL GET HERE

IN GENERAL, A SATELLITE IS NOT THE PROPER PLACE TO GET HELD UP, THERE ARE OTHER MEANS OF COMMUNICATION FOR DOING THAT

THERE ARE HAM RADIO OPERATORS WHO DO A BIG EFFORT TO ACCESS AND WORK SATELLITES (A LOT OF TIME AND MONEY FROM HIS POCKET) ACTIVATING FROM "SPECIAL" LOCATIONS



5.1- THE SINGULARITY

THERE IS ONLY ONE THING THAT MAKE YOU SPECIAL, "THE SINGULARITY", IF YOU ARE ONE OF THEM, WHY DO YOU HIDE IT?

YOU ARE SINGULAR IF:

- YOU ARE IN A "WEIRD" LOCATION FOR A WHILE
- YOU RUN UNDER EXTREME CONDITIONS
- EA4CYQ/MM
- EA4CYQ IM79
- CT7/EA4CYQ
- EA4CYQ/P
- EA4CYQ HAND-HELD



THE LAW DOES NOT FORCE YOU, BUT YOU FEEL FORCED TO SHOW YOUR SINGULARITY.

5.2- LISTEN TO FIND OUT THE SINGULARITY

A SINGULAR STATION FOR YOU CAN BE THE ALREADY WORKED ONE FOR REMAINING OPERATORS

BY THE SAME WAY, YOU CAN BE SINGULAR FOR ANY OTHER STATION



TO CHECK IF A STATION, "WHICH IS NOT WEIRD", IS SINGULAR FOR YOU, HAVE YOUR LOGBOOK IN FRONT OF YOU.

DO NOT DUPLICATE QSOS WITH ALREADY WORKED STATIONS

IF YOU ARE PORTABLE AND YOU DO NOT HAVE THE LOGBOOK, TRY TO REMEMBER PREVIOUS QSOS

LISTENING TO OTHER QSOS YOU WILL FIND THE SINGULARITY

5.3- WHAT LANGUAGE YOU SPEAK ...

HAM RADIO OPERATORS ARE NOT SINGULARS BY THEIR LANGUAGE, IT IS NEUTRAL, CLEAR, USE THE INTERNATIONAL RULES:

"Q" CODE

INTERNATIONAL SPELLING ALPHABET "ICAO"

IF YOU WANT TO SHOW EMPATHY YOU CAN REPLACE "73" WITH GREETINGS IN HIS OWN LANGUAGE

MOST QSOS ARE AROUND THE NOISE LEVEL OR OVER-MODULATIONS, OPERATORS WHO REPLY YOU WILL DO AN EFFORT TO IDENTIFY THE "ICAO" CODE

HONOLULÚ YOKOHAMA GERMANY QUEEN BAKER RUSSIA



5.4-WHAT DATA WE EXCHANGE

THEY WANT TO KNOW WITHOUT MISTAKES, NO MORE NEITHER LESS !:

- CALLSIGN

- GRIDSQUARE (FIRST 4 DIGITS IS ENOUGH)
- YOUR REAL SIGNAL REPORT

REMAINING DATA WILL BE FOUND ON INTERNET AND IF THEY ARE INTERESTED IN SOMETHING ELSE, THEY WILL WRITE YOU AN E-MAIL.

UPDATE YOUR INFO IN THE INTERNATIONAL DATABASES SUCH AS QRZ.COM, ...!

AVOID REPEATING ALREADY KNOWN INFO COMING FROM BOTH

TRY TO FINISH AND CLOSE THE QSO, IF NOT, ALL OF US WILL WASTE TIME



5.5- HELP TO HIGHLIGHT THE SINGULARITY

IF YOU SEE MOST OF OPERATORS ARE NOT AWARE OF THE SINGULARITY, HIGHLIGHT IT.

ALTHOUGH YOU ARE NOT SINGULAR, YOU CAN TRANSMIT A SENTENCE AS FOLLOWS:

PLEASE TRY AGAIN XXXX/MM

PLEASE LET ACCESS THE SPECIAL STATION XXXX/KK



6.- WORKING FM SATELLITES

6.1- LISTEN – LISTEN - LISTEN

LEO SATELLITES ARE THE BUSIEST ONES DUE TO THEIR EASY-ACCESS AND NEEDED EQUIPMENT.

LISTEN TO ONGOING QSOS, YOU KNOW ACTIVE STATIONS, GRIDSQUARES,

THAT WAY YOU WILL DETECT IF A STATION IS SINGULAR FOR YOU OR FOR THE MOST.

IF YOU FINALLY DO NOT PRESS THE PPT BUTTON IN A PASS BECAUSE THERE WERE NOT ANY SINGULAR STATION, YOU ARE BECOMING A GREAT FM SATELLITE OPERATOR



6.2- TRANSPONDER. ON/OFF

- THE SATS EQUIPPED WITH AN ACTIVE TRANSPONDER ARE THE EASIEST ONES TO ALIGN, THERE IS ALWAYS A SIGNAL TO FIND, EVEN WITHOUT TRAFFIC, GET USED TO ORIENTATE THE ANTENNA THANKS TO THE SOUND CHANGE OF THE BACKGROUND NOISE

- THE SO-50 IS DIFFICULT TO ALIGN WITH LOW CALL TRAFFIC, THAT'S WHY IT IS RECOMMENDED THAT FIXED STATIONS ALMOST CONSTANTLY CALL WHEN THERE IS NOT ACTIVITY, THAT WAY THEY HELP PORTABLE STATIONS TO FIND THE SATELLITE

TRANSMIT TO FIND THE SATELLITE IS A MISTAKE!



6.3- HOW TO CALL

- IF YOU ARE NOT REALLY A SINGULAR STATION, TRY TO AVOID CALLING, JUST LISTEN, LISTEN AND LISTEN, WHEN SOMETHING INTERESTING APPEARS CALL AS FOLLOWS: XX3JJJ DE AA2AAA
- WHEN YOU CALL TO ANOTHER STATION YOU ARE SELF-ANNOUNCING, YOU HAVE AVOIDED USING THE TRANSPONDER TO SHOW YOU ARE ONLINE.
- IF YOU WANT TO SELF-ANNOUNCE AND YOU ARE NOT A SINGULAR STATION, USE THE EXPRESSION <u>XX3JJJ SAT</u>, IF YOU ONLY SAY YOUR CALLSIGN OTHER STATIONS CAN THINK YOU ARE REPLYING TO THEIR CALLS.
- IF YOU ARE A SINGULAR STATION, LET EVERYBODY KNOW IT WITH EXPRESSIONS WE HAVE ALREADY MENTIONED
- TRY TO ALLOW THE CLOSING OF ONGOING QSOS

AVOID USING THE EXPRESSION CQ CQ

6.4- TAKE ADVANTAGE OF THE FADING

- IF YOU WORK WITH LINEAR POLARIZATION, YOU WILL HAVE FADING
- THE FADING DUE TO POLARITY CHANGES IS PERIODIC
- STUDY THE PERIOD AND TRANSMIT WHEN THE SIGNAL BEGINS TO BE STRONGER, THAT WAY YOU WILL BE ABLE TO CATCH THE REPLY IN THE PEAK, IF NOT YOU HAVE USED THE TRANSPONDER WITHOUT SUCCESS
- TRY TO BE QUICK BUT CLEAR



7- WORKING SSB SATELLITES

THE WAY OF WORKING FM AND SSB SATELLITES ARE COMPLETELY DIFFERENT.

BE AWARE OF THE TYPE OF SATELLITE YOU ARE ON

IT LOOKS MORE LIKE THE TRADITIONAL RADIO WE KNOW:

- WE CAN CALL CQ
- EXCHANGE MORE INFORMATION
- EVEN WE CAN ENJOY A NICE CHAT



7.1- SOME TIPS ON SSB

IF WE ARE IN A SSB TRANSPONDER WE HAVE ALWAYS TO HAVE A LOOK ON THE BEACON, THAT WAY WE WILL ASSESS THE RECEIVED SIGNAL WITHOUT THE NEED OF TRANSMISSION OR LISTEN TO THE TRAFFIC

ALWAYS PROGRAM A MEMORY OR THE TRACKING SOFTWARE, FOR THE BEACON

FIRSTLY EVERYBODY TEND TO TRANSMIT IN THE CENTRAL QRG, YOU WILL BE OVER-MODULATED, THEY ARE ONLY TRYING TO HEAR THEMSELVES IN THE DOWNLINK.

ALWAYS MOVE AT LEAST +/-5KhZ AWAY FROM THE CENTRAL FREQUENCY FOR CALLING

IF YOU DO NOT WANT TO CALL, QUICK-SCAN THE WHOLE BANDWIDTH TRANSPONDER, YOU CAN FIND NICE SURPRISES ON BOTH EDGES.

IF YOU HAVE A SDR, WITH A QUICK LOOK YOU WILL BE AWARE OF EVERYTHING, YOU ARE NOT GOING TO LOST ANY MOVEMENT AND THE BEACON WILL ALWAYS GIVE YOU INFO ABOUT TRANSPONDER SIGNAL. 31

7.2- THE POWER ON SSB

A LINEAR TRANSPONDER DISTRIBUTES THE OUTPUT POWER AMONG THE STATIONS TO BE REPEATED.

IN ORDER TO AVOID THE FACT OF AN UNIQUE STATION USE ALL THE POWER OF THE TRANSMITTER, MOST SSB SATS ARE EQUIPPED WITH AN AGC IN THE TRANSPONDER. THE ASSIGNED POWER OF A HUGE RECEIVED SIGNAL WILL BE LIMITED BY THE TRANSPONDER ITSELF AND IT SHOULD NOT AFFECT THE PASSBSAND

HOW MUCH POWER SHOULD I USE? IT DEPENDS ON MANY FACTORS

THE GENERAL RULE OF THE MINIMUM POWER TO GET THE CONTACT IS NOT VALID



7.2- THE POWER ON SSB

<u>IF YOU HAVE A POOR RECEPTION</u> OR FADING AND YOU INCREASE THE POWER IN YOUR TRANSMISSION MAYBE YOU NEED 100W TO FINALLY GET THE CONTACT, WHICH IS REALLY TOO MUCH IF YOU ARE ALIGNED WITH THE SATELLITE ALONG THE PROPER POLARIZATION

HOWEVER IF YOU HAVE A NICE RECEPTION, AND YOU WELL-RECEIVE THE BEACON, BUT YOU TRANSMIT WITH NON-ALIGNED LINEAR POLARIZATION, MAYBE YOU WILL NEED 100W TO GET THE SATELLITE AT CERTAIN PERIODS. IF YOU HAVE THE OPPOSITE POLARIZATION (-200B) YOUR EQUIVALENT TRANSMISSION WOULD BE 0,8W

IF YOU HAVE LINEAR POLARIZATION AND YOU ARE NOT ABLE TO HEAR THE BEACON DO NOT TRANSMIT, YOU ARE NOT GOING TO HEAR YOURSELF IN THE DOWNLINK, YOU WILL NOT KNOW IF YOU REACH THE SATELLITE THOUGH OTHER STATIONS HEAR YOU.



IF YOU HAVE A GOOD RECEPTION (POLARITY CHANGE) AND YOU ARE ABLE TO CHANGE THE TRANSMISSION POLARITY WITH 10W IS ENOUGH....

7.3- A SPECIAL CASE: AO-7

IT IS A SATELLITE WITHOUT BATTERY, ONLY SOLAR PANELS, THAT'S WHY A STRONG INPUT SIGNAL CAN CAUSE A VOLTAGE FALL WITHOUT ENOUGH TIME FOR THE AGC ACTS TO LIMIT THE POWER OUT

IF YOU ARE USING A YAGI ANTENNA,



AO-7 SHOULD NOT BE EXCITED WITH MORE THAN 10W UNDER NO CIRCUMSTANCES

DUE TO ITS LARGE FOOTPRINT, DX STATIONS AND LONG DISTANCES QSO'S ARE AFFORDABLE, USE IT FOR THAT. IT IS A JEWEL THAT WE CAN NOT ALLOW ITS MISUSE.

8- PLANNED QSOS ON THE BORDERLINE

WE LOOK LIKE AS WE WERE CIRCUS ARTISTS LOOKING FOR THE "EVEN MORE DIFFICULT" QSO. THERE ARE CONTACTS, IN MANY OCCASIONS, WITH LESS THAN 1' OF COMMON FOOTPRINT

IF YOU PLAN IT IN ADVANCE THE SUCCESS PROBABILITY WILL INCREASE DRAMATICALLY

STUDY CAREFULLY THE BEST LOCATIONS AND CHOOSE THE BEST SATELLITES PASSES FOR BOTH STATIONS

HAVE EVERYTHING READY, AT LESS 20' IN ADVANCE (COMPUTER ON, LNA TESTING, PTT, ...)

CHOOSE A NON-USED FREQUENCY WITHIN TRANSPONDER BANDWIDTH FAR AWAY FROM THE CENTRE

DO NOT ANNOUNCE SO MUCH YOUR ACTIVITY, THERE ARE REALLY ANXIOUS PEOPLE WHO CAN SPOIL THE PREVIOUS PLANNED WORK

FINALLY, EVEN IF YOU ARRANGE CONTACTS IN A SPECIFIC FREQUENCY "THIS FREQUENCY WILL NOT BE THE SAME FOR BOTH", DOPPLER WILL BE DIFFERENT FOR EACH ONE

DOPPLER DEPENDS ON TWO FACTORS:

- USED FREQUENCY



- THE SPEED OF THE SATELLITE MOVEMENT IN REGARD OF OUR POSITION

THE DOPPLER BETWEEN TWO STATIONS LOCATED IN DIFFERENT PLACES WILL BE ALWAYS DIFFERENT

THE DOPPLER DIFFERENCE WILL BE MORE SIGNIFICANT BETWEEN STATIONS LOCATED IN THE EXTREMITIES OF THE FOOTPRINT AND ALONG THE SAME DIRECTION THAN THE SATELLITE DISPLACEMENT

IT WILL BE LESS IMPORTANT WHEN, EVEN BEING IN THE FOOTPRINT EXTREMITIES, STATIONS ARE LOCATED ALONG A PERPENDICULAR DIRECTION TO THE MOVEMENT AXIS

PASS SEEN FROM IM78



PASS SEEN FROM JH72



SATELLITE A0-7 U/V 22/08/2019 17h39'

	IM78MM (B)	JH72MM (A
VHF DOPPLER	+2,754	-2,631
UHF DOPPLER	-8,153	+7,790

THE SATELLITE GETS AWAY FROM JH72 AND COMES CLOSER TO IM78

THE MEETING QRG IS ESTABLISHED AS FOLLOWS:

"THE STATION(A) WILL BE LISTENING IN 145,950"

WHAT RECEPTION FREQUENCY DOES HAVE TO TUNE THE STATION B?

BOTH STATIONS TUNE THEIR QRG IN TRANSMISSION FOR THE CHOSEN RECEPTION











IBERRADIO ÁVILA 2019 – EA4CYQ Juan Antonio Fernández Montaña