

**Feasibility study
which has resulted in establishing
the target of 11+2 layers in the UHF band
for the French government plan “France Numérique 2012”**

The information in this document has been prepared by the broadcast network operator TDF.

Aim of the study

The Geneva 2006 (GE-06) Agreement currently offers no less than seven DTT layers across the entire UHF frequency band (channels 21 to 69) in France:

- Six DTT layers providing nationwide coverage
- One or two DTT layers providing regional coverage (two, except for the north-eastern part of France)
- A few additional frequencies at the local level
- The preferential reception mode is either fixed reception (slightly less than six layers) or portable outdoor reception (for the remaining layers)

As such, the Geneva 2006 Agreement provides only a partial response to the potential future usage needs in France. Specifically, it makes no provision for switching DTT SD services to HD or developing mobile TV services using the DVB-H standard. It is for this reason that further work has been undertaken to show that the agreement can be optimised in order to free up frequencies for these uses.

The service objectives of the French feasibility study (meaning that interference is taken into account) were as follows:

- 10 to 11 DTT networks offering nationwide coverage without any regional variations, serving at least 95% of the population
- One nationwide network offering regional variations and serving at least 95% of the population
- Two mobile TV networks serving at least 70% of the population with good indoor reception

A close look has been taken at several scenarios for sharing the UHF band:

- An "all audiovisual" scenario with 12 DTT networks and two mobile TV networks: use of the channels currently allocated to broadcasting: channels 21 to 69 for existing DTT networks, channels 21 to 65 for new DTT networks, channels 21 to 55 for mobile TV networks, but channel 38 is not used by the new networks.

- An "audiovisual / telecoms" scenario with 11 or 12 DTT networks and two mobile TV networks: analysis of the situation where the allocated broadcasting band is reduced: sub-band of seven (SB7: channels 63-69) to nine channels (SB9: channels 61-69) reserved for other uses, channels 21 to 55 for mobile TV networks, but channel 38 is not used by the new networks.

In light of the decisions taken by French authorities on how to allocate the UHF band (and decisions already taken or pending by national authorities in neighbouring countries), the feasibility study has focused exclusively on optimising a frequency plan built outside the 790-862 MHz sub-band (SB9), which allows for the deployment of 11 DTT networks covering 95% of the population and two mobile TV networks (DVB-H) covering 70% of the population.

Working assumptions for DTT networks



The feasibility study sourced DTT frequencies from a list of sites in the main TF1 / France 2 / France 3 networks, including a few sites in the main DTT network:

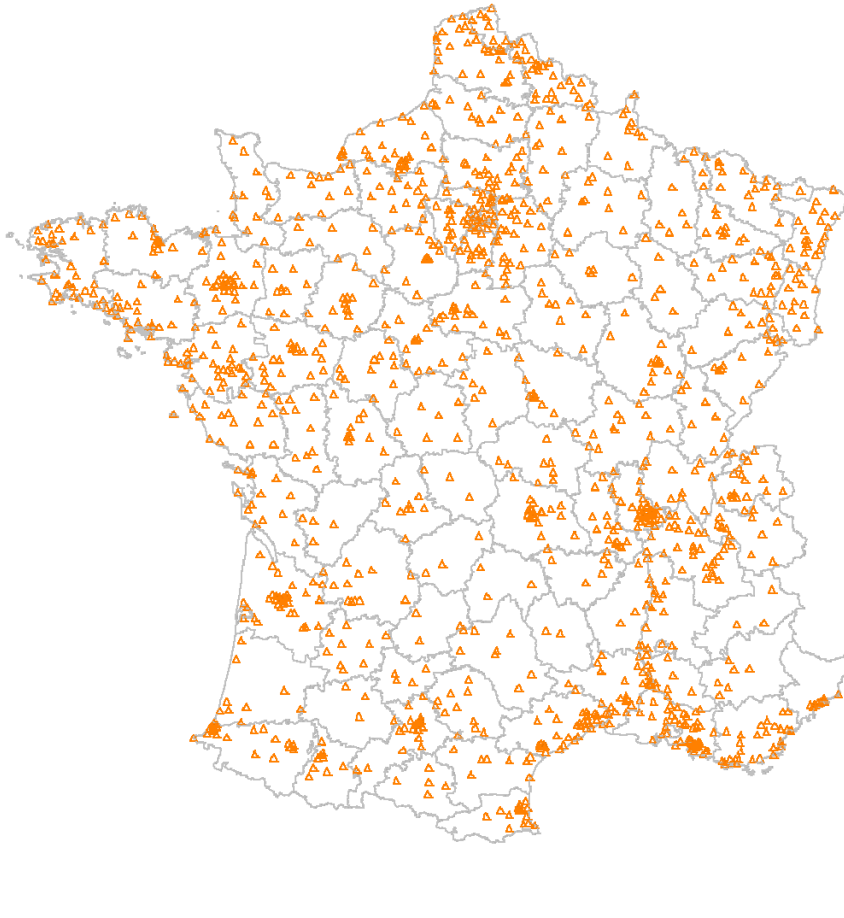
- 150 sites in the DTT networks without regional variations
- 157 sites in the DTT networks offering regional variations

The digital ERP values chosen for this study were equal to the analogue ERP values – 10 dB, except for the north and east, where the chosen ERP values were equal to the coordinated

ERP values in GE-06 (– 3 dB). The radiation patterns are as shown in GE-06 for coordinated sites and omni-directional patterns for other sites.

For the purpose of calculating the quality of the frequency plans obtained (service levels), 2,393 sites had been added from the additional network to these sites. The frequencies for these sites have been allocated depending on the allotment area to which they belong.

Working assumptions for mobile TV networks

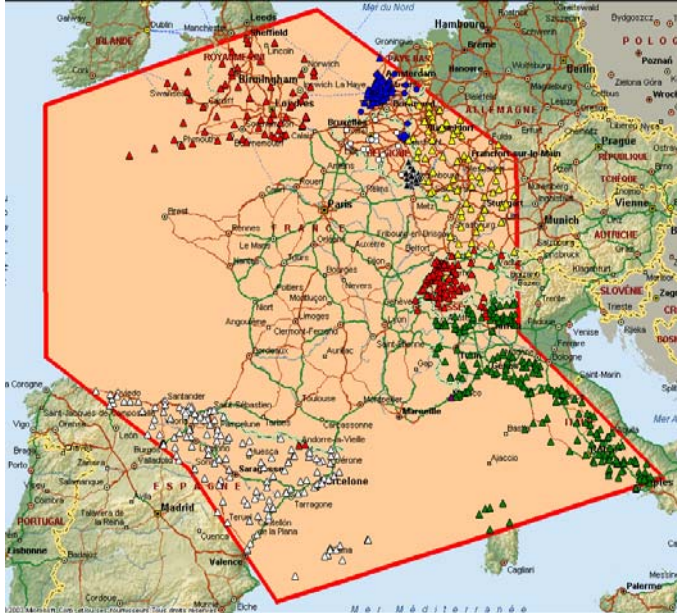


For mobile TV, coverage for 1,000 urban areas has been assumed. In terms of the 70 urban areas for which a search of frequencies was carried out, the networks were modelled by "real" or theoretical sites, but were close to a "real" network (location, antenna height, ERP and omni-directional patterns). In the other urban areas, mobile TV networks were modelled by a single site located at the corresponding town hall and supplemented by three peripheral sites.

Based on this model, the maximum theoretical population covered reaches 74%.

Other limitations

To guarantee fair access to spectrum, the search for frequencies has been made taking into consideration the needs of each neighbouring country. The same number of networks has been planned in neighbouring countries as those planned in France.



The numbers of layers and the channels defined in GE-06 have been applied to the feasibility study.

In France:

- In international coordination areas, the channels stipulated in GE-06, excluding the sub-band, are identical and the sub-band channels are replaced
- In areas not subject to international coordination (central France), the layers defined by GE-06 have been challenged in an attempt to ensure extra leeway in identifying additional channels

For all networks (including overseas), alternatives to the channels in the telecoms sub-band have been sought.

Results of the feasibility study

The following table presents the performance levels (service percentage) of the plans based on the three previously described scenarios. The chosen guard interval is 1/8. This frequency plan (feasibility study) has been submitted to the broadcast regulator CSA.

These results provide positive proof of the feasibility of deploying 11 DTT networks and 2 mobile TV (DVB-H) networks, using frequencies outside of the 790-862 MHz sub-band.

Network	"All audiovisual" plan 12+2	"Audiovisual/telecoms" SB7 plan 12+2	"Audiovisual/telecoms" SB9 plan 11+2
Mobile TV no. 1	71.8%	69.1%	67.2%
Mobile TV no. 2	71.2%	68.9%	68.3%
Nat. DTT no. 1	97.2%	96.2%	94.8%
Nat. DTT no. 2	96.7%	96.3%	96.0%
Nat. DTT no. 3	96.7%	96.0%	92.0%
Nat. DTT no. 4	97.5%	96.6%	94.9%
Nat. DTT no. 5	97.6%	96.2%	95.3%
Nat. DTT no. 6	97.5%	95.8%	95.1%
Nat. DTT no. 7	94.3%	96.9%	95.6%
Nat. DTT no. 8	95.3%	95.6%	95.0%
Nat. DTT no. 9	93.0%	95.6%	96.2%
Nat. DTT no. 10	95.7%	96.0%	95.6%
Nat. DTT no. 11	95.9%	95.7%	
Regional DTT	95.1%	95.8%	96.8%

Average DTT	96.0%	96.1%	95.2%
Average mobile TV	71.5%	69.0%	67.8%
Min DTT	93.0%	95.6%	92.0%
Max DTT	97.6%	96.9%	96.8%

From the feasibility study to a finalised plan

In 2008, an "all digital" frequency plan in 2008 with 11 DTT networks and two mobile TV networks had been developed, compatible with the release of nine channels in the upper UHF band for very high-speed mobile services.

The plan was subsequently refined and improved through successive iterations, gradually incorporating the results of negotiations for cross-border frequency coordination. The plan is based on the list of 1,626 sites published by the CSA for DTT coverage. It provides details on population coverage levels for each region as well as per multiplex for each of the 13 multiplex areas planned. Major networking efforts have also been made and tailored engineering solutions have been found.

Tailored engineering solutions

The feasibility study is based on antenna templates. This approach offers a maximalist view of the interference levels at neighbouring sites (French and/or abroad) and an optimistic view of the coverage areas.

To go further still, the possibilities for site engineering needed to be taken into account. The well-known, albeit infrequently used, antenna beam tilt engineering technique should be specifically considered.

This is a worthwhile solution that has the advantage of using the original antennas in the initial coverage area and boasting considerable attenuation on the horizontal plane, leading to a strong fall in interference levels. This technique is used in the current frequency plan. For example, in Montpellier, multiplex R6 is broadcast from an antenna whose beam has been tilted (electrically) by more than 4°.

To test this approach as part of the search for frequencies, analyses have been carried out based on the two following cases:

- Tilting the antenna beam at Lille Bouvigny reduces interference levels on the horizontal plane by over 10 dB
- Tilting the antenna beam at Nancy Malzéville reduces interference levels on the horizontal plane by over 15 dB (either over a given sector with a partial tilt or over all sectors with a full tilt)

Antenna beams can either be tilted by electrical means (for antennas with a sufficient number of stages), mechanical means or a combination of the two. The chosen tilt, and therefore the reduction in interference levels on the horizontal plane, is a trade-off between maintaining the coverage area, factoring in overlapping coverage areas and reducing interference.

To ensure the greatest possible efficiency when searching for frequencies, such a solution must be adopted by all stakeholders (i.e. France and neighbouring countries).

Two iterations have helped to improve the frequency plan by taking into account the radiation patterns of the antennas installed for analogue television, for the sites in the main network, with local modifications to reduce interference as indicated above.

Work resulting from cross-border frequency coordination

A target plan with 13 layers for all mainland allotment areas can be recalculated, by introducing channels negotiated with bordering countries or proposed by the CSA. Already, the feasibility study incorporates the results or assumptions for cross-border frequency coordination for all countries except Spain and Italy.

The feasibility study takes into account the channels requested by the CSA (and included in its baseline plan) in coordination areas. In areas not subject to coordination, questions about these channels have been raised.

Number of sites

As previously mentioned, the modelled networks are based on existing sites (high points): **there is consequently no need to increase the number of sites to achieve 95% coverage.**

The broadcasting networks in a 11+2+SB9 plan are therefore at the same price as networks in a six-layer plan.

Conclusion

The studies carried out in France confirm the technical and economic feasibility of a plan with 11 DTT networks offering an average population coverage rate of 95% and two mobile TV networks offering 70% coverage.

This clearly paves the way for the migration from SDTV to HDTV on the terrestrial platform, as is requested by most of the broadcast industry.