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Authors (Institutes)	José A. López-Pérez (UAH-IGN), Félix Tercero (UAH-IGN),

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1 Introduction

BRAND-EVN is a work package of the RadioNet project funded by the European Union's Horizon 2020 research and innovation programme, under grant agreement No. 730562.

The purpose of this work package is the development of a prototype prime focus broad-band digital receiver in the 1.5 – 15.5 GHz for VLBI with EVN (European VLBI Network) radio telescopes.

In this work package, some input information is required from the EVN stations in order to have all the relevant information to accomplish the design of the receiver. The first steps in this work package comprise the following tasks:

- Collection of geometrical/optical parameters of EVN radio telescope in order to provide recommendations about BRAND receiver installation.

- Evaluation of the RFI environment in three EVN radio telescopes with strong interest in BRAND receiver installation: Effelsberg, Westerbork and Yebes. This evaluation is required to decide whether RFI mitigation techniques have to be implemented in the receiver, as its operating band will be shared with multiple telecommunication services.

For the sake of clarity, the input information is written in the appendixes of this report while the main body of the report summarizes a set of recommendations about BRAND receiver to be considered in later design stages.

2 BRAND receiver layout

This section shows block diagram of the BRAND receiver. It can be seen in Figure 1, and it follows a similar approach as other broad-band receivers, such as the VGOS 2 – 14 GHz one.

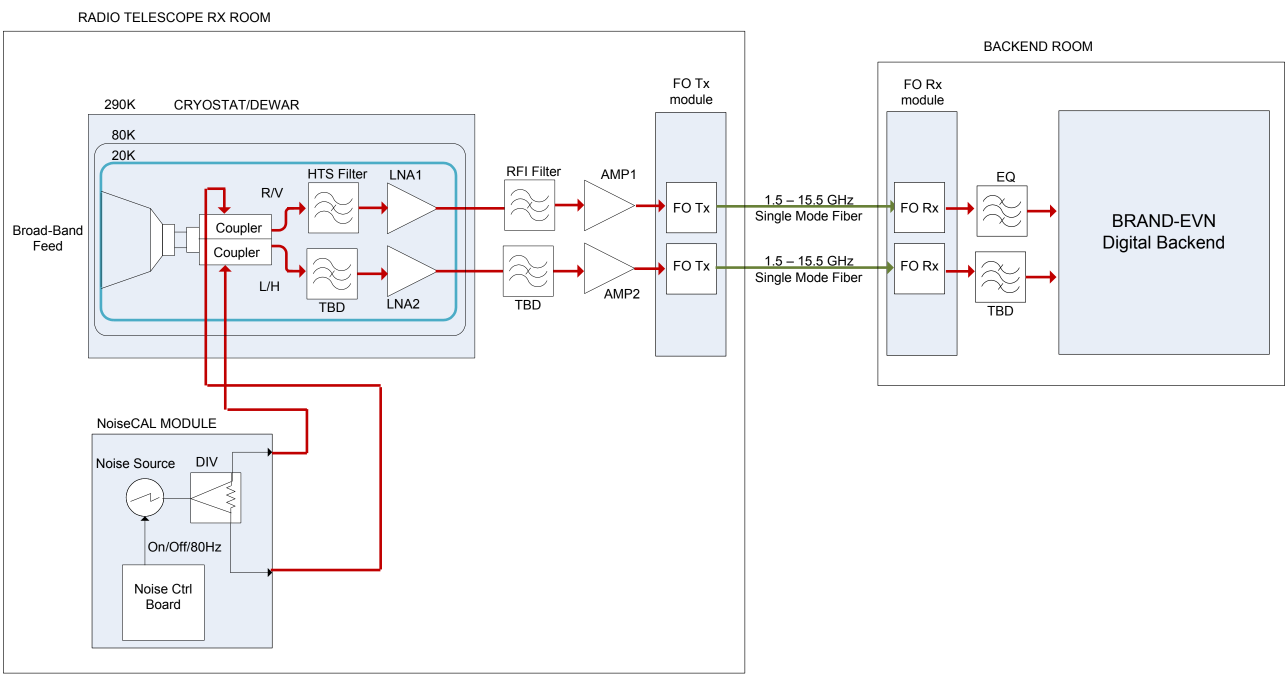

Figure 1: Broad-band receiver block diagram.

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The radio telescope receiver room can be located in either prime focus or secondary focus of the radio telescope, depending on the optical configuration. The receiver's dewar will be placed this room, so helium pipes from the compressor will have to be provided up to this point.

Depending on the final location of the receiver (either prime or secondary focus), the receiver broad-band feed horn will be different, as the illumination angle and taper will be different too for each radio telescope. The feed will provide two outputs, one for each orthogonal polarization of the incoming waves.

After the broad-band feed, directional couplers, working in the range 1.5 – 15-5 GHz at cryogenic temperatures, will be needed to inject the noise calibration signal from the NoiseCal module, which is required for amplitude calibration.

The following device in the receiver chain is the high-temperature superconducting (HTS) filters for RFI rejection. They are low-loss devices, so they can be installed in front of the LNA to avoid saturation or intermodulation due to strong RFI, at the cost of a little degradation of receiver noise temperature. These devices will likely be different for each radio telescope too, as the RFI environment is not the same in all EVN sites.

Then, the broad-band cryogenic low noise amplifiers are the first active device in the receiver chain. They will be designed in BRAND work package 6.2.4.

After them, the block diagram considers a new set of RFI filters at room temperature. It may happen that the HTS filters won't be required at some sites, but the room-temperature amplifiers at the input of the fibre optic transmission system could be driven into saturation, due to the large amount of power (signal + RFI) at the dewar's output in the whole BRAND frequency band. In this case, the strongest RFI signals might be rejected with room temperature filters, which are cheaper than HTS ones.

The room temperature amplifiers (AMP1 and AMP2 in the diagram) are usually required because the noise figure of the fibre optic transmission system is high (20 dB, typically). If these amplifiers are not installed, there will be contribution from the fibre optic system to the total receiver noise.

As the frequency range is so broad, the signal transport from the front-end to the back-end can't be performed through coaxial cable. This is because coaxial cable shows a steep slope in transmission loss versus frequency, while fibre optic systems have a flatter response with little losses or even gain. Nevertheless, some equalization might be required at the input of the digital backend.

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3 Receiver recommendations

Recommendations about RFI

This section will provide some recommendations about RFI, which can be concluded from the measurements shown in Appendix 1: RFI measurements in the framework of BRAND-EVN project.

3.1.1 Low noise amplifier input power limit estimation.

According to [2], the input power at -1 dB gain compression point of broad-band low-noise amplifiers has been measured to be -30 dBm. In order to establish a security margin to ensure linear operation of the amplifier, a power 10 dB lower that this point should be considered. Then, if a maximum power of **-40 dBm** is imposed at the input port of the amplifier, linear regime and absence of intermodulation products can be assumed.

As a result, all the RFI signals that produce a radio telescope received power higher than -40 dBm at the LNA input port should be rejected.

3.1.2 RFI power spectrum discussion.

In Figure 13 of Appendix 1: RFI measurements in the framework of BRAND-EVN project, it can be seen the power received by an isotropic antenna (0 dBi) on each measurement site in the full azimuth range. An isotropic antenna has been selected for this plot because RFI is commonly received through radio telescope beam side-lobes, and it is easy to compute the receiver power for any other antenna by just adding its gain.

A good approximation for radio telescope beam gain is modelled in recommendation ITU-R SA.509 in the range 2 – 30 GHz. In this model, the side-lobe level varies with angular distance (θ, in degrees) from the main axis as:

$$SLL\ (dBi) = 32 - 25 \cdot log\theta$$

$$1° < \theta < 48°$$

A SLL of 0 dBi corresponds to an angle of 19º. As a result, it can be said that Figure 13 is showing the RFI power spectrum received on each site at 19º elevation, when turning the radio telescope by 360º in azimuth.

From that plot, it can be seen that none of the RFI surpasses the -40 dBm established in section 3.1.1. The maximum levels are -65 dBm for Yebes, -75 dBm for Westerbork and -55 dBm for Effelsberg. However, when the power spectrum is integrated in the BRAND frequency range (1.5 – 15.5 GHz) the power at the amplifier input will be higher, as shown in the following table.

Place	Total Integrated Power (dBm) assuming 0 dBi gain
Yebes	-53.7
Westerbork	-70.3
Effelsberg	-48.5

Table 1: Total RFI power integrated in 1.5 - 15.5 GHz.

Three considerations have to be mentioned concerning Table 1. Firstly, the power outside the BRAND frequency range has not been included, so the total RFI power could actually be even

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higher, depending on the selectivity of the actual feed, HTS filters and LNAs. Secondly, the spectrum from all azimuth directions is being integrated, which is is not a realistic approach, as only the signals coming from the front of the radio telescope should be included (back lobes usually have very low gain). Thirdly, the numbers are including the power from both polarizations and each amplifier will be fed with signal from one polarization only.

Therefore, keeping in mind the above three considerations and the estimated LNA input power limit, it can be concluded that RFI will not drive the LNA into saturation or intermodulation, when the RFI signals come from the ground and the radio telescope points at elevation angles higher than 19º. Nothing can be assured in other conditions.

However, special care will have to be taken in the design phase with the first room temperature amplifiers and fibre optic transmission system, as they can be driven into saturation and intermodulation when fed with the signal from the dewar's output.

Feed and optics in primary

There are several suitable wideband (7:1) feeds developed in the VGOS project that they could be a good chose for the primary focus illumination (Eleven [3], QRFH [4] and Dyqsa [5]). All of them have the common characteristic of having a similar FED optimal behaviour illumination figure. They are small enough to be cooled down and dual polarization feeds. Differences remain in the feeding network system, that it must be taken into account with receiver side recommendations. From the optical point of view, any of the mentioned feeds (extended in a (1:10) bandwidth to accomplish the BRAND specifications) would be a good choice in the primary focus.

Additional analysis of the individual feed and antenna should be done in order to have the better one in each telescope.

Feed and optics in secondary

The wide range in magnification figures of the surveyed antennas makes not realizable to have a single feed receiver for just all the antennas. Tailored optics is mandatory to match the feed illumination angle to the sub-reflector optimal figure. As a consequence, the optical secondary design is not as straightforward as the primary design. The wideband feed that it can designed to have different angles of illumination is the QRFH. Both Dyqsa and Eleven feed work at a fixed beam-width. As a preliminary recommendation, a tailored QRFH design could work in the secondary focus of each antenna. As in the primary focus recommendation, a 1:10 bandwidth feed must be developed first, to use it as solution.

The second alternative is the use of a wideband feed and an additional mirror as tertiary optics. These kinds of assemblies are usually bulky and bigger than a single feed arrangement. The optical system with a mirror adds some degree of freedom to choose a mirror and feed geometry that fits with subtended sub-reflector angle. This solution allows to play with different beamwidth feeds. In this case it is interesting because we could choose the wider bandwidth feed to match with an additional mirror. Approximate calculation of the mirror size has been done to have a ROM of the system size. It has been calculated to be a mirror that truncates the beam to the subreflector at -20 dB (with gaussian beam illumination, the losses are 1-2% and they mean 3-6K of additional noise in the receiver noise temperature). Next table shows the approximate mirror size for the surveyed radio telescopes.

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Antenna	**Aprox. Mirror projected aperture (m)**	**Any limiting existing aperture to use this mirror?**
Yebes40m	2.7	Yes, M3 and M4 Nasmyth mirrors diameter 1.9m
Onsala20m	1.5	No
Onsala25m	0.9	No
Efelsberg100m	1.8	No
Medicina32m	1.3	No
NSRT26m(Ur)	0.9	No

Only Yebes40m cannot install a 2.7m mirror inside its secondary focus cabin because the nasmyth focus mirrors are smaller than the required size of additional optics. It is a low frequency limitation, so in case that a portion of the low frequency band near 1.5 GHz was not used, the mirror size could be relaxed to be lower than currently proposed, but this implies that the low part of the BRAND band would be sacrificed.

The definition of the secondary focus optics is part of the next work-package and it will follow the two alternatives of designs proposed here to study the feasibility of both solutions.

Dewar

Maximum room for whole receiver in primary focus position is a cylinder of 540 x 1190 mm (diameter x length) limited by the Yebes40m. Detailed interfacing information must be provided because around the feed position free room is limited with a diameter of 250mm. A dewar design with a *cap* is desirable to fit in the small room around primary focus of the Yebes40m. Basic interface equipment is installed in all antennas but Yebes40m should install helium pipes in the primary focus in order to have the capability of observing in primary focus mode.

4 Conclusions

There has been at present a low response from the EVN institutes in the answer of the questionnaire (6/30). The collection of the responses is continuing.

At least three EVN stations could hold the BRAND receiver installed in primary focus (Yebes40m, Efelsberg100m and Medicina32m). They all three are interested in purchasing a BRAND receiver in the future.

The conclusions about the secondary focus are not so straightforward because of the different antenna magnification. However two working paths are proposed to get the optical solution: a single QRFH tailored for each antenna and a combination of feed and mirror.

An extended 1:10 bandwidth frequency coverage feed of Eleven, QRFH and Dyqsa is suitable to be used in the primary focus receiver. At the moment, there is not such a frequency bandwidth antenna ready. They are small enough to be cooled down.

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5 References

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[2] I. López-Fernández, C. Díez-González, A. García-Castellano, J. D. Gallego-Puyol "Y214G 1012 2-14 GHz cryogenic low noise amplifier report". Yebes Internal Technical Report 2016-28, available at: http://www1.oan.es/informes/archivos/IT-CDT-2016-28.pdf

[3] A. Akgiray, S. Weinreb, W. Imbriale et al., "Circular Quadruple-Ridged Flared Horn Achieving Near-Constant Beamwidth Over Multioctave Bandwidth: Design and Measurements", *IEEE Trans. On Antennas and Propagation,* vol. 61, March 2013, pp. 1099-1107.

[4] R. Olsson, P. Kildal, S. Weinreb, "The Eleven Antenna: A compact Low-Profile Decade Bandwidth Dual Polarized Feed for Reflector Antennas", IEEE Trans. On Antennas and Propagation, vol. 54, February 2006, pp. 368-375.

[5] E. Garcia, S. Llorente, A. Lampérez et al., "Dyson Conical quad-spiral array as ultrawideband feed system", Antennas & Propagation Conference (LAPC), 2015 Loughborough

Appendix 1: RFI measurements in the framework of BRAND-EVN project

A.1.1 Introduction

BRAND-EVN work package will develop a prototype broad-band receiver in the range 1.5 - 15.5 GHz for the European VLBI Network (EVN) of radio telescopes. This prototype is to be installed in the prime focus of the 100 meter Effelsberg radio telescope.

As this frequency range is populated with several telecommunication services and the receiver will be very sensitive, there is a risk of receiver saturation, intermodulation, and even cryogenic low noise amplifier (LNA) damage due to the reception of strong interference signals. All these issues can degrade the receiver performance seriously.

As a result, one of the very first tasks of the BRAND-EVN work package is to perform a measurement of the radio frequency interference (RFI) environment in those observatories with strong interest in such a broad-band receiver.

This section will show the results of RFI measurements performed with standardised equipment used in Effelsberg, Westerbork and Yebes observatories. The purpose is to determine the frequency and level of unwanted radio signals/emissions that could degrade the performance of the BRAND receiver.

The analysis of these measurements will allow the definition of RFI mitigation techniques, such as high temperature superconducting (HTS) filters in front of the LNAs, to avoid degradation of BRAND receiver performance.

It has to be noted that the measurements are given in logarithmic electric field intensity units (dB(uV/m)) at the measurement site, which is independent from the measurement equipment, and allows the computation of received RFI levels with any other antenna with known gain.

Other EVN observatories in the frame of the BRAN-EVN work package, willing to perform the RFI measurements on their own, were taught on how to use the RFI instrumentation during the RFI workshop performed at Yebes Observatory during the 7^{th}-8^{th} of June, 2017. This measurement equipment could be borrowed from Yebes Observatory at no cost other than transportation from and to Yebes.

Firstly, the RFI measurement equipment available from Yebes Observatory, and measurement locations will be shown. After this, a direct comparison of RFI levels between the three observatories will be performed at different frequency bands.

A.1.2. Description of RFI measurement equipment

Details on the instrumentation used for the RFI measurements, the characterization of this equipment in order to calibrate the measurements, the conversion formulas to convert dBm units from the spectrum analyzer to dB(uV/m), the measurement procedure and datasheets of each device are given in [1].

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A.1.3. Description of RFI measurement locations

Table 2 shows the geographical parameters of the three measurement locations and Figure 2, Figure 3 and Figure 4 show a picture of the measurement equipment in each location. The support provided by the local staff at each observatory is appreciated.

In Yebes and Westerbork, only one place in each observatory was measured. However, three places were measured in Effelsberg: on the roof of the main building, on top of the subreflector room with the 100 meter radio telescope pointing to the zenith and at the entrance of the visitor's centre. The results shown for Effelsberg correspond to the ones on top of the subreflector room, as it was the worst case.

Date	Place	Latitude (+N)	Longitude (+E)	Altitude (m)	Elevation angle
2017-03-07	Yebes	40º 31' 28.7"	-3º 5' 18.8"	927	0º
2017-04-03	Westerbork	52º 54' 57.8"	6º 35' 42"	38	0º
2017-05-04	Effelsberg	50º 31' 29.7"	6º 53' 2.8"	420	0º

Table 2: Description of measurement locations.

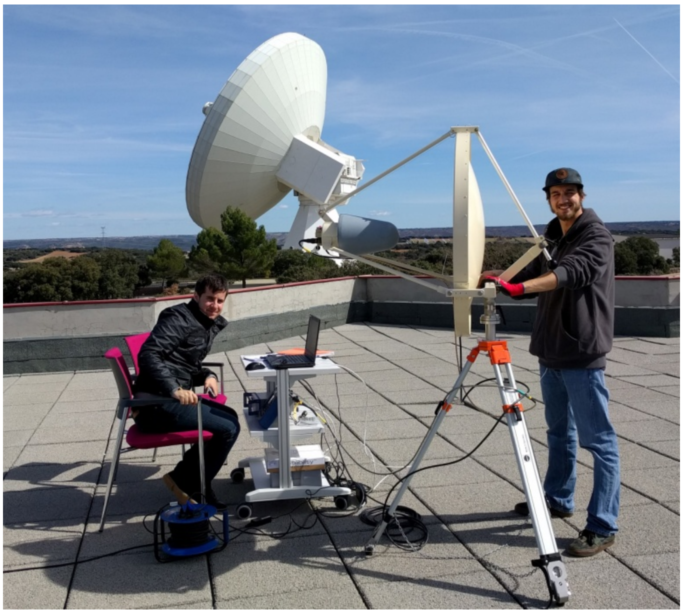

Figure 2: RFI measurements on the roof of Yebes laboratory building.

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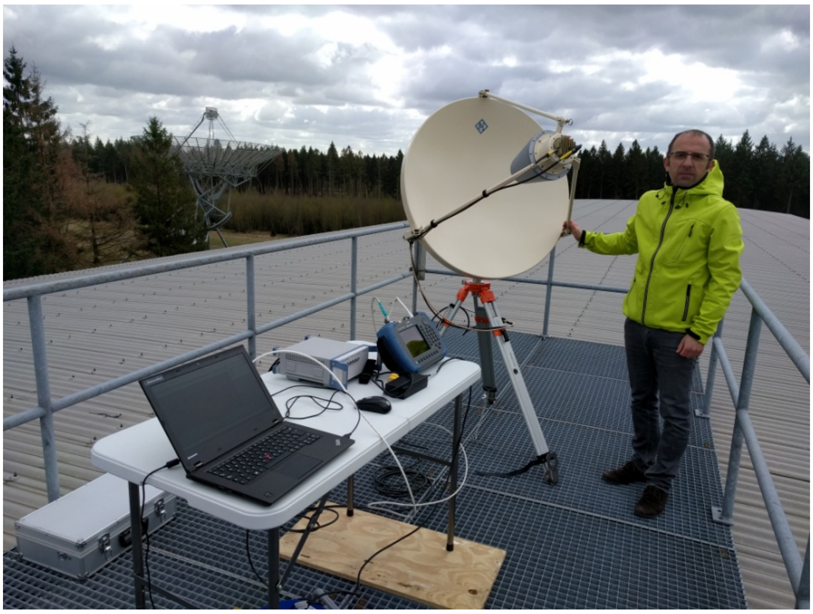

Figure 3: RFI measurements on the roof of the Westerbork construction building.

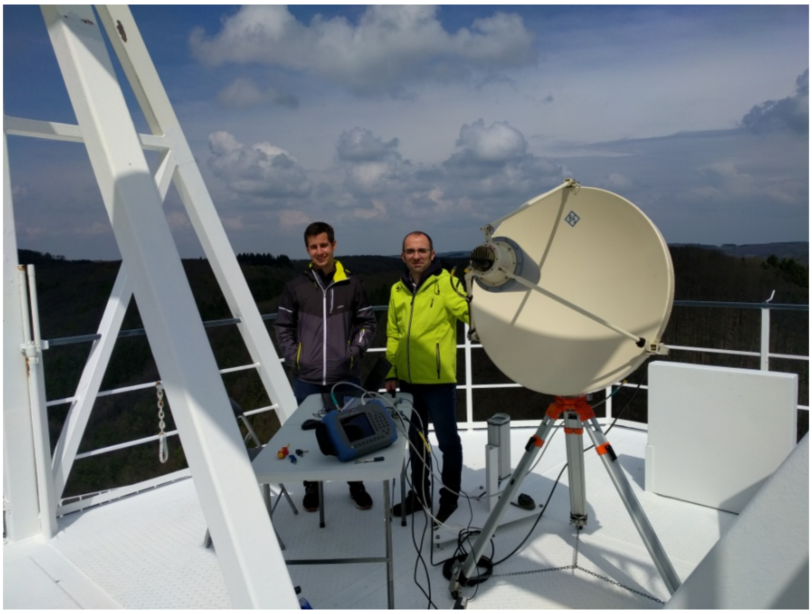

Figure 4: RFI measurements on top of Effelsberg radio telescope subreflector room.

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A.1.4. RFI measurement results

The following set of plots show a comparison of the RFI spectrum in each measurement location through different frequency bands. The vertical axis is given in electric field units, as mentioned above, and accounts for the total E-field, i.e., the root-sum-squared of both E-field linear polarizations (horizontal and vertical).

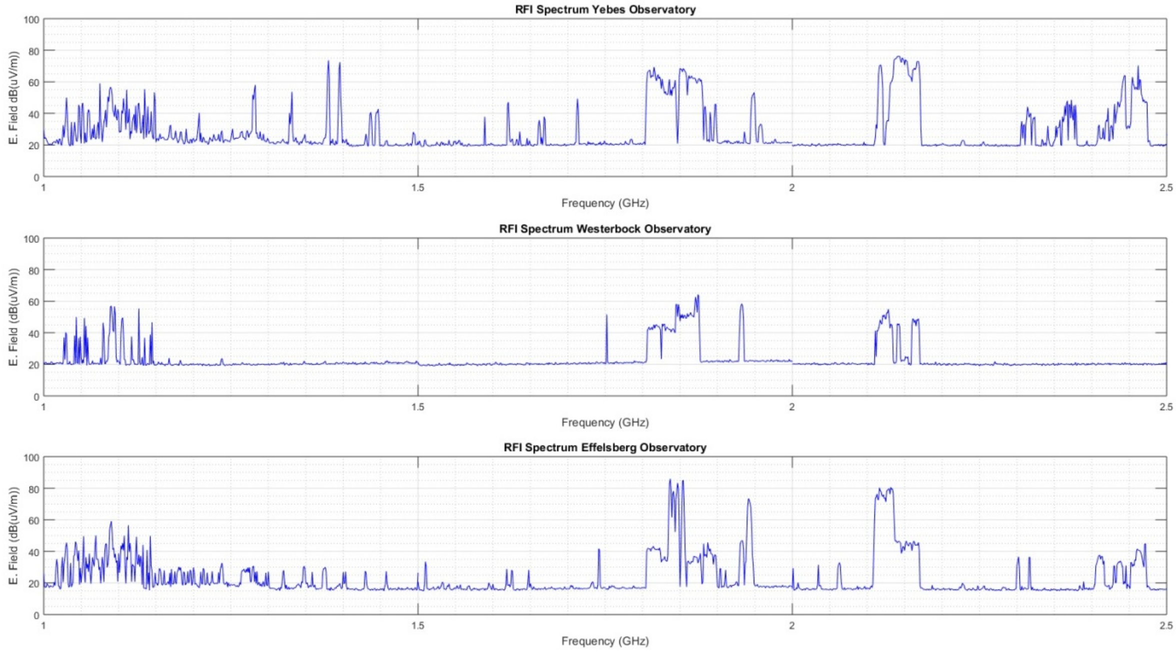

Figure 5: 1 - 2.5 GHz RFI spectrum comparison.

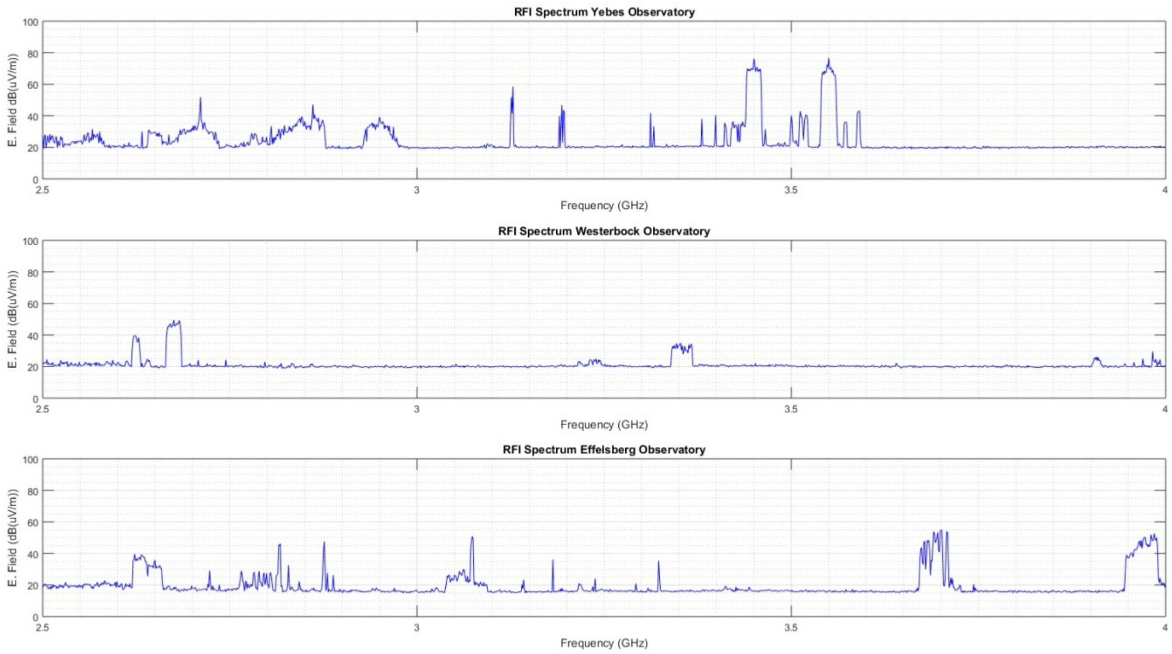

Figure 6: 2.5 - 4 GHz RFI spectrum comparison.

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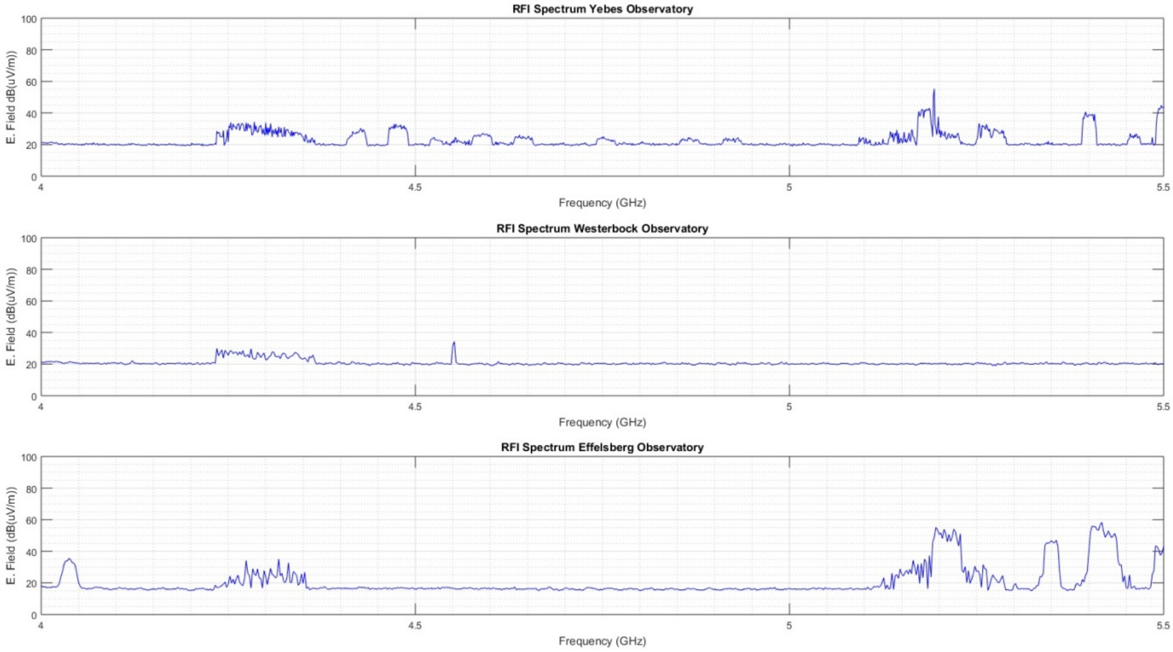

Figure 7: 4 - 5.5 GHz RFI spectrum comparison.

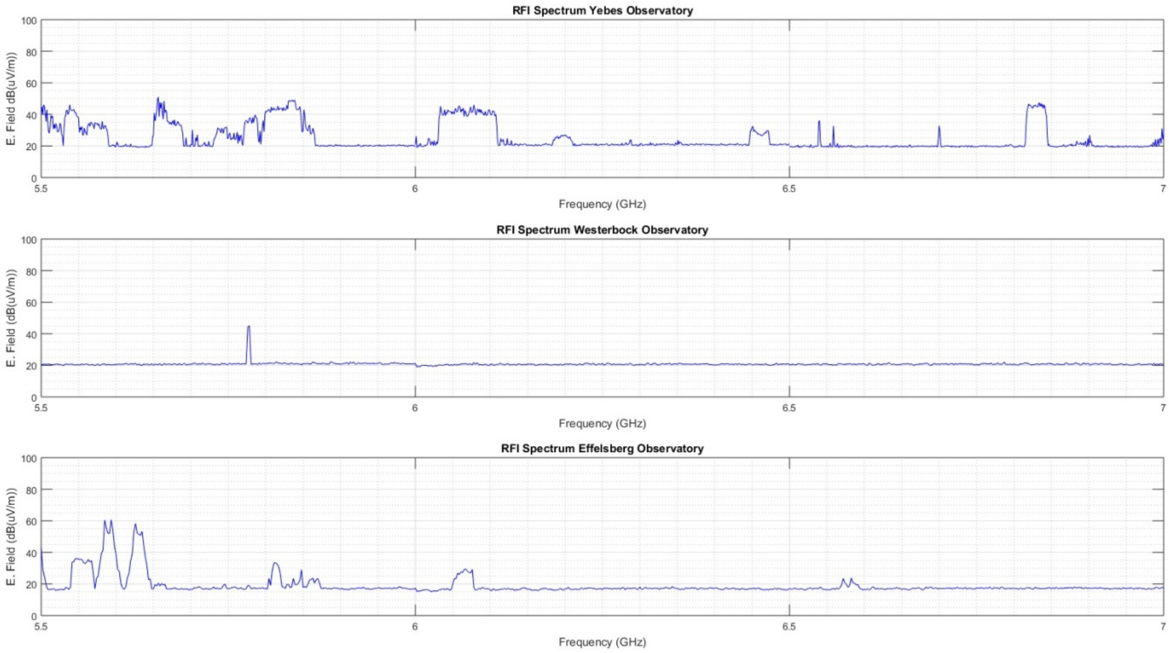

Figure 8: 5.5 - 7 GHz RFI spectrum comparison.

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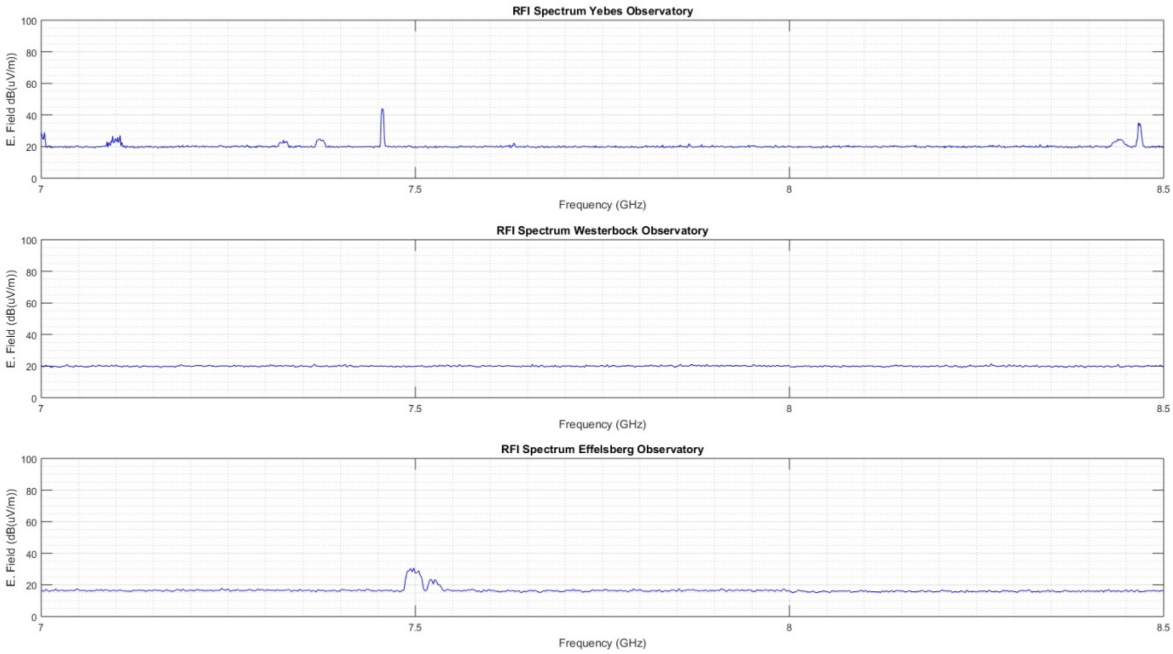

Figure 9: 7 - 8.5 GHz RFI spectrum comparison.

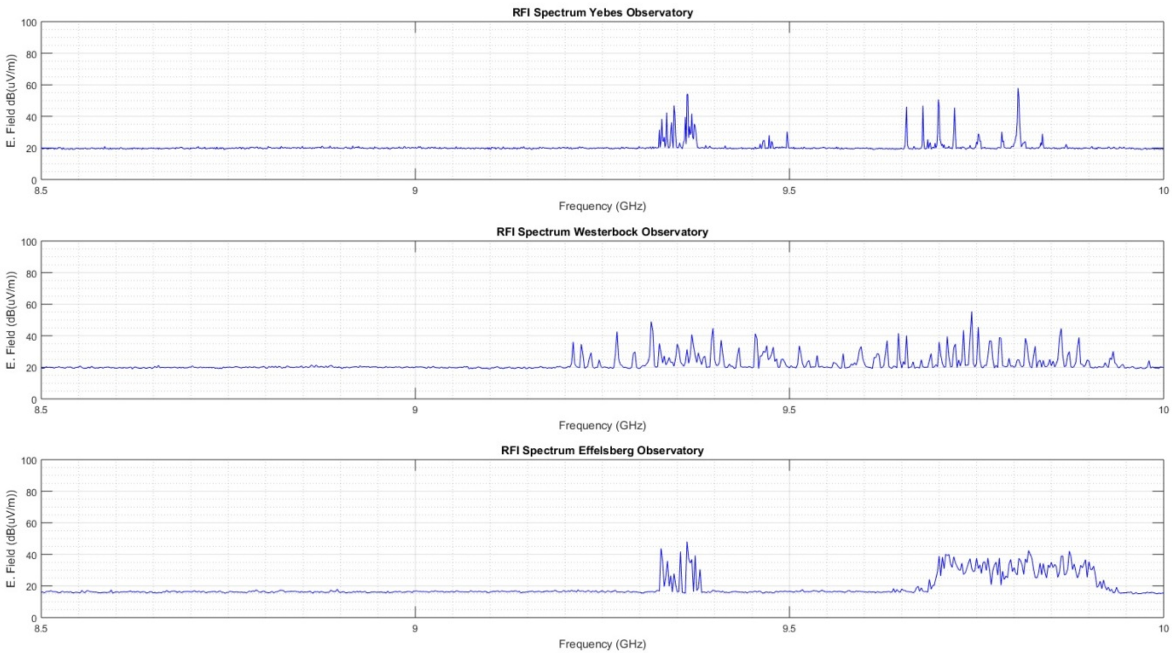

Figure 10: 8.5 - 10 GHz RFI spectrum comparison.

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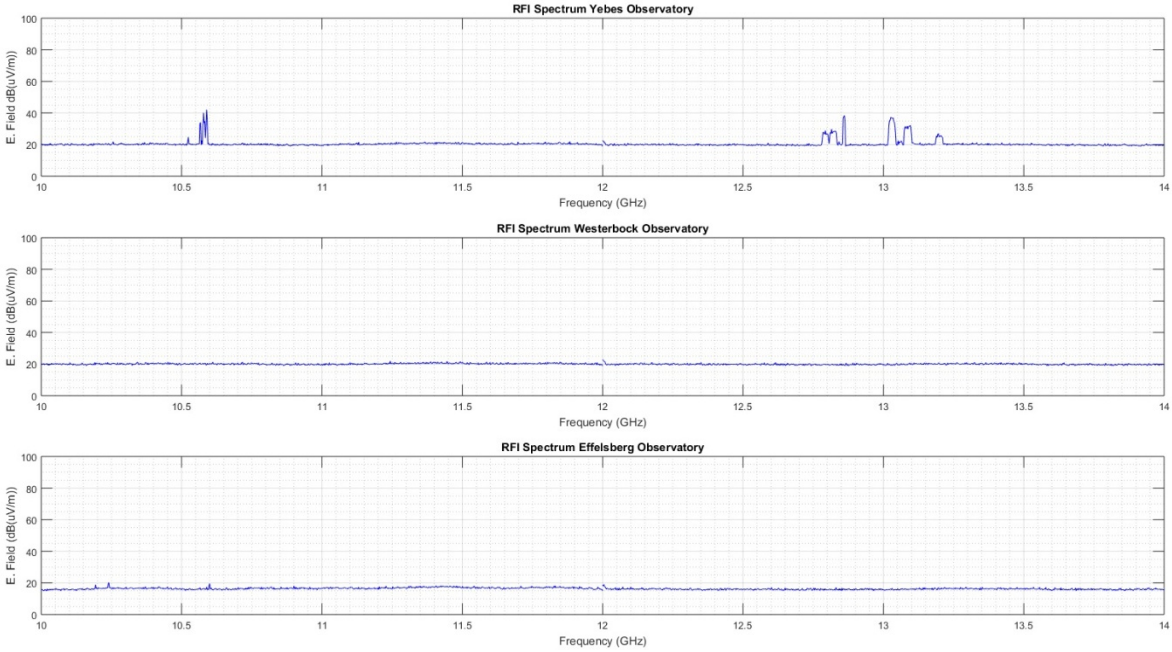

Figure 11: 10 - 14 GHz RFI spectrum comparison.

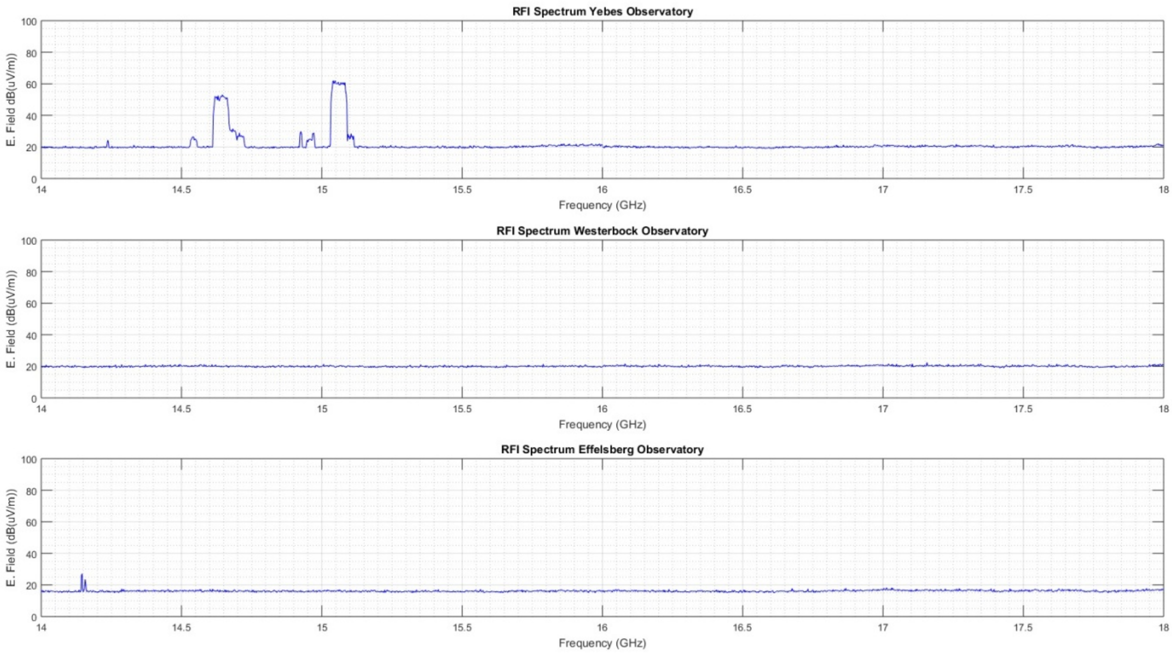

Figure 12: 14 - 18 GHz RFI spectrum comparison.

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From this set of measurements, the received power by an isotropic antenna (0 dBi) has been computed and plotted too for each site. This is shown in Figure 13. From this picture, it is easy to compute the power received by any other antenna, just adding its gain, or the level received through side-lobes by adding the side-lobe gain.

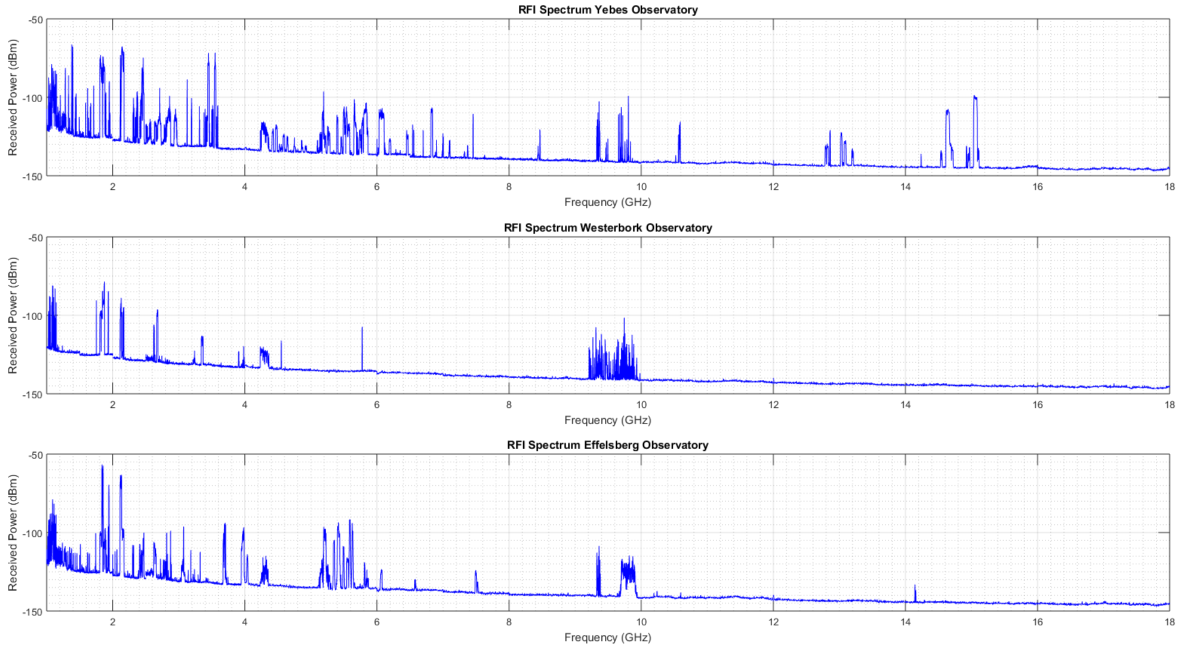

Figure 13: Comparison of received power by an isotropic antenna.

Appendix 2: Antenna questionnaire and results

A.2.1 Introduction

The specifications for the installation of a BRAND receiver at the EVN antennas depend on individual antenna current configuration. The EVN is an inhomogeneous network made of completely different antennas run with different institutions. The main goal of the BRAND project is not only to have a receiver prototype installed in the *proof of concept* antenna, which it will be described and tested in the next project deliverables. The main goal is to have a roadmap design to adapt the general receiver design to any individual antenna of the EVN. It should follow a general design with a design methodology that it could be matched to each individual antenna. With this purpose, a previous survey on interested antennas has been made to have main inputs characteristics of the EVN antennas. This survey asks for general specifications of the antennas to drive a general design that it could be matched to any of the antennas in the future. The previous knowledge of general technical specification is an essential requirement to start with the general design as well as assure a good dissemination of the receiver's design with the EVN antennas.

In order to collect all the relevant data of the EVN stations, two actions were done in this first period of time: a standard questionnaire to collect basic data from stations and RFI measurements in three EVN station. After these two actions, collected data were used to have an overview of plausible designs and recommendations.

A.2.2 Inputs from stations

A.2.2.1 Antenna questionnaire description

General information of the next areas was asked:

- Antenna identification: Basic antenna data, location, person of contact and possible interest in purchasing a BRAND receiver.
- Antenna general data: Main observing modes (primary and/or secondary) and basic interfacing equipment.
- Antenna primary reflector data: Geometrical optical data and taper of feeders
- Antenna secondary reflector data: Geometrical optical data and taper of feeders
- Antenna system optical data (both primary and secondary): Optical system data including the magnification and total surface accuracy.
- Tertiary optics and reflectors in receiver's cabin: Additional mirrors used to guide the beam to receivers (in case that it is used in the antenna)
- Room for primary focus BRAND receiver: Approximate available room, in case that BRAND receiver were installed in primary focus
- Room for secondary focus BRAND receiver.
- References from station: Additional references to clarify, to add or show relevant information.
- Comments: Short piece of information to clarify some of the cells filled before

The questionnaire was sent with additional instruction to fill it. Both are in Appendix A3.1

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A.2.2.2 Antenna questionnaire answers

The questionnaire and the instructions to fill it were sent to the VLBI list currently in use in EVN to participants in Europe, Africa and Asia (more than 30 people from different institutions). The antennas which fed-back are in the next list and the detailed input information of the received surveys can be found in the Appendix A3.3.

Yebes Observatoy (IGN-UAH)	Yebes40m
Onsala Observatory (OSO)	Onsala20m
	Onsala25m
Efelsberg Observatory (MPIfR)	Efelsberg100m
Metsähovi Observatory	MCA5.5m
Medicina Observatory (IRA-INAF)	Medicina32m
NSRT	NSRT26m(Ur)

Related with capability of primary observation, only big main dish antennas (Yebes40m, Efelsberg100m and Medicina32m) have the capability of observing in primary. They have basic interfacing equipment to install a receiver in the primary. They have also a similar FED (Focal Equivalent over Diameter) figure. They have also room enough for installation of a receiver in primary focus.

The surveyed antennas are all capable to observe in secondary focus. In this case, the antenna magnification for the several radio telescopes changes from 21 to 6. As a consequence, the illumination angle of the subreflector varies from 3.6º to 14.4º(1).

Not much information was reported about the secondary zone or beam wave guide. Size of vertex holes seemed to be big enough to let the 1.5GHz beam receiver installation without truncation.

Information with envelopes for installation of receivers has been reported and it is a good starting point to define the cryostat and optics.

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(1) MCA5.5 has been excluded in this analysis because no consistent data of the geometry in the secondary focus was reported.

Appendix 3: Questionnaire sent to EVN stations

A.3.1 Questionnaire sent to stations

group	id.	parameter	symbol	unit
ANTENNA ID.	1	ANTENNA NAME		
	2	LONGITUDE	long	deg
	3	LATITUDE	lat	deg
	4	ALTITUDE	alt	m
	5	CONTACT NAME		
	6	CONTACT EMAIL		
	7	INTERESTED IN PURCHASING A BRAND RECEIVER		
ANTENNA GENERAL	8	OBSERVATION FROM PRIMARY		
	9	BASIC INTERFACING EQUIPMENT IN PRIMARY FOCUS		
	10	IF SIGNAL TRANSPORTATION FROM PRIMARY TO CONTROL ROOM		
	11	OBSERVATION FROM SECONDARY		
	12	BASIC INTERFACING EQUIPMENT IN SECONDARY FOCUS		
	13	IF SIGNAL TRANPORTATION FROM SECONDARY TO CONTROL ROOM		
	14	ANTENNA MOUNT		
	15	MAIN OPTICS CONFIGURATION		
PRIMARY REFLECTOR	16	DIAMETER PRIMARY	Dp	m
	17	FOCAL LENGTH PRIMARY	fp	m
	18	F.E.D. PRIMARY	fp/Dp	
	19	EDGE SUBTENDED SEMIANGLE PRIMARY	φv	deg
	20	REFLECTOR DEPTH PRIMARY	hp	m
	21	STANDARD EDGE TAPER PRIMARY	ETp	dB
SECONDARY REFLECTOR	22	DIAMETER SECONDARY	Ds	m
	23	FOCAL LENGTH SECONDARY	2c	m
	24	ECCENTRITY	e	
	25	REFLECTOR DEPTH SECONDARY	hs	m
	26	STANDARD EDGE TAPER SECONDARY	ETs	dB

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ANTENNA SYSTEM	27	MAGNIFICATION	m	
	28	F.E.D. SECONDARY		
	29	EDGE SUBTENDED SEMIANGLE SECONDARY	φr	deg
	30	DISTANCE FROM PRIMARY FOCUS TO SECONDARY VERTEX	Lv	m
	31	DISTANCE FROM SECONDARY FOCUS TO SECONDARY VERTEX	Lr	m
	32	DISTANCE BEHIND PRIMARY REFLECTOR TO SECONDARY FOCUS	h0	m
	33	TOTAL SURFACE ACCURACCY	eps	um
RECEIVERS CABIN REFLECTORS AND APERTURES	34	DIAMETER OF VERTEX HOLE	Dv	m
	35	NASMYTH OR BEAM WAVE GUIDE SYSTEM		
	36	NUMBER OF MIRRORS OR APERTURES		
	37	DISTANCES BETWEEN APERTURES FROM THE VERTEX TO THE SECONDARY FOCUS	(d0,d1,…,dn)	m
	38	DIAMETRES OF MIRRORS AND APERTURES	(D0,D1,…,Dn)	m
BRAND PRIMARY RECEIVER	39	BOX FOR A PRIMARY RECEIVER		
	40	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm
	41	VECTOR FROM BOX BASE TO PRIMARY FOCUS	vpc1	mm
BRAND SECONDARY RECEIVER	42	BOX FOR A SECONDARY RECEIVER		
	43	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm
	44	VECTOR FROM BOX BASE TO SECONDARY FOCUS	vpc2	mm
REFERENCES	45	REFERENCE 1		
	46	REFERENCE 2		
	46	REFERENCE 3		
COMMENTS	50	COMMENTS FROM STATION		
	51	COMMENTS FROM WP MAKER		

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A.3.2 Questionnaire instructions

A.3.2.1 Introduction

This form is distributed as part as RadioNet activity called BRAND. The main goal of BRAND EVN is to develop and build a prototype broad-band digital receiver front-end and back-end, which will cover a frequency range from 1.5 GHz to 15.5 GHz. One of the project objectives is to design the BRAND frontend in such way that it can be adapted to as many as possible different EVN antennas. This form is distributed with the request to collect data for the telescopes that are part of EVN and use the information to propose a unified receiver front-end for the 1.5-15 GHz frequency range.

A.3.2.2 General information

The form has been developed to be easy to use in primary and secondary focus classical Gregorian or Cassegrains antennas with or without flat mirrors in Nasmyth focus. Other configurations like shaped or BWG must be detailed separately in references. In these cases illumination angles and edge taper are important to fill in the table but the full optical information must be given with some documentation.

The table must have homogeneous data, in case of doubt, fill the comments cell to show the particular circumstance of your antenna. In case of doubt, fill as many as possible, send additional information and write an email (f.tercero@oan.es) to show your inquiry.

If there is some parameter where you have some doubts or you do not know exactly in your antenna configuration, we prefer that you send it written in red and you make a comment.

Finally, it is recommended to fill as many cells as possible, but do not get blocked. It is preferable to send the questionnaire with blanks or reds cells, that wait to have all the information.

Questions 1 – 33 are general questions about the geometry of the antenna.

Questions 34 – 39 are addressing the location and volume occupied by the receiver currently used for EVN session. The assumptions is that if an EVN station will decide to go for upgrade and replace the existing receiver with BRAND receiver, the new receiver will fit in that volume and match the existing optics configuration. Alternatively, if there is some other space available in the antenna, give the corresponding parameters as answers to questions 34 – 39.

A.3.2.3 Cell to cell instructions

1. ANTENNA NAME. Try to use only one word or acronym without spaces
2. LONGITUDE. Positive to north from equator
3. LATITUDE. Positive from east.
4. ALTITUDE
5. CONTACT NAME. Name surname. Relative to this excel data file, optics and receivers configuration. please, send the name of the person (people) that could help in giving more additional information or the person that could answer questions.
6. CONTACT EMAIL
7. INTERESTED IN PURCHASING A BRAND RECEIVER.
8. OBSERVATION FROM PRIMARY. Y/N. Yes or Not.
9. BASIC INTERFACING EQUIPMENT IN PRIMARY FOCUS. It is assumed that all basic equipment could be available. Fill Y if the station has power, ethernet connection, maser signal and helium pipes. In case there is not any of these, fill N and comment. You can add some references to give additional information about interfacing and control information.

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10. IF SIGNAL TRANPORTATION FROM PRIMARY TO CONTROL ROOM. In the table, please fill COAX or FO. Please use the comment cell to give more information about there are free cables or room to install aditional cables. Give more information in references, like number of links and bandwidth, minimum/maximum signal level or attenuation of the lines.
11. Idem to 8.
12. Idem to 9.
13. Idem to 10.
14. ANTENNA MOUNT. EL.overAZ. or AZ.overEL. or EQ or Other (fill the comment and attach a reference).
15. MAIN OPTICS CONFIGURATION. Cass, Greg or Shap (fill the comment and attach a reference with the shaped optics).
16. DIAMETER PRIMARY. Use figure 1 for explanation.
17. FOCAL LENGTH PRIMARY. Use figure 1 for explanation.
18. FED PRIMARY. Use figure 1 for explanation.
19. EDGE SUBTENDED SEMIANGLE PRIMARY. Use figure 1 for explanation.
20. REFLECTOR DEPTH PRIMARY. Use figure 1 for explanation.
21. STANDARD EDGE TAPER PRIMARY. Use the taper that you usually use as design goal. If you have any other information like simulations, use it and comment.

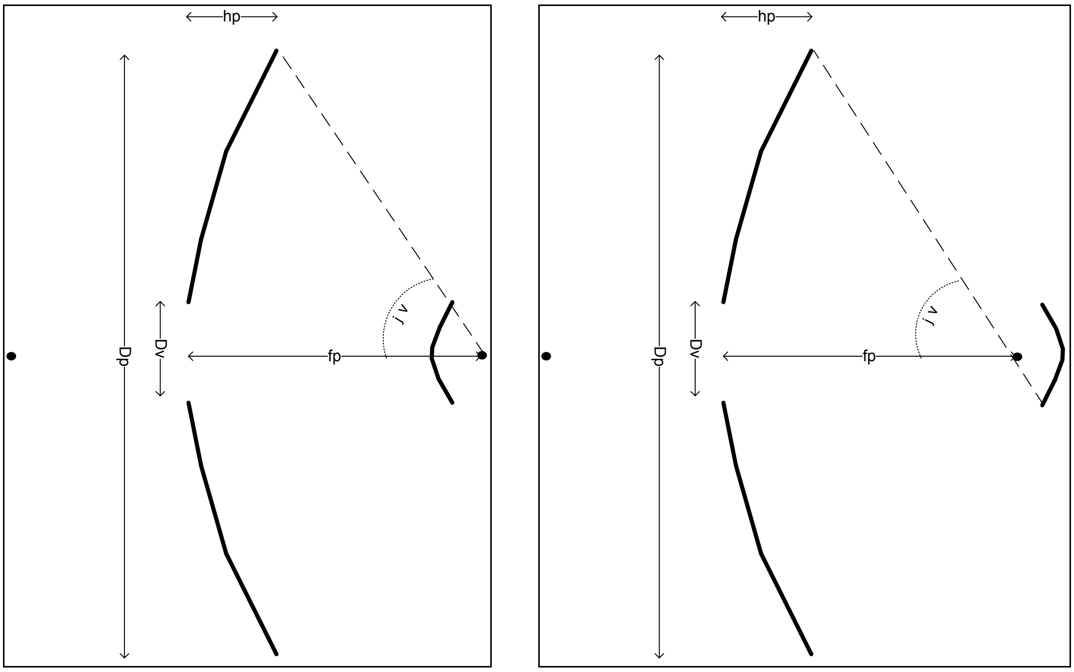

Figure 1. Cassegrain and gregorian PRIMARY parameters

22. DIAMETER SECONDARY. Use figure 2 for explanation
23. FOCAL LENGTH SECONDARY. Interfoci distance
24. ECCENTRITY. If cassegrain, the subreflector is an hyperbola (e>1). If gregorian, the subreflector is an ellipse (e<1).
25. REFLECTOR DEPTH SECONDARY. Use figure 2 for explanation.
26. STANDARD EDGE TAPER SECONDARY. Use the taper that you usually use as design goal. If you have any other information like simulations, use it and comment.
27. MAGNIFICATION
28. FED SECONDARY. Equivalent parabola focal. F number of the system.

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29. EDGE SUBTENDED SEMIANGLE SECONDARY. Use figure 2 for explanation.
30. DISTANCE FROM PRIMARY FOCUS TO SECONDARY VERTEX. Use figure 2 for explanation.
31. DISTANCE FROM SECONDARY FOCUS TO SECONDARY VERTEX. Use figure 2 for explanation.
32. DISTANCE BEHIND PRIMARY REFLECTOR TO SECONDARY FOCUS. Use figure 2 for explanation.

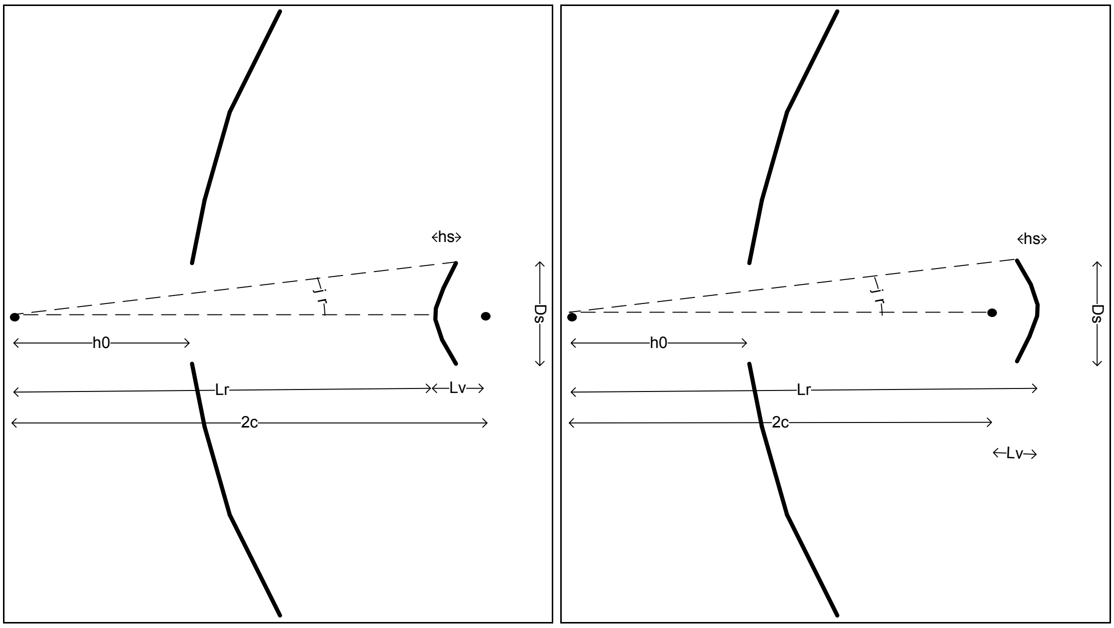

Figure 2. Cassegrain and gregorian SECONDARY parameters

33. TOTAL SURFACE ACCURACY. RMS main surface in microns
34. DIAMETER OF VERTEX HOLE. Use figure 1 for explanation.
35. NASMYTH OR BEAM WAVE GUIDE SYSTEM. Only mirrors between vertex of primary and the secondary focus. Use Nasmyth if flat mirrors are employed. Use BWG if conical mirrors are employed that are modifying primary and secondary optics.
36. NUMBER OF MIRRORS OR APERTURES. Only mirrors and apertures between vertex of primary and the secondary focus. Exclude the vertex hole as an aperture in this cell.
37. DISTANCES BETWEEN APERTURES FROM THE VERTEX TO THE SECONDARY FOCUS. Use figure 3. for explanation. d0 is first distance aperture or mirror from the vertex. dn is the last distance from aperture or mirror to the secondary focus. Check that Σdi=h0.
38. DIAMETRES OF MIRRORS AND APERTURES. Diameter for the vertex (D0) and next apertures or mirrors. Projected aperture diameter in the direction of the propagation. Use figure 3. for explanation.
39. BOX FOR A PRIMARY RECEIVER. Choose an envelope, cylinder or parallelepiped
40. DIMENSION FOR BOX RECEIVER. 2 parameters cylinder (diameter x depth) 3 parameters box (heigth x width x depth).
41. VECTOR FROM BOX BASE TO PRIMARY FOCUS. Use a reference frame based on your box envelope (parameter 35). The origin is the base center of the box (opposite to antenna) and z-vector points to antenna. In this reference frame, use the vector that points to the primary focus. Use figure 4 for explanation.

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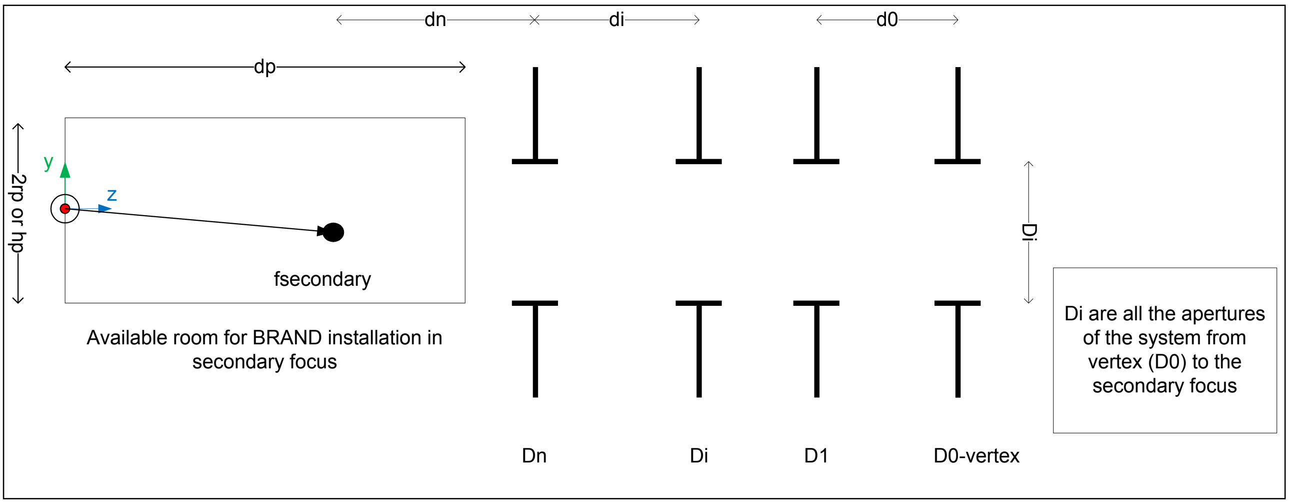

Figure 3. SECONDARY apertures and flat mirrors between the vertex hole and the secondary focus. It also shows the room available for the installation of BRAND receiver.

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A.3.3 Answers from stations

group	id.	parameter	symbol	unit	value
ANTENNA ID.	**1**	**ANTENNA NAME**			**Yebes40m**
	2	**LONGITUDE**	**long**	**deg**	**40.524655**
	3	**LATITUDE**	**lat**	**deg**	**-3.086818**
	4	**ALTITUDE**	**alt**	**m**	**980**
	5	**CONTACT NAME**			
	6	**CONTACT EMAIL**			
	7	**INTERESTED IN PURCHASING A BRAND RECEIVER**			**Y**
ANTENNA GENERAL	8	OBSERVATION FROM PRIMARY			Y
	9	BASIC INTERFACING EQUIPMENT IN PRIMARY FOCUS			N
	10	IF SIGNAL TRANSPORTATION FROM PRIMARY TO CONTROL ROOM			COAX
	11	OBSERVATION FROM SECONDARY			Y
	12	BASIC INTERFACING EQUIPMENT IN SECONDARY FOCUS			Y
	13	IF SIGNAL TRANPORTATION FROM SECONDARY TO CONTROL ROOM			COAX
	14	ANTENNA MOUNT			EL.overAZ.
	15	MAIN OPTICS CONFIGURATION			Cass
PRIMARY REFLECTOR	16	DIAMETER PRIMARY	Dp	m	40.000
	17	FOCAL LENGTH PRIMARY	fp	m	15.000
	18	F.E.D. PRIMARY	fp/Dp		0.375
	19	EDGE SUBTENDED SEMIANGLE PRIMARY	φv	deg	67.380
	20	REFLECTOR DEPTH PRIMARY	hp	m	6.667
	21	STANDARD EDGE TAPER PRIMARY	ETp	dB	-12.00
SECONDARY REFLECTOR	22	DIAMETER SECONDARY	Ds	m	3.280
	23	FOCAL LENGTH SECONDARY	2c	m	26.600
	24	ECCENTRITY	e		1.099555
	25	REFLECTOR DEPTH SECONDARY	hs	m	0.520
	26	STANDARD EDGE TAPER SECONDARY	ETs	dB	-12.00
ANTENNA SYSTEM	27	MAGNIFICATION	m		21
	28	F.E.D. SECONDARY			7.909
	29	EDGE SUBTENDED SEMIANGLE SECONDARY	φr	deg	3.621
	30	DISTANCE FROM PRIMARY FOCUS TO SECONDARY VERTEX	Lv	m	1.204
	31	DISTANCE FROM SECONDARY FOCUS TO SECONDARY VERTEX	Lr	m	25.396
	32	DISTANCE BEHIND PRIMARY REFLECTOR TO SECONDARY FOCUS	h0	m	11.600
	33	TOTAL SURFACE ACCURACCY	eps	um	300

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RECEIVERS CABIN REFLECTORS AND APERTURES	34	DIAMETER OF VERTEX HOLE	Dv	m	3.170
	35	NASMYTH OR BEAM WAVE GUIDE SYSTEM			Nasmyth
	36	NUMBER OF MIRRORS OR APERTURES			2
	37	DISTANCES BETWEEN APERTURES FROM THE VERTEX TO THE SECONDARY FOCUS	(d0,d1,…,dn)	m	(5.000, 2.275, 4325)
	38	DIAMETRES OF MIRRORS AND APERTURES	(D0,D1,…,Dn)	m	(3.170, 1875, 1875)
BRAND PRIMARY RECEIVER	39	BOX FOR A PRIMARY RECEIVER			Cilinder
	40	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	540 x 1190
	41	VECTOR FROM BOX BASE TO PRIMARY FOCUS	vpc1	mm	
BRAND SECONDARY RECEIVER	42	BOX FOR A SECONDARY RECEIVER			Parallelepiped
	43	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	1000 x 1000 x 1000
	44	VECTOR FROM BOX BASE TO SECONDARY FOCUS	vpc2	mm	
REFERENCES	45	REFERENCE 1			yebes40m_01_primary_envelope.pdf
	46	REFERENCE 2			
	46	REFERENCE 3			
COMMENTS	50	COMMENTS FROM STATION			9. Not helium pipes in primary 21. Design goal. 40. Circular hole for feed 250mm diametre
	51	COMMENTS FROM WP MAKER			

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group	id.	parameter	symbol	unit	value
ANTENNA ID.	1	**ANTENNA NAME**			**Onsala20m**
	2	**LONGITUDE**	**long**	**deg**	**11.917778**
	3	**LATITUDE**	**lat**	**deg**	**57.393056**
	4	**ALTITUDE**	**alt**	**m**	**22**
	5	**CONTACT NAME**			
	6	**CONTACT EMAIL**			
	7	**INTERESTED IN PURCHASING A BRAND RECEIVER**			**Y**
ANTENNA GENERAL	8	OBSERVATION FROM PRIMARY			N
	9	BASIC INTERFACING EQUIPMENT IN PRIMARY FOCUS			
	10	IF SIGNAL TRANSPORTATION FROM PRIMARY TO CONTROL ROOM			
	11	OBSERVATION FROM SECONDARY			Y
	12	BASIC INTERFACING EQUIPMENT IN SECONDARY FOCUS			
	13	IF SIGNAL TRANPORTATION FROM SECONDARY TO CONTROL ROOM			
	14	ANTENNA MOUNT			El.overAz
	15	MAIN OPTICS CONFIGURATION			Cass
PRIMARY REFLECTOR	16	DIAMETER PRIMARY	Dp	m	20.117
	17	FOCAL LENGTH PRIMARY	fp	m	8.992
	18	F.E.D. PRIMARY	fp/Dp		0.447
	19	EDGE SUBTENDED SEMIANGLE PRIMARY	φv	deg	58.440
	20	REFLECTOR DEPTH PRIMARY	hp	m	2.813
	21	STANDARD EDGE TAPER PRIMARY	ETp	dB	-12.00
SECONDARY REFLECTOR	22	DIAMETER SECONDARY	Ds	m	1.800
	23	FOCAL LENGTH SECONDARY	2c	m	8.992
	24	ECCENTRITY	e		1.21
	25	REFLECTOR DEPTH SECONDARY	hs	m	0.228
	26	STANDARD EDGE TAPER SECONDARY	ETs	dB	-12.00
ANTENNA SYSTEM	27	MAGNIFICATION	m		10.51
	28	F.E.D. SECONDARY			4.698
	29	EDGE SUBTENDED SEMIANGLE SECONDARY	φr	deg	6.090
	30	DISTANCE FROM PRIMARY FOCUS TO SECONDARY VERTEX	Lv	m	0.781
	31	DISTANCE FROM SECONDARY FOCUS TO SECONDARY VERTEX	Lr	m	8.211
	32	DISTANCE BEHIND PRIMARY REFLECTOR TO SECONDARY FOCUS	h0	m	0.000
	33	TOTAL SURFACE ACCURACCY	eps	um	90

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RECEIVERS CABIN REFLECTORS AND APERTURES	34	DIAMETER OF VERTEX HOLE	Dv	m	
	35	NASMYTH OR BEAM WAVE GUIDE SYSTEM			
	36	NUMBER OF MIRRORS OR APERTURES			
	37	DISTANCES BETWEEN APERTURES FROM THE VERTEX TO THE SECONDARY FOCUS	(d0,d1,…,dn)	m	
	38	DIAMETRES OF MIRRORS AND APERTURES	(D0,D1,…,Dn)	m	
BRAND PRIMARY RECEIVER	39	BOX FOR A PRIMARY RECEIVER			
	40	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	
	41	VECTOR FROM BOX BASE TO PRIMARY FOCUS	vpc1	mm	
BRAND SECONDARY RECEIVER	42	BOX FOR A SECONDARY RECEIVER			
	43	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	
	44	VECTOR FROM BOX BASE TO SECONDARY FOCUS	vpc2	mm	
REFERENCES	45	REFERENCE 1			
	46	REFERENCE 2			
	46	REFERENCE 3			
COMMENTS	50	COMMENTS FROM STATION			36. Up to 170um depending on elevation
	51	COMMENTS FROM WP MAKER			

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group	id.	parameter	symbol	unit	value
ANTENNA ID.	1	**ANTENNA NAME**			**Efelsberg100m**
	2	**LONGITUDE**	**long**	**deg**	**50.52483**
	3	**LATITUDE**	**lat**	**deg**	**6.88361**
	4	**ALTITUDE**	**alt**	**m**	**417**
	5	**CONTACT NAME**			
	6	**CONTACT EMAIL**			
	7	**INTERESTED IN PURCHASING A BRAND RECEIVER**			**Y**
ANTENNA GENERAL	8	OBSERVATION FROM PRIMARY			Y
	9	BASIC INTERFACING EQUIPMENT IN PRIMARY FOCUS			Y
	10	IF SIGNAL TRANSPORTATION FROM PRIMARY TO CONTROL ROOM			COAX and FO
	11	OBSERVATION FROM SECONDARY			Y
	12	BASIC INTERFACING EQUIPMENT IN SECONDARY FOCUS			Y
	13	IF SIGNAL TRANPORTATION FROM SECONDARY TO CONTROL ROOM			COAX and FO
	14	ANTENNA MOUNT			EL.overAZ.
	15	MAIN OPTICS CONFIGURATION			Greg
PRIMARY REFLECTOR	16	DIAMETER PRIMARY	Dp	m	100.000
	17	FOCAL LENGTH PRIMARY	fp	m	30.000
	18	F.E.D. PRIMARY	fp/Dp		0.3
	19	EDGE SUBTENDED SEMIANGLE PRIMARY	φv	deg	79.610
	20	REFLECTOR DEPTH PRIMARY	hp	m	20.830
	21	STANDARD EDGE TAPER PRIMARY	ETp	dB	-14.00
SECONDARY REFLECTOR	22	DIAMETER SECONDARY	Ds	m	6.500
	23	FOCAL LENGTH SECONDARY	2c	m	24.500
	24	ECCENTRITY	e		0.85634
	25	REFLECTOR DEPTH SECONDARY	hs	m	1.459
	26	STANDARD EDGE TAPER SECONDARY	ETs	dB	-14.00
ANTENNA SYSTEM	27	MAGNIFICATION	m		12.92
	28	F.E.D. SECONDARY			-3.877
	29	EDGE SUBTENDED SEMIANGLE SECONDARY	φr	deg	7.379
	30	DISTANCE FROM PRIMARY FOCUS TO SECONDARY VERTEX	Lv	m	2.055
	31	DISTANCE FROM SECONDARY FOCUS TO SECONDARY VERTEX	Lr	m	26.555
	32	DISTANCE BEHIND PRIMARY REFLECTOR TO SECONDARY FOCUS	h0	m	-5,5
	33	TOTAL SURFACE ACCURACCY	eps	um	550

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RECEIVERS CABIN REFLECTORS AND APERTURES	34	DIAMETER OF VERTEX HOLE	Dv	m	
	35	NASMYTH OR BEAM WAVE GUIDE SYSTEM			
	36	NUMBER OF MIRRORS OR APERTURES			
	37	DISTANCES BETWEEN APERTURES FROM THE VERTEX TO THE SECONDARY FOCUS	(d0,d1,…,dn)	m	
	38	DIAMETRES OF MIRRORS AND APERTURES	(D0,D1,…,Dn)	m	
BRAND PRIMARY RECEIVER	39	BOX FOR A PRIMARY RECEIVER			Cylinder
	40	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	1100 x 1700
	41	VECTOR FROM BOX BASE TO PRIMARY FOCUS	vpc1	mm	varying
BRAND SECONDARY RECEIVER	42	BOX FOR A SECONDARY RECEIVER			Parallelepiped
	43	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	1750 x 800 x 800 (typical value)
	44	VECTOR FROM BOX BASE TO SECONDARY FOCUS	vpc2	mm	varying
REFERENCES	45	REFERENCE 1			efelsberg100m_01_drawing_prime_focus_box.pdf
	46	REFERENCE 2			efelsberg100m_02_Primary Focus.png
	46	REFERENCE 3			efelsberg100m_03_Secondary Focus.png
COMMENTS	50	COMMENTS FROM STATION			
	51	COMMENTS FROM WP MAKER			

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group	id.	parameter	symbol	unit	value
ANTENNA ID.	**1**	**ANTENNA NAME**			**Medicina32m**
	2	**LONGITUDE**	**long**	**deg**	**11.646944**
	3	**LATITUDE**	**lat**	**deg**	**44.520833**
	4	**ALTITUDE**	**alt**	**m**	**25**
	5	**CONTACT NAME**			
	6	**CONTACT EMAIL**			
	7	**INTERESTED IN PURCHASING A BRAND RECEIVER**			**Y**
ANTENNA GENERAL	8	OBSERVATION FROM PRIMARY			Y
	9	BASIC INTERFACING EQUIPMENT IN PRIMARY FOCUS			Y
	10	IF SIGNAL TRANSPORTATION FROM PRIMARY TO CONTROL ROOM			COAX
	11	OBSERVATION FROM SECONDARY			Y
	12	BASIC INTERFACING EQUIPMENT IN SECONDARY FOCUS			Y
	13	IF SIGNAL TRANPORTATION FROM SECONDARY TO CONTROL ROOM			FO
	14	ANTENNA MOUNT			AZoverEL.
	15	MAIN OPTICS CONFIGURATION			Cass
PRIMARY REFLECTOR	16	DIAMETER PRIMARY	Dp	m	32.000
	17	FOCAL LENGTH PRIMARY	fp	m	10.259
	18	F.E.D. PRIMARY	fp/Dp		0.32059375
	19	EDGE SUBTENDED SEMIANGLE PRIMARY	φv	deg	75.900
	20	REFLECTOR DEPTH PRIMARY	hp	m	6.240
	21	STANDARD EDGE TAPER PRIMARY	ETp	dB	-14.00
SECONDARY REFLECTOR	22	DIAMETER SECONDARY	Ds	m	3.200
	23	FOCAL LENGTH SECONDARY	2c	m	10.030
	24	ECCENTRITY	e		1.2357
	25	REFLECTOR DEPTH SECONDARY	hs	m	0.558
	26	STANDARD EDGE TAPER SECONDARY	ETs	dB	-12.00
ANTENNA SYSTEM	27	MAGNIFICATION	m		9.48
	28	F.E.D. SECONDARY			3.040
	29	EDGE SUBTENDED SEMIANGLE SECONDARY	φr	deg	9.430
	30	DISTANCE FROM PRIMARY FOCUS TO SECONDARY VERTEX	Lv	m	0.957
	31	DISTANCE FROM SECONDARY FOCUS TO SECONDARY VERTEX	Lr	m	9.074
	32	DISTANCE BEHIND PRIMARY REFLECTOR TO SECONDARY FOCUS	h0	m	-0.229
	33	TOTAL SURFACE ACCURACCY	eps	um	700

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RECEIVERS CABIN REFLECTORS AND APERTURES	34	DIAMETER OF VERTEX HOLE	Dv	m	3.454
	35	NASMYTH OR BEAM WAVE GUIDE SYSTEM			N
	36	NUMBER OF MIRRORS OR APERTURES			0
	37	DISTANCES BETWEEN APERTURES FROM THE VERTEX TO THE SECONDARY FOCUS	(d0,d1,…,dn)	m	0.229
	38	DIAMETRES OF MIRRORS AND APERTURES	(D0,D1,…,Dn)	m	3.454
BRAND PRIMARY RECEIVER	39	BOX FOR A PRIMARY RECEIVER			Parallelepiped
	40	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	1000 x 900 x 950
	41	VECTOR FROM BOX BASE TO PRIMARY FOCUS	vpc1	mm	
BRAND SECONDARY RECEIVER	42	BOX FOR A SECONDARY RECEIVER			Cylinder
	43	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	3000 x 600
	44	VECTOR FROM BOX BASE TO SECONDARY FOCUS	vpc2	mm	
REFERENCES	45	REFERENCE 1			
	46	REFERENCE 2			
	46	REFERENCE 3			
COMMENTS	50	COMMENTS FROM STATION			
	51	COMMENTS FROM WP MAKER			

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group	id.	parameter	symbol	unit	value
ANTENNA ID.	**1**	**ANTENNA NAME**			**NSRT26m(Ur)**
	2	**LONGITUDE**	**long**	**deg**	**43.471152**
	3	**LATITUDE**	**lat**	**deg**	**87.1779065**
	4	**ALTITUDE**	**alt**	**m**	**2080**
	5	**CONTACT NAME**			
	6	**CONTACT EMAIL**			
	7	**INTERESTED IN PURCHASING A BRAND RECEIVER**			**Y**
ANTENNA GENERAL	8	OBSERVATION FROM PRIMARY			N
	9	BASIC INTERFACING EQUIPMENT IN PRIMARY FOCUS			N
	10	IF SIGNAL TRANSPORTATION FROM PRIMARY TO CONTROL ROOM			N
	11	OBSERVATION FROM SECONDARY			Y
	12	BASIC INTERFACING EQUIPMENT IN SECONDARY FOCUS			Y
	13	IF SIGNAL TRANPORTATION FROM SECONDARY TO CONTROL ROOM			COAX
	14	ANTENNA MOUNT			EL.overAZ
	15	MAIN OPTICS CONFIGURATION			Shaped Cass
PRIMARY REFLECTOR	16	DIAMETER PRIMARY	Dp	m	26.00
	17	FOCAL LENGTH PRIMARY	fp	m	7.80
	18	F.E.D. PRIMARY	fp/Dp		0.24
	19	EDGE SUBTENDED SEMIANGLE PRIMARY	φv	deg	79.61
	20	REFLECTOR DEPTH PRIMARY	hp	m	5.53
	21	STANDARD EDGE TAPER PRIMARY	ETp	dB	-15.17
SECONDARY REFLECTOR	22	DIAMETER SECONDARY	Ds	m	3
	23	FOCAL LENGTH SECONDARY	2c	m	6.1
	24	ECCENTRITY	e		1.358
	25	REFLECTOR DEPTH SECONDARY	hs	m	0.548
	26	STANDARD EDGE TAPER SECONDARY	ETs	dB	-15.00
ANTENNA SYSTEM	27	MAGNIFICATION	m		6.583
	28	F.E.D. SECONDARY			2.033
	29	EDGE SUBTENDED SEMIANGLE SECONDARY	φr	deg	14.430
	30	DISTANCE FROM PRIMARY FOCUS TO SECONDARY VERTEX	Lv	m	0.885
	31	DISTANCE FROM SECONDARY FOCUS TO SECONDARY VERTEX	Lr	m	5.469
	32	DISTANCE BEHIND PRIMARY REFLECTOR TO SECONDARY FOCUS	h0	m	-1.209
	33	TOTAL SURFACE ACCURACCY	eps	um	400

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RECEIVERS CABIN REFLECTORS AND APERTURES	34	DIAMETER OF VERTEX HOLE	Dv	m	3.611
	35	NASMYTH OR BEAM WAVE GUIDE SYSTEM			
	36	NUMBER OF MIRRORS OR APERTURES			2
	37	DISTANCES BETWEEN APERTURES FROM THE VERTEX TO THE SECONDARY FOCUS	(d0,d1,…,dn)	m	
	38	DIAMETRES OF MIRRORS AND APERTURES	(D0,D1,…,Dn)	m	
BRAND PRIMARY RECEIVER	39	BOX FOR A PRIMARY RECEIVER			
	40	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	
	41	VECTOR FROM BOX BASE TO PRIMARY FOCUS	vpc1	mm	
BRAND SECONDARY RECEIVER	42	BOX FOR A SECONDARY RECEIVER			Cilinder
	43	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	3400 x 1900
	44	VECTOR FROM BOX BASE TO SECONDARY FOCUS	vpc2	mm	
REFERENCES	45	REFERENCE 1			
	46	REFERENCE 2			
	46	REFERENCE 3			
COMMENTS	50	COMMENTS FROM STATION			13. 2 links of 0.1-2.0 GHz bandwidth
	51	COMMENTS FROM WP MAKER			

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group	id.	parameter	symbol	unit	value
ANTENNA ID.	**1**	**ANTENNA NAME**			**Onsala25m**
	2	**LONGITUDE**	**long**	**deg**	**11.917778**
	3	**LATITUDE**	**lat**	**deg**	**57.393056**
	4	**ALTITUDE**	**alt**	**m**	**18**
	5	**CONTACT NAME**			
	6	**CONTACT EMAIL**			
	7	**INTERESTED IN PURCHASING A BRAND RECEIVER**			**Y**
ANTENNA GENERAL	8	OBSERVATION FROM PRIMARY			N
	9	BASIC INTERFACING EQUIPMENT IN PRIMARY FOCUS			
	10	IF SIGNAL TRANSPORTATION FROM PRIMARY TO CONTROL ROOM			
	11	OBSERVATION FROM SECONDARY			Y
	12	BASIC INTERFACING EQUIPMENT IN SECONDARY FOCUS			
	13	IF SIGNAL TRANPORTATION FROM SECONDARY TO CONTROL ROOM			
	14	ANTENNA MOUNT			Equatorial Mount
	15	MAIN OPTICS CONFIGURATION			Cass
PRIMARY REFLECTOR	16	DIAMETER PRIMARY	Dp	m	25.600
	17	FOCAL LENGTH PRIMARY	fp	m	7.675
	18	F.E.D. PRIMARY	fp/Dp		0.3
	19	EDGE SUBTENDED SEMIANGLE PRIMARY	φv	deg	79.650
	20	REFLECTOR DEPTH PRIMARY	hp	m	5.337
	21	STANDARD EDGE TAPER PRIMARY	ETp	dB	N/A
SECONDARY REFLECTOR	22	DIAMETER SECONDARY	Ds	m	3.050
	23	FOCAL LENGTH SECONDARY	2c	m	6.095
	24	ECCENTRITY	e		1.33
	25	REFLECTOR DEPTH SECONDARY	hs	m	0.580
	26	STANDARD EDGE TAPER SECONDARY	ETs	dB	-11
ANTENNA SYSTEM	27	MAGNIFICATION	m		7
	28	F.E.D. SECONDARY			1.749
	29	EDGE SUBTENDED SEMIANGLE SECONDARY	φr	deg	14
	30	DISTANCE FROM PRIMARY FOCUS TO SECONDARY VERTEX	Lv	m	0.762
	31	DISTANCE FROM SECONDARY FOCUS TO SECONDARY VERTEX	Lr	m	5.333
	32	DISTANCE BEHIND PRIMARY REFLECTOR TO SECONDARY FOCUS	h0	m	-1.580
	33	TOTAL SURFACE ACCURACCY	eps	um	3800

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RECEIVERS CABIN REFLECTORS AND APERTURES	34	DIAMETER OF VERTEX HOLE	Dv	m	3.050
	35	NASMYTH OR BEAM WAVE GUIDE SYSTEM			
	36	NUMBER OF MIRRORS OR APERTURES			
	37	DISTANCES BETWEEN APERTURES FROM THE VERTEX TO THE SECONDARY FOCUS	(d0,d1,…,dn)	m	
	38	DIAMETRES OF MIRRORS AND APERTURES	(D0,D1,…,Dn)	m	
BRAND PRIMARY RECEIVER	39	BOX FOR A PRIMARY RECEIVER			
	40	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	
	41	VECTOR FROM BOX BASE TO PRIMARY FOCUS	vpc1	mm	
BRAND SECONDARY RECEIVER	42	BOX FOR A SECONDARY RECEIVER			
	43	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	
	44	VECTOR FROM BOX BASE TO SECONDARY FOCUS	vpc2	mm	
REFERENCES	45	REFERENCE 1			
	46	REFERENCE 2			
	46	REFERENCE 3			
COMMENTS	50	COMMENTS FROM STATION			19. Nominal value (maximum value up to 14.46 due to fixation of sub-reflector). Realistic optimum is somewhere inbetween 32. Nominal value (maximum value up to 83.21 due to fixation of sub-reflector) 33. Uncertain value. Nominal frequency 4.17GHz 34. Tube shape
	51	COMMENTS FROM WP MAKER			

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group	id.	parameter	symbol	unit	value
ANTENNA ID.	1	**ANTENNA NAME**			**MCA5.5m**
	2	**LONGITUDE**	**long**	**deg**	**60.2177**
	3	**LATITUDE**	**lat**	**deg**	**24.3935**
	4	**ALTITUDE**	**alt**	**m**	**73**
	5	**CONTACT NAME**			
	6	**CONTACT EMAIL**			
	7	**INTERESTED IN PURCHASING A BRAND RECEIVER**			**Y**
ANTENNA GENERAL	8	OBSERVATION FROM PRIMARY			N
	9	BASIC INTERFACING EQUIPMENT IN PRIMARY FOCUS			N
	10	IF SIGNAL TRANSPORTATION FROM PRIMARY TO CONTROL ROOM			
	11	OBSERVATION FROM SECONDARY			Y
	12	BASIC INTERFACING EQUIPMENT IN SECONDARY FOCUS			Y
	13	IF SIGNAL TRANPORTATION FROM SECONDARY TO CONTROL ROOM			COAX and FO(TBC)
	14	ANTENNA MOUNT			EL.overAZ.
	15	MAIN OPTICS CONFIGURATION			Cass
PRIMARY REFLECTOR	16	DIAMETER PRIMARY	Dp	m	5.500
	17	FOCAL LENGTH PRIMARY	fp	m	1.720
	18	F.E.D. PRIMARY	fp/Dp		0.31
	19	EDGE SUBTENDED SEMIANGLE PRIMARY	φv	deg	78
	20	REFLECTOR DEPTH PRIMARY	hp	m	1.10
	21	STANDARD EDGE TAPER PRIMARY	ETp	dB	-12
SECONDARY REFLECTOR	22	DIAMETER SECONDARY	Ds	m	0.80
	23	FOCAL LENGTH SECONDARY	2c	m	0.52
	24	ECCENTRITY	e		1.86
	25	REFLECTOR DEPTH SECONDARY	hs	m	0.18
	26	STANDARD EDGE TAPER SECONDARY	ETs	dB	-12.00
ANTENNA SYSTEM	27	MAGNIFICATION	m		3.33
	28	F.E.D. SECONDARY			5.73
	29	EDGE SUBTENDED SEMIANGLE SECONDARY	φr	deg	34
	30	DISTANCE FROM PRIMARY FOCUS TO SECONDARY VERTEX	Lv	m	0.18
	31	DISTANCE FROM SECONDARY FOCUS TO SECONDARY VERTEX	Lr	m	0.80
	32	DISTANCE BEHIND PRIMARY REFLECTOR TO SECONDARY FOCUS	h0	m	-1.27
	33	TOTAL SURFACE ACCURACCY	eps	um	

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RECEIVERS CABIN REFLECTORS AND APERTURES	34	DIAMETER OF VERTEX HOLE	Dv	m	0.40
	35	NASMYTH OR BEAM WAVE GUIDE SYSTEM			Nasmyth
	36	NUMBER OF MIRRORS OR APERTURES			
	37	DISTANCES BETWEEN APERTURES FROM THE VERTEX TO THE SECONDARY FOCUS	(d0,d1,…,dn)	m	
	38	DIAMETRES OF MIRRORS AND APERTURES	(D0,D1,…,Dn)	m	
BRAND PRIMARY RECEIVER	39	BOX FOR A PRIMARY RECEIVER			
	40	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	
	41	VECTOR FROM BOX BASE TO PRIMARY FOCUS	vpc1	mm	
BRAND SECONDARY RECEIVER	42	BOX FOR A SECONDARY RECEIVER			Cylinder
	43	DIMENSION FOR BOX RECEIVER	2rp x dp hp x wp x dp	mm	400 x 2000
	44	VECTOR FROM BOX BASE TO SECONDARY FOCUS	vpc2	mm	
REFERENCES	45	REFERENCE 1			
	46	REFERENCE 2			
	46	REFERENCE 3			
COMMENTS	50	COMMENTS FROM STATION			1.The receiver is not planned for Metsähovi's EVN-antenna. We are building a small local array (Metsähovi Compact Array, MCA) where the receiver could be used. 7. Totally 3-4 receivers are needed
	51	COMMENTS FROM WP MAKER			27-31. Data is not consistent

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Acronyms

BRAND	BRoad-bAND
EVN	European VLBI Network
INAF	Istituto Nazionale di Astrofisica
LNA	Low Noise Amplifier
OSO	Onsala Space Observatory
RFI	Radio Frequency Interference
ROM	Rough Order of Magnitude
UAH-IGN	Universidad de Alcalá de Henares – Instituto Geográfico Nacional
VGOS	VLBI Global Observing System (International VLBI Service).

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