Documentation on CA_compat

Compatibility Analysis planning software for Central America and Caribbean Region

User Manual

V2.0

Terrestrial Services Department

Broadcasting Division

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Contents

1. Introduction

CA_compat is the online compatibility analysis tool, developed by the Radiocommunication Bureau, for parts of Region 2 including Central America and Caribbean countries.

This tool, based on the software used at the RRC06 Conference and still in use for compatibility analyses in GE06 planning area, facilitates the planning of digital television assignments in the frequency bands 174-216 MHz and 470-698 MHz for Central American and Caribbean countries.

The input of this tool consists in electronic notification files containing digital requirements for one or more administrations.

The planning software takes into account relevant existing analogue and digital television assignments as well as frequency assignments to other primary services recorded in the MIFR. It takes also into account the List of Reference, as agreed during the Belize-City meeting on 14 September 2018.

The software performs the necessary interference calculations and prepares as output the compatibility analyses results as a MS Access database, to be downloaded from eTools and analyzed via CADisplay.

The planning software is based on the sharing and compatibility criteria contained in the relevant ITU-R Recommendations (ITU-R BT.1368, ITU-R BT.2033, ITU-R BT.2036, and ITU-R BT.655) and Reports (ITU-R BT.2254, ITU-R BT.2383). The specific study of the technical criteria for the Central America and Caribbean Region has been consolidated in the Report ITU-R BT.2432.

CA_compat, accessible via a TIES user account, is available under eTools.

2. Technical criteria and assumptions

I. The technical criteria used for DTT planning in Central American and Caribbean Region are contained in the Report ITU-R BT.2432.

II. The propagation prediction model implemented by the Bureau is described in the Recommendation ITU-R P.1546-5. The time probability validity range for this recommendation is between 1% and 50%, while for planning ATSC and ISDB-T standards 90% values should be used. Report ITU-R BT.2383-1 suggests that Recommendation ITU-R P.1546 can be applied also for 90% of time, by using the formula described in note 19 on page 26. The Bureau sent a Note to ITU-R WP 3K for advice and received the confirmation that indeed this approach can be applied (worst case scenario).

III. Digital Terrain Model is not used. However, the calculations takes into terrain via the effective antenna height, which represents the height of the transmitting antenna above terrain height averaged between distances of 3 to 15 km, in the direction of the receiving antenna

IV. The explanation of the suggested margins is contained in Document INFO-4

3. How to use CA_compat

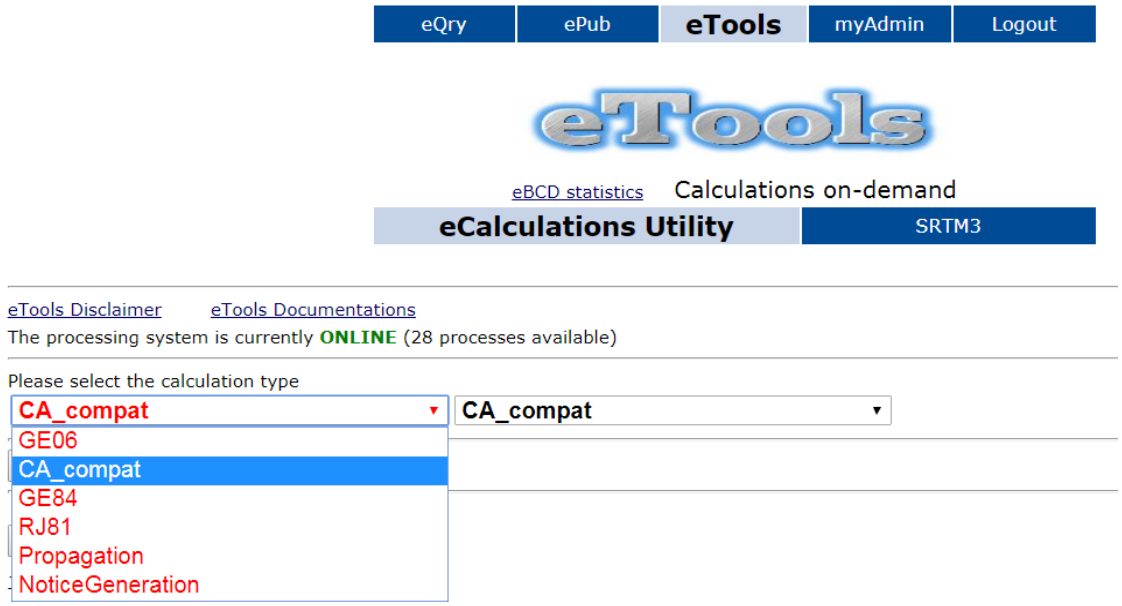
This section describes how to use the tool, from notice preparation and validation to the submission of the file for calculation via eTools.

3.1. Electronic notice file preparation

The electronic notice file (notice type T02) can be created using TerRaNotices from the BRIFIC DVD. A tutorial for the preparation of electronic notices is available here. After creating the file please make sure to validate it using the Online Validation , to ensure that the file is valid against the up to date MIFR database.

3.2. eTools

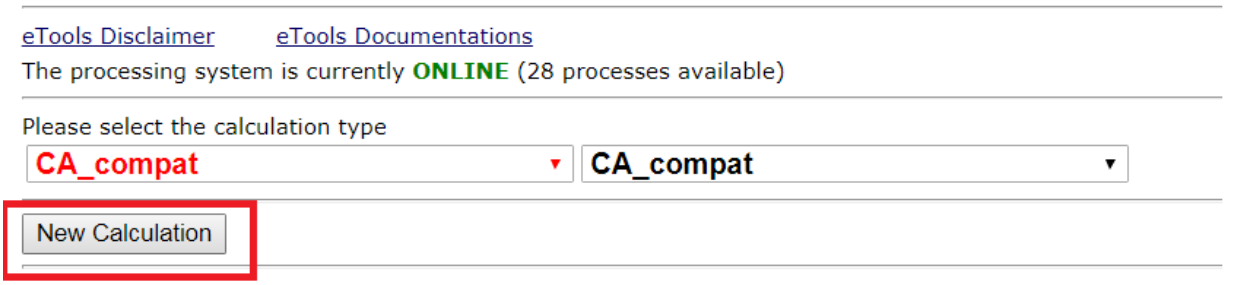
To use eTools the user should authenticate using his TIES account.
After login, the user should choose CA_compat job type as the calculation type



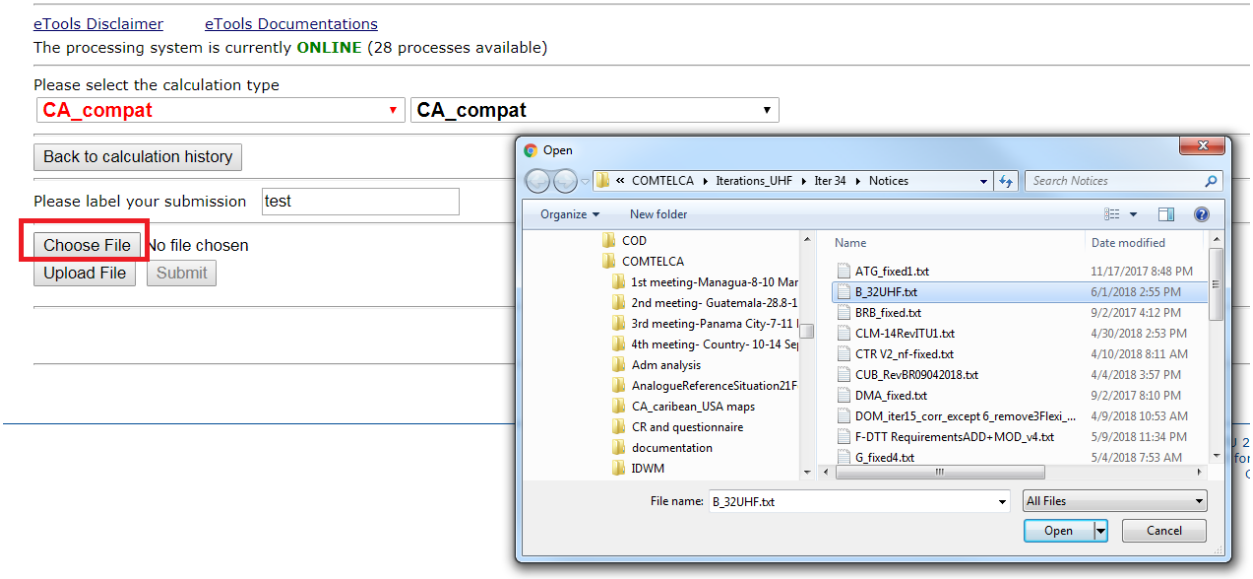
3.2.1. Calculation submission

To submit one or more file to the compatibility analysis tools the following steps must be followed

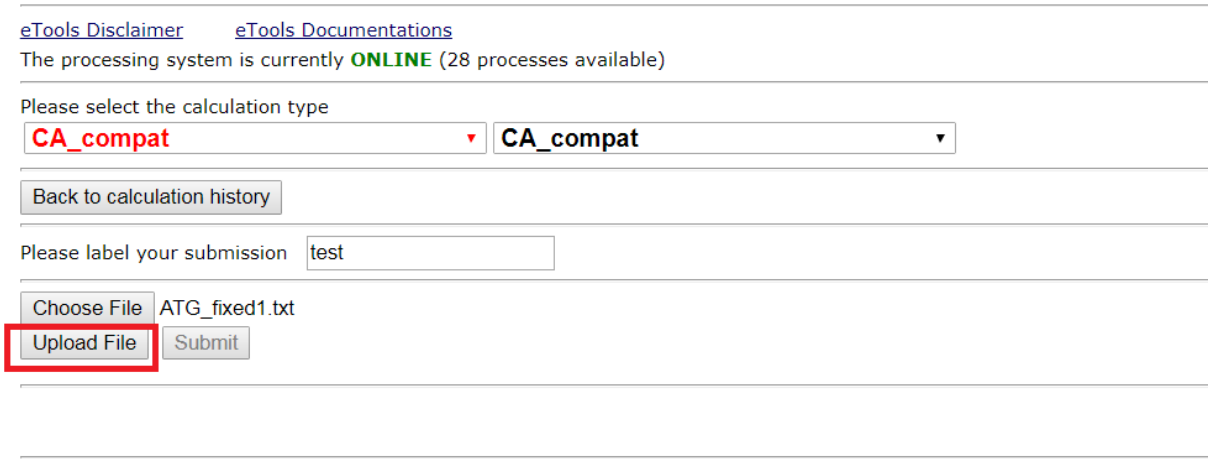
a. To initiate the new calculation request, press the New Calculation .button.



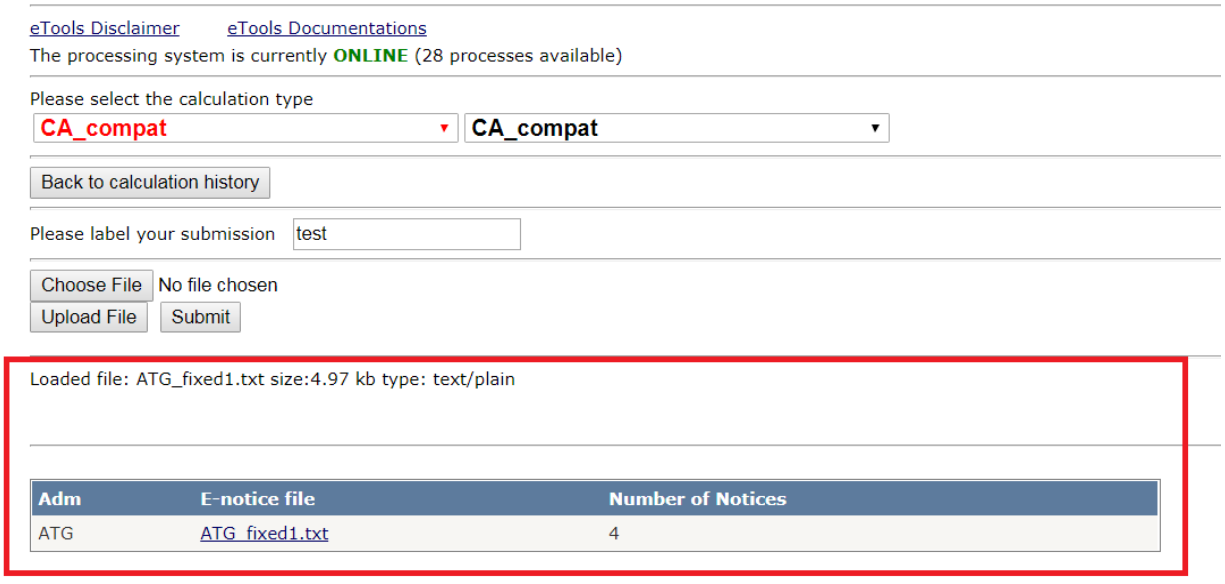
b. To load the first electronic notice file, press Choose File button



c. After selecting the wanted file in the pop-up window, push the Upload File button to upload the file to the web server

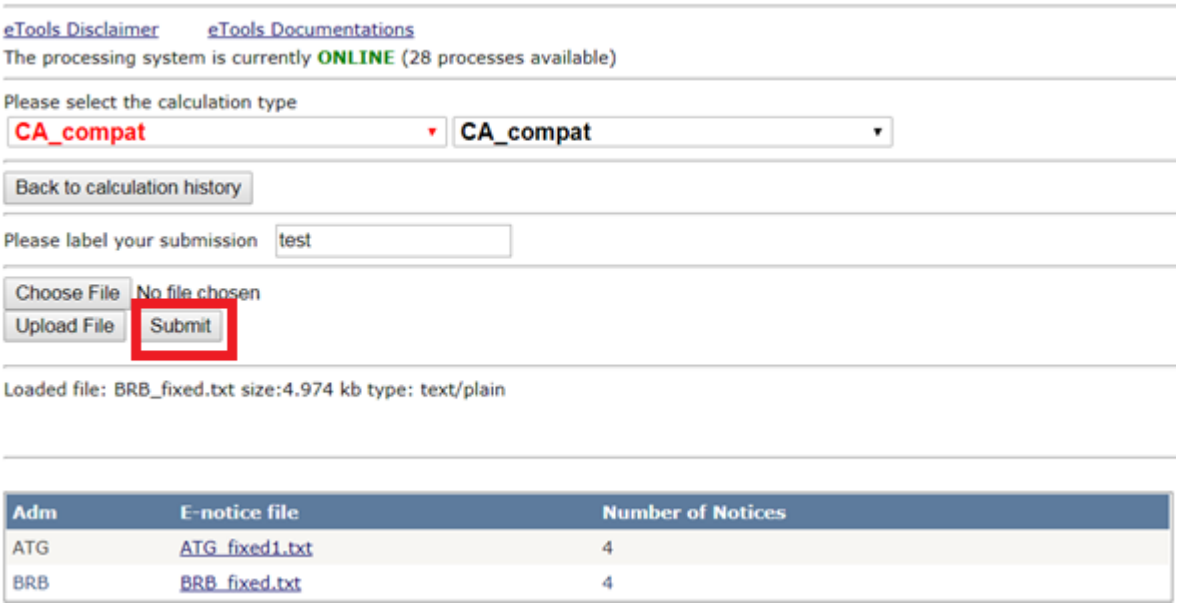


d. The file will then appear in the summary list of uploaded files.

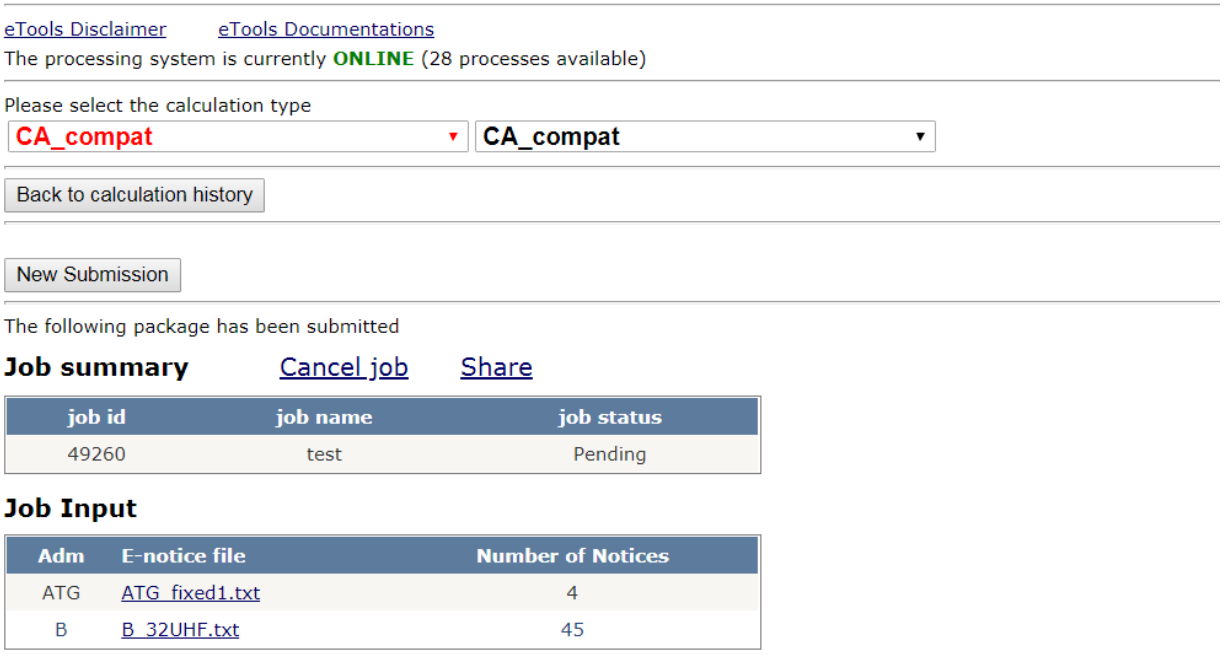


To submit more than one file repeat stops b, c and d.

e. When all the files have been uploaded the calculation must be submitted by pressing the Submit button



f. The calculation request is now sent to the server and the user is provided with a Job ID, used to uniquely identify the calculation request.

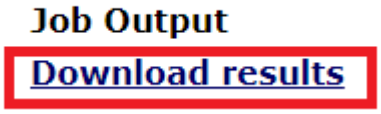


3.2.2. Job life-cycle

The job submitted would be in status Pending. At this point the backend infrastructure, composed by around 30 parallel process, would take care of the calculation. The first step would be the calculation of the digital requirement service areas (status: InProcess). When this calculation is done, the system would split the requirements in small batch of 20 requirements, in such a way to benefit from the distributed calculation infrastructure. The compatibility analyses sub-jobs would then be run in parallel. (status: Calculating). At the end of the compatibility analyses, the results would be consolidated (status: PreparingResultsFile) and finally imported in an MS ACCESS database (status: Success). In case of problems during the calculation, the job would be labeled with the status: Failed, and the reasons for the failure displayed to the users via the web interface.

3.2.3. Results download

When the job completes, the database can be downloaded from the web interface in the Job Output section, and later analyzed in the CA Display application.



4. Planning software description

This section intends to provide a brief description of the planning software.
Details of compatibility calculations and the concept of margin are explained in the INFO 4 document.
The minimum field strength and protection ratios values referenced in this chapter comes from the relevant tables in the Report BT.2432. The propagation model in the ITU-R P.1546. Terrain is taken into account via the effective antenna height only.

4.1. Preparation of digital requirement/assignment noise limited service area

For each requirement or assignment the software determines the wanted minimum median field strength in the following way:

1. Retrieve the relevant minimum field strength from Table 1 (UHF: reference frequency = 650 MHz) or Table 2(VHF: reference frequency = 200 MHz). For DVB-T, DVB-T2, ISDB-T, DTMB the values are given for 95% of locations and 50% of time while for ATSC the values are given for 50% of locations and 90% of time.
2. Perform the appropriate frequency correction[1]. In case of flexible channels the software considers the assigned frequency of lowest channel in the appropriate band (UHF or VHF).
3. Add a 3dB margin to make provision to up to six interferers

To determine the coverage area, the software calculates the points (at every 10° bearing) where the field strength equals the wanted minimum median field strength determined above.

To determine the service area, the coverage points outside the country boundary (if any), are brought back around the radial towards the location of the wanted assignment until they are within the county borders. Those points on the border will have therefore a protected value higher than the wanted minimum median field strength.

4.2. Compatibility Analysis amongst digital requirements/assignments

For each wanted requirement, the software verifies the compatibility against all the others (interfering) requirements or assignments.

For each wanted requirement, the software retrieves all requirements/assignments that satisfy the following conditions:

- co-channel or overlapping channel (in case of flexible against flexible, just consider the lowest channel(s))[2].

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[1] Formula given in in Section §11.4 of Report ITU-R BT.2383-1 (page 21)

[2] Adjacent channels are NOT considered, since the PR are very low (see Table 5).

- less than 1000 km away from the wanted assignment

For those requirements, the software selects from Table 4 the relevant Protection Ratio (PR), which depends on wanted and unwanted broadcasting standard and on the requirements being co-channels or overlapping..

A correction factor is applied in the following cases:

- For wanted ISDB-T (when ISDB-T not interfering) with non-zero offset: PR = PR - 1
- For wanted system not ATSC, the PR is adjusted with the combined location correction factor for 95% of locations.

The software evaluates the center frequency as the average between wanted and unwanted channel, and determines the wanted minimum median field strength following steps 1) and 2) from Section 4.1.

Calculation of nuisance field strength is not necessary in the following cases:

- if the interfering transmitter is inside the wanted station service area (CAdisplay interference type: TX Inside).
- if interfering and wanted service area overlap (CAdisplay interference type: Overlap)

In all other cases the software checks if there is excess interference from the potentially interfering assignment at any of the wanted assignment's boundary test points, by calculating the protection margin.

- if the margin is higher than 1.25 dB, we have interference and the software stores the margin, distance and nfs (CAdisplay interference type: Interference) value for CAdisplay purposes

4.3. Preparation of the Analogue Reference Situation

The analogue assignments recorded in the Master Register since 1986 are in operations since the 50's. Some of the older data did not have all the needed technical parameters for planning or some data was not consistent, therefore administrations were requested to assist in the data cleaning, by notifying the missing information. In case of no reply, the BR did not change the information in the MIFR but generated the appropriate data for calculation purposes.
The main data inconsistences referred to missing values in the antenna patterns, inconsistences between antenna directivity and pattern. In case of missing value of the antenna above ground level, the software used a value of 50m. In case of missing effective antenna height, the values were generated based on the SRTM3 database.
The reference situation is calculated based on recorded analogue assignments in the Master Register.

4.3.1. Noise limited coverage area

For each analogue assignment, the software determines the wanted minimum median field strength in the following way:

Retrieve the relevant minimum field strength from Table 3 for 50% of time and 50% of locations

- Band III: 55 dB(µV/m)
- Band IV: 65 dB(µV/m)
- Band V: 70 dB(µV/m)

No allowance for interference, unlike for digital assignments, is made at this point. The actual interference is taken into account in the following step.

To determine the coverage area, the software calculates the points (at every 10° bearing) where the calculated field strength equals the wanted minimum median field strength determined above.

4.3.2. Interference limited coverage area

The interference analysis is performed for 1% of time.

For each wanted assignment, the software retrieves all the potential interferers satisfying the following conditions:

- co-channel or adjacent channels (N-1, N+1)
- distance less than 1000km for co-channel or less than 300km for adjacent channel

For each of those potential interferers, the software determines the analogue-to-analogue protection ratios from Table 12 (co-channel) or Table 13 (adjacent channel) for tropospheric (1% of time) and continuous interference (50% of time). In case of co-channel, when both assignments have an offset, the Table 12 outlines the value to select based on the offset difference.

Starting from the noise limited service area, for each test point (36 values at every 10° azimuth around the location of the wanted station), the software evaluates if the wanted field strength is above the nuisance field strength (highest of continuous and tropospheric) evaluated as the power sum of field strength from all interfering analogue transmitters. When it is the case, the point is considered as the interference limited coverage point. Otherwise, an iterative process brings the point inward of the noise limited coverage area towards the wanted transmitter until the wanted field strength exceeds the nuisance field strength.

At the end of the iterative process, all the 36 values defining the coverage area have been determined. To determine the service area, the coverage points outside the country boundary (if any), are brought back towards the location of the wanted assignment until they are within the country boundaries. Those points on the border will have therefore a protected value higher than the wanted minimum median field strength.

5. Current processes implemented by the Bureau to ensure respect of the Reference List and to provide up-to-date data for compatibility analyses.

In order to record new assignments in the Master Register, if not corresponding to Reference List entries, administrations are responsible to run the planning software and get all the necessary agreements from administration for which incompatibilities exist. Those new digital assignments must also be taken into account in the calculations, once they are recorded in the Master Register.

After the establishment of the Reference List, the Bureau modified its software to consider the assignments contained in the List in the calculation, if those are not yet recorded in the Master Register.

Any analog notification to the Master Register triggers a recalculation of the Analogue Reference Situation to include the latest modification(s) to the MIFR.