

## Realising a Telestreet: the example of Orfeo TV.

Date of publication 27-1-2004 :: Reading :: 384 :: Review :: Technical  
Original Italian can be found [here](#).

### Realisation

The technical solutions at the base of the Orfeo TV project have been dictated by multiple needs and problems. For those interested in deepening the argument, in this document we will try and describe choices that have been made, the eventual alternatives taken into consideration and the criteria upon which those choices were made.

Before anything the three primary needs to satisfy were

1. cheapness
2. ease of installation
3. cover of an small area evading as much as possible disturbing other users and transmitters.

### Choosing the frequency

The problem we came up against was "on which frequency ([channel](#)) can we transmit given that all the existing channels are already taken by transmitters much bigger than ourselves, in the national [frequency](#) layout.

Don't even think about going over other channels! From an ethical point of view it seemed wrong, from the technical point of view a loss, (the smallest commercial transmitter is 1000 volts more powerful, we would have disturbed little without anyone even noticing).

So we realised that the correct choice was to build a micro-tv. Due to the optical inclination of the television signal, when a transmitter is hidden by obstacles or hilly terrain it isn't receivable anymore, so the coverage of a signal is always a bit like leopard spots, we transmit exploiting these "spots of shadow".

This is easy to verify when you turn on your television and look at all of the 48 usable channels one by one (from 21 to 69) moving around the city uncovering the channels for which there is no signal; there will be different channels according to the zone in which you're in.

That's why almost all the stations transmit on more than one channel (in Bologna for example RAI Uno transmits on channel 5 (d VHF) and 31, and Canale5 on channels 23, 24 and 39), with transmitters established in the north, south, east and west of the city, possibly on hills or large towers.

So installing our small transmitter on channel 51, which was free in the zone of orfeotv, we can transmit without disturbing anyone: our signal is too weak to disturb out of the transmission shadow in which we are located.

### Choosing a Transmitter

Commercially there are various types of transmitters adapted for television transmission, but based on our requirements we didn't chose real television equipment for broadcasting, that is excessive in both cost and power, but a device born from the distribution of video signals inside apartments. In short; the antenna amplifiers that everyone uses in their house.

This equipment is very wide spread, costs little, is built to be on for years with little maintenance and is easy to use.

To put together a transmitter with these objectives three things are required

1. The modulator: that generates the frequency base of the transmission, it determines the channel on which you transmit and aggregates the audio and video content (modulation) that constitutes the television message.
2. The amplifier: that takes our weak signal produced from the modulator and sends it to the antenna supplying the power necessary for transmission.
3. The power device: that serves to give the necessary power to the amplifier, transforming the household electrical current (220 volts alternating) to that which needed for this equipment (continuous 12 volts).

These are the products we chose amongst those we saw.

#### Modulator:

Brand: <b>AxoSat Line</b>	<u>details</u>	Distributor: <b>Antenna Club Srl</b> <b>Via Castelvetro 16</b> <b>20154 Milano</b> <a href="http://www.antennaclub.it">http://www.antennaclub.it</a>	Able to define the working channel simply by moving the micro-interrupters on the panel. We eliminated the resistance of the "automiscelazione" (small caps on the connectors on the side of the entrance) to increase the power.
Model: <b>AVM200E/u</b>		Cost: <b>70 Euros</b>	

#### Amplifier:

Brand: <b>Helman</b>	<u>details</u>	Distributor: <a href="http://www.helman.it">http://www.helman.it</a>	Output level : <b>125 dBuV</b> (Equal to 200mW theoretically, 80mW in reality)
Model: <b>1D161</b>		Cost: <b>135 Euros</b>	

**Power Supply :**

Brand: <b>Helman</b>	<u>details</u>	Distributor:  <a href="http://www.helman.it">http://www.helman.it</a>	Tension:: <b>12 Volts</b>
Model: <b>1G452</b>		Cost: <b>55 Euros</b>	Current: <b>1 A</b>

This is how we mounted the three components for the transmission equipment on a basis of 6 modules (**Helman1J780**) made specifically to take them.

**Choosing and Placing an Antenna**

The antenna is the principal element of a transmission set up, more important than the transmitter itself, given that it is this that distributes the signal in the area.

The choice of Orfeo TV was an omni-directional antenna positioned towards heart of the area we wanted to cover. (orfeo and limitrofe streets).

This choice, a bit dirtier technically than a directional antenna positioned outside of the pre-chosen area, was dictated substantially by 3 factors: a) a directional antenna would have required a place in which to position the transmitter in which we didn't have access. b) A directional antenna would have amplified the coverage of our emitter but on the other hand reduced the percentage of people able to receive in the pre-selected area, increasing the possibility of creating disturbances. c) The costs would have risen decisively to the degree that it would have been necessary to have a more powerful transmitter and radio-bridge for it to reach our studio.

[[It is worth elaborating more on this concept](#)]

We said that Orfeo TV installed an omni-directional antenna, this is not exact. The antenna is multi-directional with a prevalence towards the east and a shadowy side to the west. This has enabled the linking of four different directive antennas (north, west, and 2 in the east), each one uses a fourth of the signal emitted from the transmitter, so 50% goes towards the east. [for a deeper understanding of the connecting up see [Antenna Installation](#)].

This was all done so as to best cover the area of Orfeo street, which was at a major disadvantage due to the fact that all the roof antennas pointed in away from ourselves.

Also to get the transmission antenna we had to revert to common products, basing it in a fundamental technical concept: theoretically there is no difference between an antenna for reception and one for transmission, save the quantity of signal (power) that it can put out.

A receiving antenna with certain frequency characteristics, implementation and angle of transmission has identical characteristics and specifications as used in transmission because it comes covered by hundreds of milliwatts and not of 100, 1000, 10000 watts as in professional systems.

We selected our antenna between those that are installed commonly on the roof for receiving, spending very few euros, with the advantage that these antennas are light and don't require special pylons and can be installed on normal television poles.

There exists types of antenna pairs but in our opinion the most useful for us were the Log-Periodica and Pannello.

The Log-Periodiche support a bit more power on average and are a little bit more directive (so they give a bit more for those that receive it from the right direction). In the end Orfeo TV chose to use a panel antenna. This is because we wanted to send the signal out in more directions and to do that we had to link more antennas, it's particularly difficult to do this with the Log-Peridica antenna.

Beyond that, in Bologna in winter the antennas often get covered in snow and ice and short circuit the two longitudinal elements of the log-peridica antenna, which stops it transmitting.

These are the products we chose amongst those we saw.

#### Log-Periodiche:

Brand: <b>Fracarro</b>	<u>details</u>	Maker: <b>Fracarro</b> <b>Radioindustrie S.p.A.,</b> <b>via Cazzaro 3,</b> <b>Castelfranco Veneto</b> <b>TV</b> <a href="http://www.fracarro.it">http://www.fracarro.it</a>	.
Model: <b>LP45HV</b>			
Channels: <b>21 - 69</b>			
Guadagno: <b>10 dB</b>		Cost: <b>30 Euros</b>	

#### Panels:

Brand: <b>Fracarro</b>	<u>details</u>	Maker: <b>Fracarro</b> <b>Radioindustrie S.p.A.,</b> <b>via Cazzaro 3,</b> <b>Castelfranco Veneto</b> <b>TV</b> <a href="http://www.fracarro.it">http://www.fracarro.it</a>	It is well built mechanically (in steel and aluminium).
Model: <b>PU4</b>			
Channels: <b>21 - 69</b>			
Guadagno: <b>9 - 12 dB</b>		Cost: <b>30 Euros</b>	

### **Installation and positioning of the antenna, connecting up and divisions**

From a technical point of view and also to describe, the installation of the transmission antenna is the most complex operation of the whole set-up. To simplify we have sub-divided the process.

#### **Mounting more than one antenna onto one pole.**

Every antenna comes with a species of clamp that allows you to fix it to the pole and, when you need to install only one antenna, it's enough to follow the makers instructions for a perfect result. But when you need to mount more antennas that are all linked the problem becomes more difficult.

In fact the antennas can't simply be attached one above the other on the pole, it's necessary to cover more sides, directionally specifically. You also need to take some physics into account.

Before anything you need to know that the antennas interfere with each other, for that reason you have to maintain a certain distance between a panel on the base of the specific wave length of the transmitter and the chosen angle of radiation.

For those that like a bit of theory we'll say that to position two panels 90° apart the maximum distance between the centre of the pole and the reflector (the back grill) of the panel mustn't reach the typical wavelength of our transmission frequency. Meanwhile the minimum distance from the pole should be set up so that the two reflectors don't touch or cover each other.

For those that prefer practice to words let's just say that we have maintained a good distance between the edges of the panels, taking care that the reflectors were equidistant from the pole.

For the installation of Orfeo TV we constructed a support structure: to the principal pole we connected a small additional horizontal pole at the end of which we connected up two other vertical tubes, on these 2 palettes we fixed two counter posed panels, one towards the north and the other towards the south.

Then we fixed the main pole to the end of a tube in the form of a "C", turned towards the east, and on this we placed 2 panels one on top of the other, centred vertically with respect to the other 2.

#### **Connecting up more antennas and partitioning the power**

There are two reasons why you might decide to connect more than one antenna to the transmitter: 1. The need to sub-divide the power of the transmitter when it exceeds the capacity of a single antenna. 2. The need to direct the signal in more than one direction (the principal reason of Orfeo TV).

Whatever the reason all the antennas must be the same, so much so that for Orfeo TV we took the trouble to check the signature of the stamped model on the base of the antennas,

also checking they were from the same product set.

It isn't however enough to just link the antennas together as if they were loudspeakers, you have to link them with an appropriate circuit of the above mentioned splitter.

For Orfeo TV, which broadcasts with a low frequency, we chose a commercial splitter used for the subdivision of signals in apartments, 'S02-04 della TEK0 (which is identical to the PAR 410 of Mediasat.)

To be excessively cautious and sure of not having problems in the future we opened the cover of the splitter, which is underneath the label, we took out the diode, used for satellite receiving, which is found inside.

If we had had a more powerful transmitter we would have constructed our splitter using a particular connection method made with just connected cables.

## **Cables and Connections**

### **Installation of the Transmitter at the Foot of the Antenna**

The cable from the transmitter that carries the signal to the antenna has the unfortunate defect of eating up a large portion of the power in relation to its length. The decay is equivalent to 18db per 100 meters, which means to say that 30 metres of cable losses 50% of the power.

To maintain the integrity of the signal it is essential to install the transmitter as close as possible to the antenna. Not having access to an attic we had to install a transmitter in a water-proof box fixed directly to the pole.

We used a fiberglass box (Lume, London Series, model IP65 (16209), 30 x 50 x 20cm.) in such a way that inside the box there remained a good quantity of air circulation, enough for it to not heat up too much under the summer sun.

Inside the box we fixed the three transmitter modules and the splitter, making all the cables enter at the base and taking care that no moisture was able to get in.

In this way the signal loss along the 30 metres of cable that connect the studio to the transmitter and the 2 metres from there to the antenna means little, whilst if we had had the transmitter in the studio, on the ground floor, we would have lost 50% of the power.

On the roof we also had to mount three different cables:

- the cable for the 220 volts of power
- the cable for the video signal
- the audio cable

Naturally, on ground level, where the network cable of 220 volts comes out we installed a thermo-magnetic valve with a differential of 6 amps because it's not smart to have a electric cable run through a building without adequate protection.

The modulator has a SCART entry, the rectangular big plug that is used daily on every television and VCR, but we preferred to connect using RCA adapters (the same as any hi-fi system) and to use a RCA-SCART adapter, rather than solder the wires.

Luckily there was someone who knew how to solder the connections.

### **The cables used**

As we wanted to do the best job possible we studied deeply which types of cables to use to get the best results, considering both the cost and ease of installation.

To connect the antennas to the splitter and this to the transmitter we used a SAT300 cable from ITC; we could have used other brands such as the Mircrotek H12 or the Cavel SAT703 because as 75 ohm it doubles the defenses from electronic disturbance due to its black colour (that resists UV rays better).

To correctly mount it we trained installing the F connectors (those on the the splitter) because the four cables that go to the antenna have to be absolutely the same, a millimetre more or less at the maximum.

The 4 cables (and the cable which connects the transmitter to the divider) should have a length which is equal to an odd multiple of the wavelength divided by 2 and multiplied by the velocity of the cable you are using.

To better understand, considering Orfeo TV is on channel 51 (frequency 714Mhz) and the velocity factor of the cable and the factor of speed of the cable (which the seller of the cable should know and which is usually 0,48) this is the calculation:

**[speed of light]/[frequency of MHZ]/2 x [factor of speed)**

This measure has been multiplied by 11, which is an odd value, and is enough to connect the divider to the aerials.

**Or rather:  $300000 / 714 / 2 * 0.84 = 176.47\text{mm}$**

For the low frequency (from the studio to the transmitter), there were fewer problems, but in any case we used a quality cable:

- RG58 for the video signal (also called banda-base).
- for the twin lead screen of the Tasker at low capacity and with expansive dielectric for the audio signal.
- A VINILGOMMA cable 3 x 1.5 mm<sup>2</sup> for the power.

### **Low frequency apparati**

What we wanted to tell you was the set-up installation for the Orfeo TV transmission, but to really finish we'll also tell you what low frequency equipment we used in the studio, these were outside of the 1000 euro budget.

- 2 VHS VCRs
- One small mixer
- 1 PC (Pentium III, 128MB, 8GB, Windows 98)

- 1 web-cam creative pc-cam 600

Teleaut, Spegnila-TV, Candida-TV and Ant-TV in Rome have used the kit by Orfeo-TV and can add some notes:

1) The amplifier is 7milliwat with which you can cover one street if the frequency you choose is totally empty.

2) If you want to power the amplifier you will have trouble with the modulator because it's not "vestigiale". It means that if you power the signal you will cover the frequencies near the one you choose instead of having a better transmission.

We found another solution which is a 5 watt amplifier and a modulator vestigiale. These tools were hacked junk from mobile telephone geer over the past years.

Revision: r1.4 - 27 Sep 2004 - 02:00 - Main.Guest

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