# Visualyse GSO

# Version 3

# Introduction and Example Coordination

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## Version and Copyright Information

Product:             Version GSO

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# Table of Contents

# 1 Introduction

The aim of this document is to introduce new users to Visualyse GSO by giving a step-by-step description of a typical coordination process. It covers key elements of the process, including:

- Loading your networks from the SRS or an IFIC

- Undertaking a coordination check from an IFIC

- Analysing a scenario as part of detailed coordination with another network.

This document should be read in conjunction with the other documents provided, in particular the User Guide which is available from the Visualyse GSO help menu.

This document assumes the reader is familiar with the coordination process for GSO satellites including ITU databases, ITU software tools and the calculation of metrics such as DT/T and C/I.

It goes through the process step-by-step in a way that allows readers with access to a copy of Visualyse GSO to repeat the process. Note that this is a brief introduction that doesn't cover all the features of the tool, in particular the slot finder, priority map and shaped beam editor.

Additional Technical Notes and White Papers can be found on our web site at:

https://www.transfinite.com

**Important Note**

*While this worked example uses data from various ITU databases of actual filings, it is solely for demonstration purposes and no implications or conclusions should be drawn as to coordination or operation of any network mentioned.*

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# 2    Loading Your Networks into Visualyse GSO

The first step when using Visualyse GSO is to identify which are "Your Networks". These are the ones which will be used to identify if coordination is required and, if so, to undertake detailed coordination.
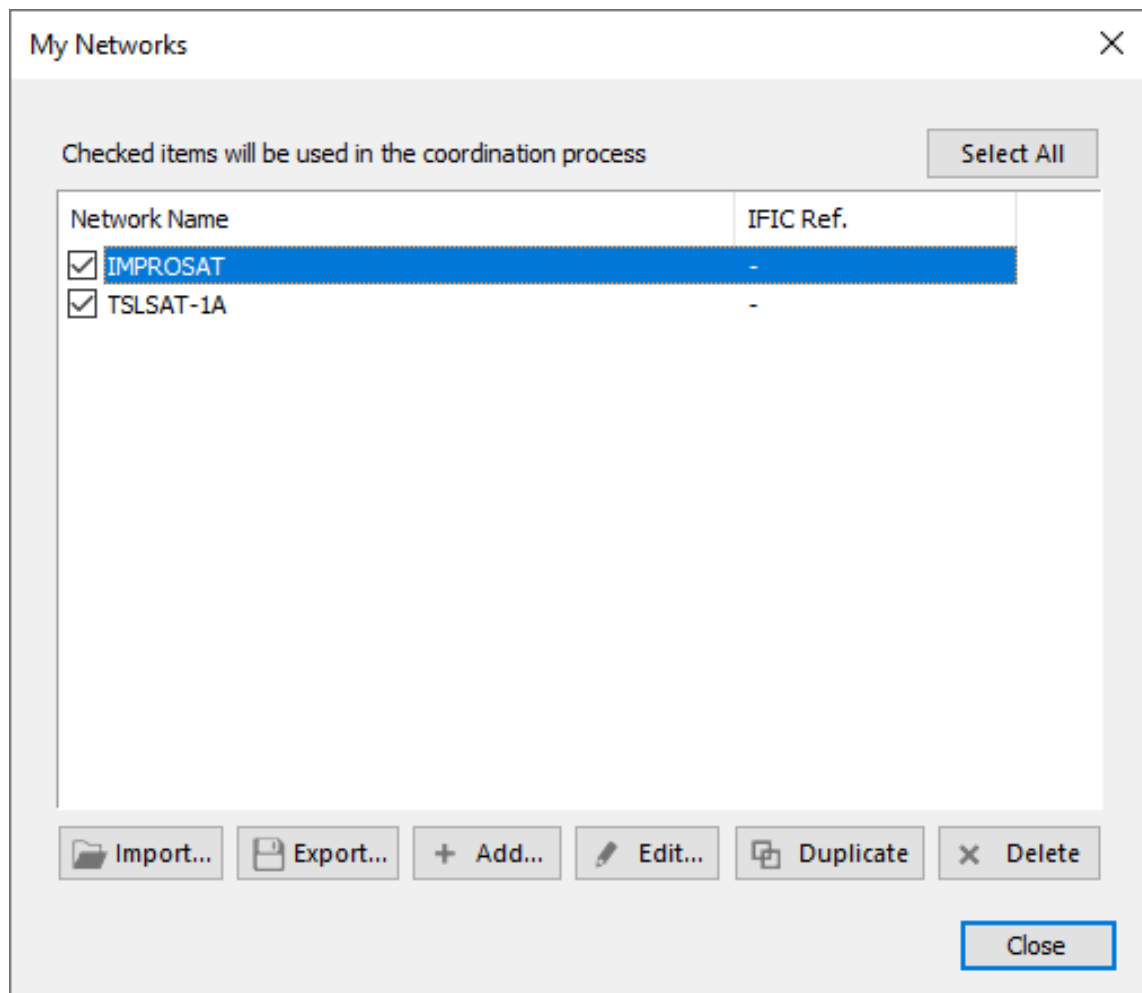
When you start Visualyse GSO you will see the initial screen:
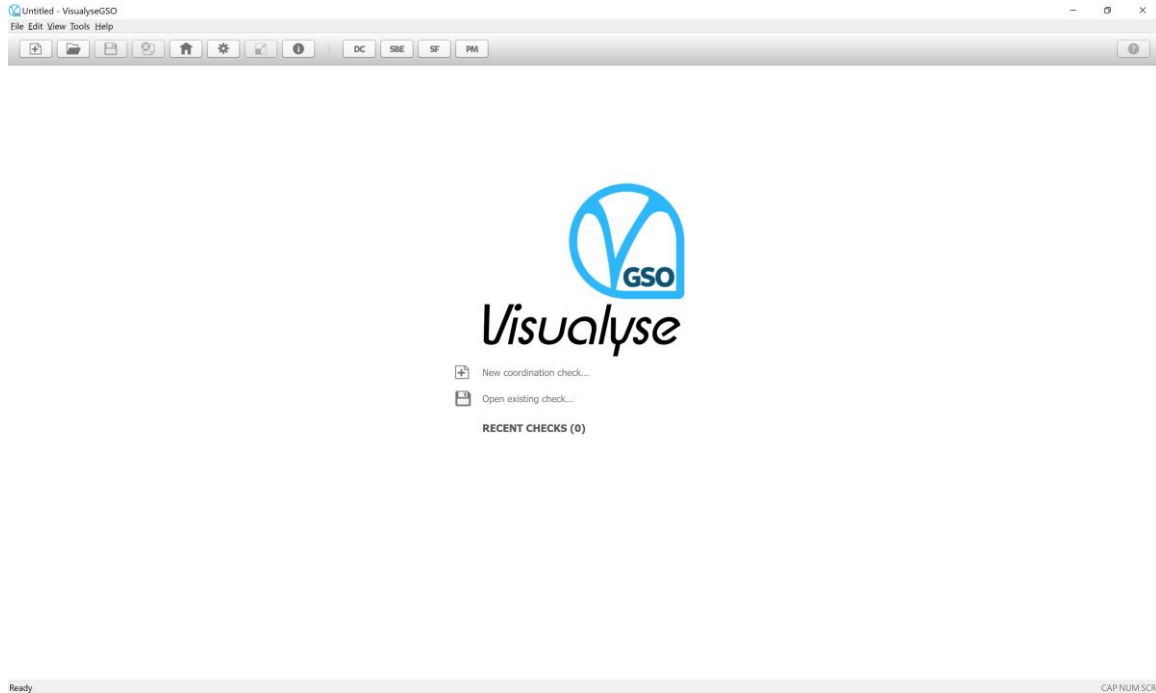


From the home screen select the "My Networks" icon at the top:



From the default installation, you will then see the list of networks currently in the "My Networks" database, which by default are the two test networks "Improsat" and "TSLSAT-1A":

The first step is to replace these with your networks. While this could be done by creating the network using the editor in Visualyse GSO, the best way is to import from another database including:

- One of the ITU's SRS databases

- One of the ITU's IFIC databases

- A local database created using (for example) SpaceCap.

In this case we'll import some of the networks from the Cyprus administration from a recent SRS. To do this, click on "Import…" and the following dialog will appear:
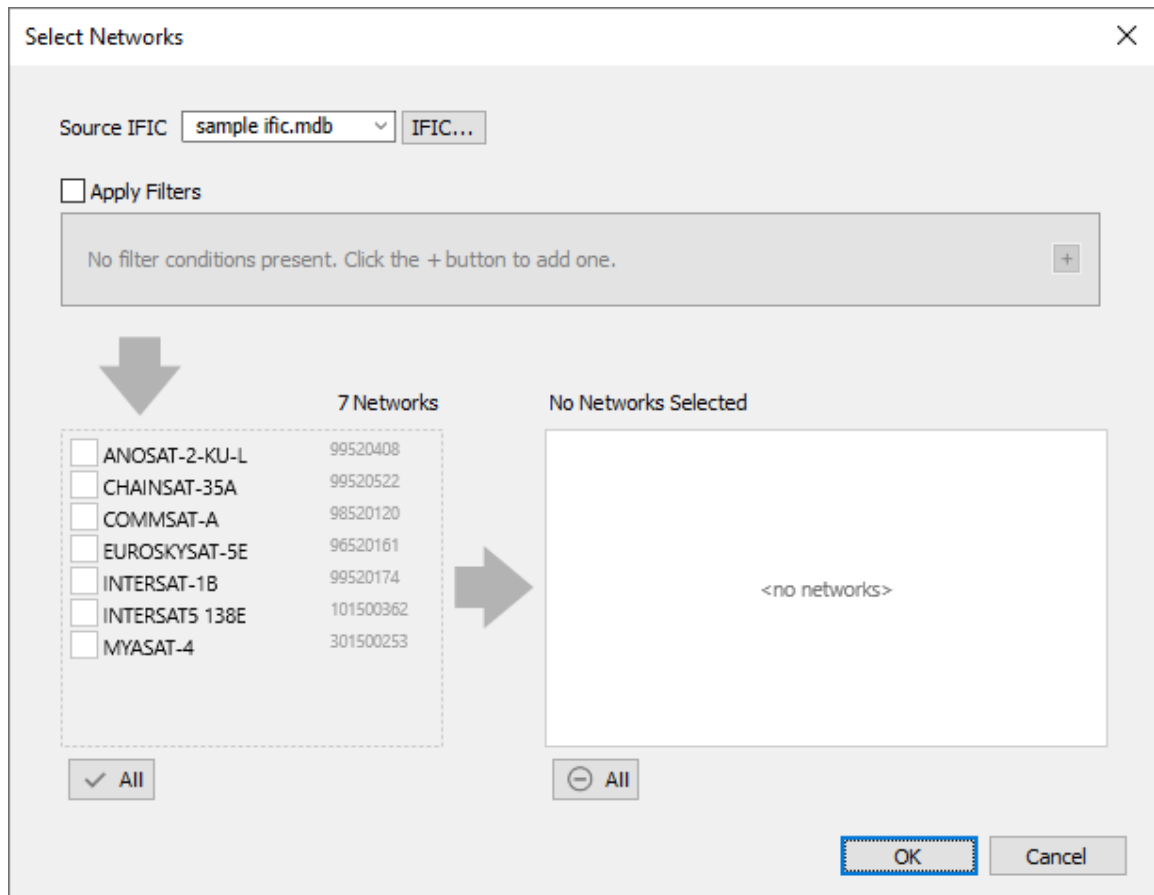
By default, the source IFIC is the "sample ific" database but in this case we want to import from the SRS database. Click on "IFIC…" and then select an SRS – for this example the srs2865 was used. If the database is split over two MDB files, then the first should be selected.

This should update the list of networks as following:
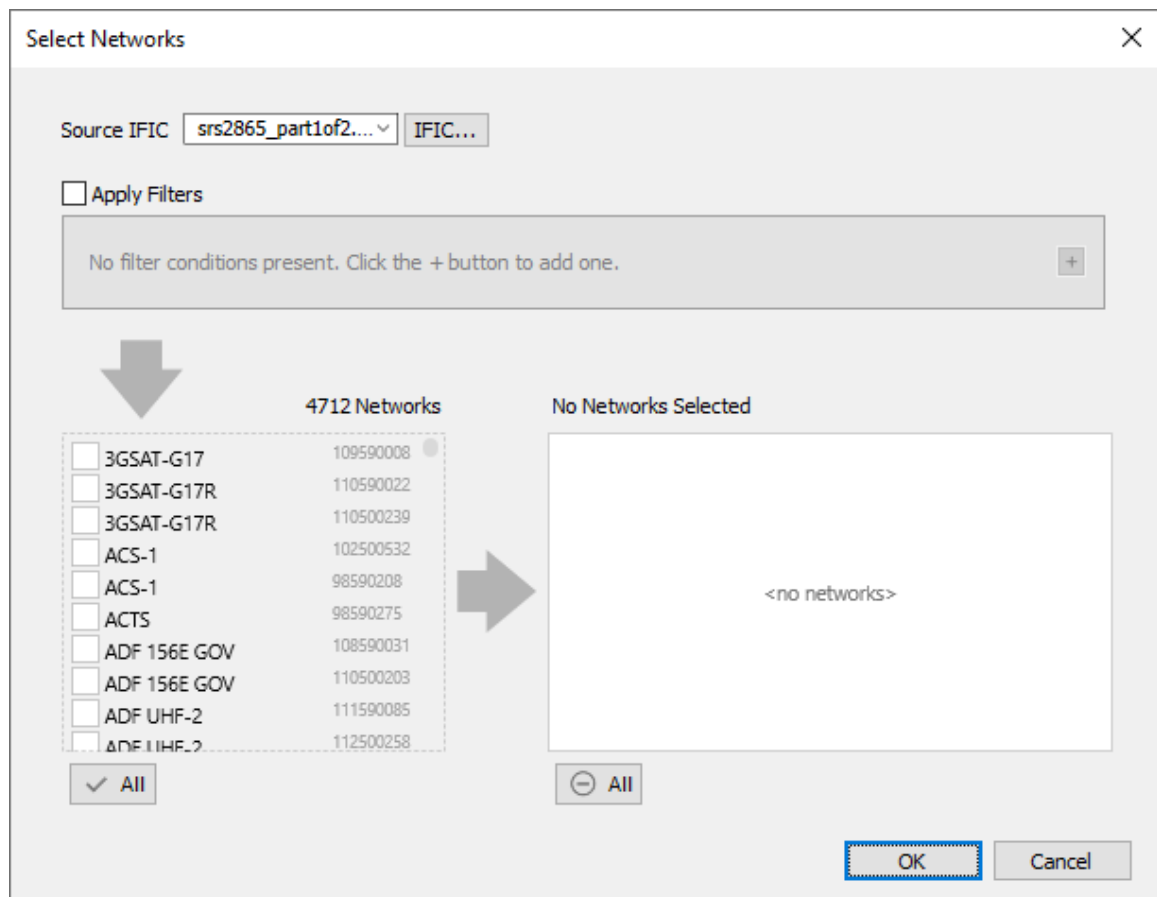
The list here contains 4712 networks, of which we only want selected filings from the Cyprus administration. This can be achieved by using a filter on those networks in the list. Example filters include:

- Frequency
- Network name
- Administration
- Longitude on the GSO arc
- Separation
- Date of receipt
- Filing type (e.g. A, C or N)
- Organization.

In this case we want to look at N notices from the Cyprus Administration. Hence add two filters:

- Filter 1: "Administration" + "is" + "Cyprus (Republic of)"
- Filter 2: "Notice Type" + "is" + "Notification"

This gives us two satellites, as in the following list:
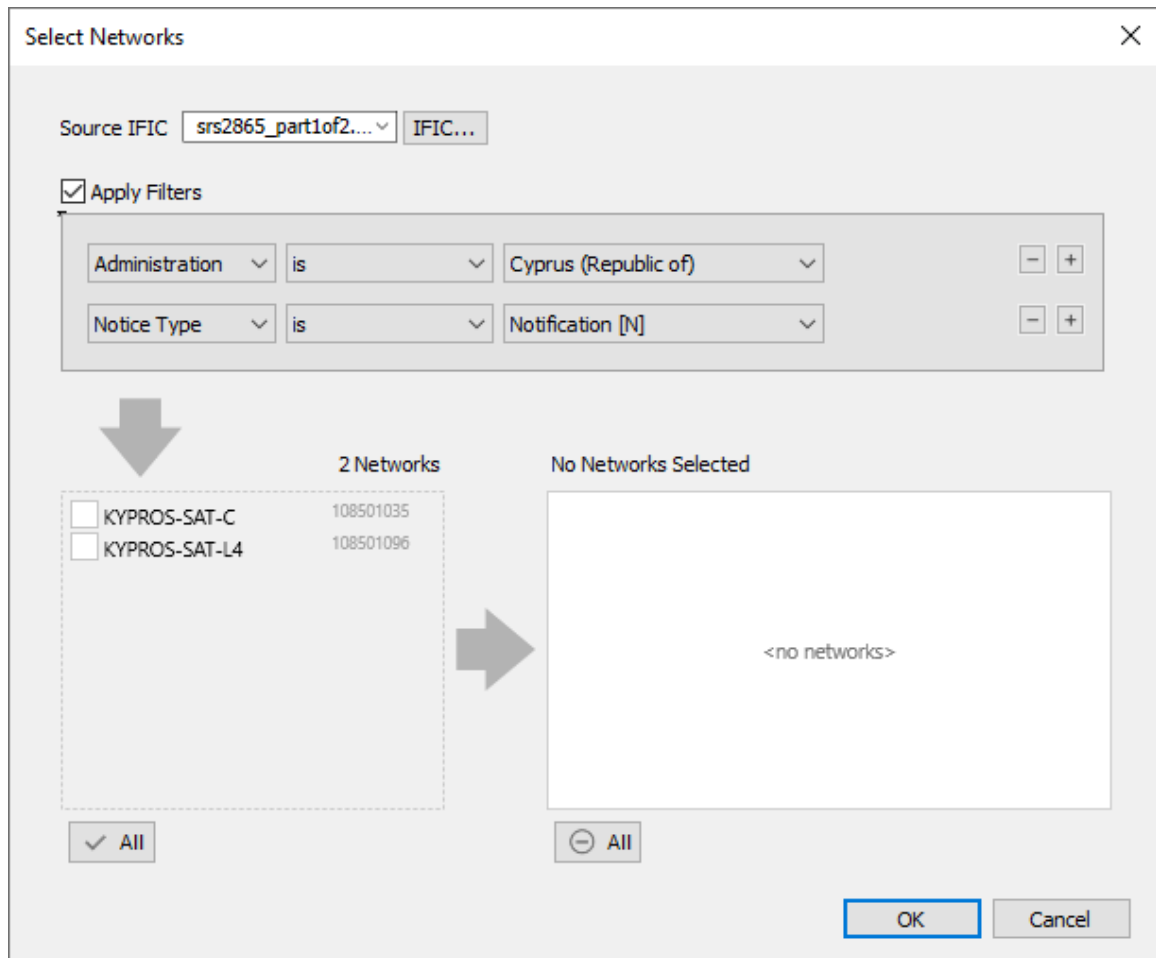
These can be included in the analysis by:

- Click on "All" to select the two networks
- Click on "Ok" to close this dialog and include the two networks.

More networks could be included – for example, also including C notices and other filing types.

Make sure that the two Cyprus satellites are enabled and the two test networks deselected so that the "My Networks" dialog looks like this:
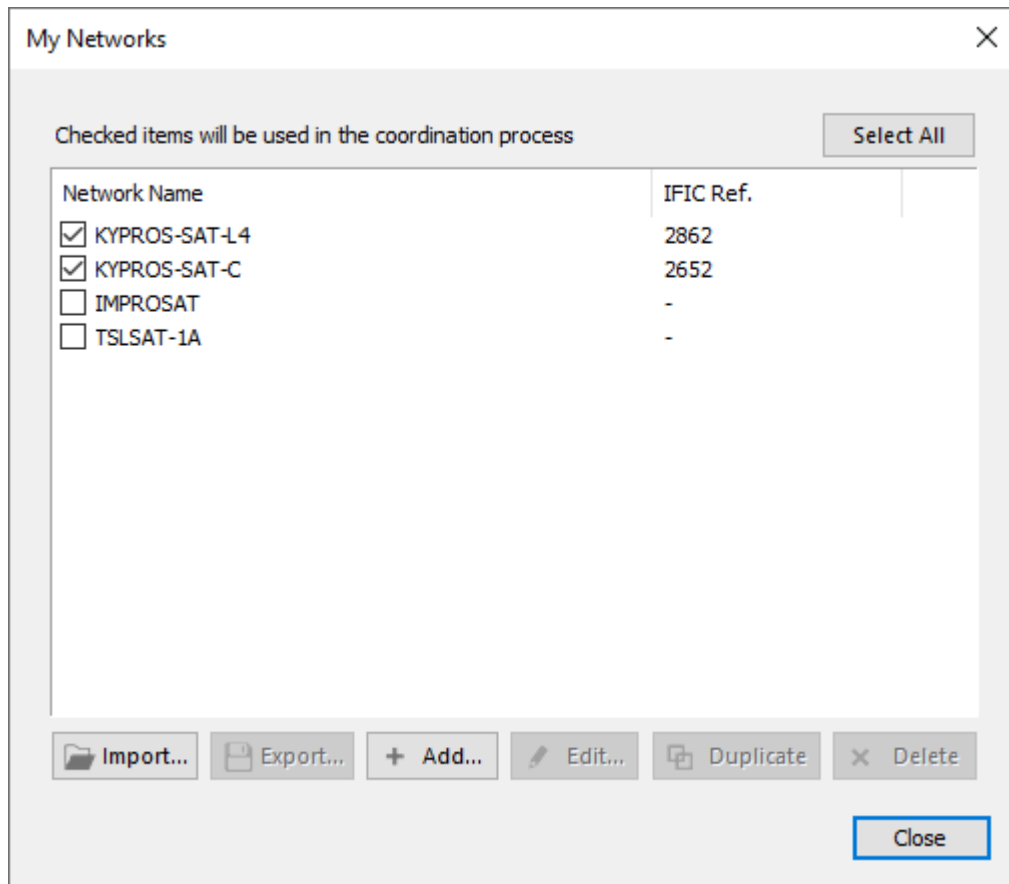
If the dialog looks like the above, then its ok to click on "Close".

This completes the first stage: the "My Networks" database has been updated to reflect the networks we wish to protect. This can then be used in the coordination trigger checks and then detailed coordination analysis in the following two sections.

# 3 Undertaking a Coordination Check

## 3.1 *Introduction*

Having configured "My Networks" to include those GSO satellite networks we wish to protect, we can continue with an example Coordination Check. In this, we process one of the ITU's IFICs in order to:

- Identify those GSO networks we need to coordination with (e.g. because within the GSO coordination arc or the worst-case DT/T > 6%)

- Check whether a coordination request from another GSO operator is valid (e.g. because within the GSO coordination arc or the worst-case DT/T > 6%)

- Identify if coordination is required with a non-GSO network (e.g. due to frequency overlap)

- If coordination is required, to provide documentary evidence as to why (e.g. for GSO because the satellite is within the GSO coordination arc or the worst-case DT/T > 6% or for non-GSO due to frequency overlap)

- If coordination is required with a GSO network, to provide access to the Detailed Coordination analysis tool

In this case we are going to undertake a coordination check of our two Cyprus satellites with ific2885.

## 3.2 *Creating a New Coordination Check*

From the Visualyse GSO home screen click on the "New coordination check…" text in the middle of the screen or the button on the toolbar:



This will open the following dialog:

Note that by default the coordination analysis is done in both directions, namely:

1. Interference from "My Networks" into those networks in the IFIC

2. Interference from those networks in the IFIC into "My Networks"

This is done using both the coordination arc (for those bands where one is defined) and also the DT/T check.

To select ific2885, click on the "IFIC…" button and select that database which is available from this web address:

> https://www.itu.int/sns/demowic18.html

When this has been selected click on "Go…" and Visualyse GSO will analyse all those networks in this filing one by one. There will be a status dialog that shows for a very short time identifying the database import stages and then the main Visualyse GSO Coordination Trigger screen will open. In this IFIC there are 185 networks and Visualyse GSO will go through each one, calculating:

- If there is frequency overlap

- If both are GSO, if the other satellite is within the coordination arc of one of "My Networks"

- If both are GSO, if the DT/T exceeds the 6% threshold

## 3.3 List of Networks

By default, with no networks selected, the view looks like this:
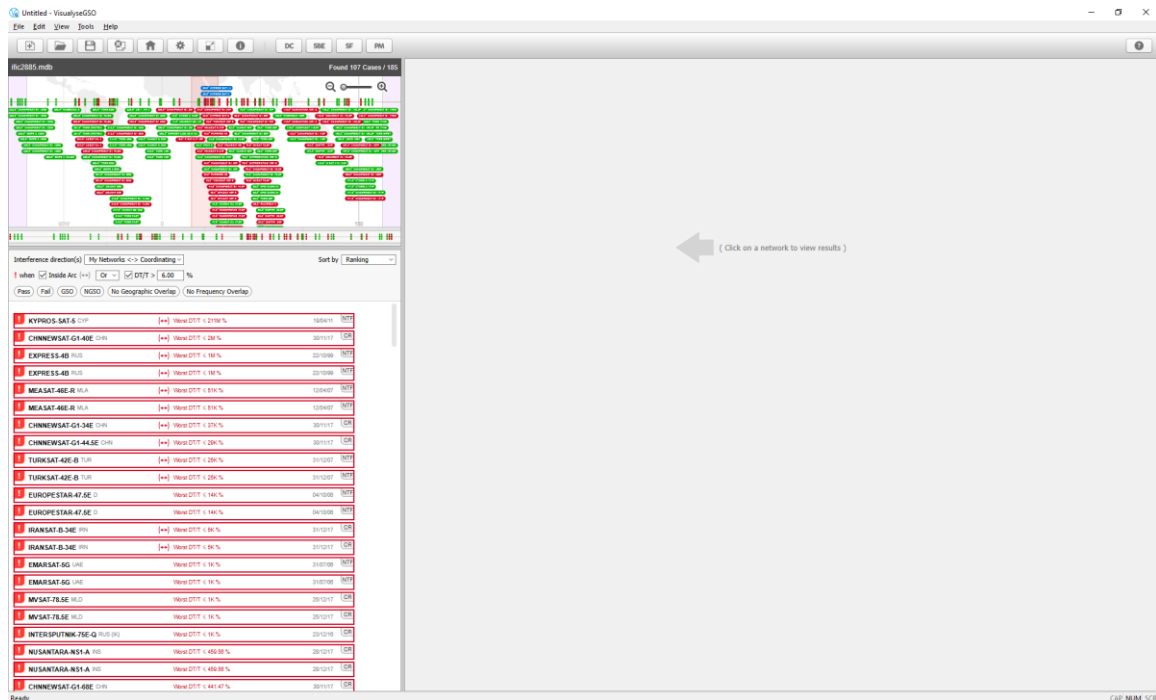


If you scroll down the list of networks, you will see:

- Some networks are highlighted in red which implies they require further analysis (most likely coordination) and others in green for which no further work is required

- Some which are GSO and some identified as non-GSO

- For GSO networks, the list also shows the worst-case DT/T and whether inside the coordination arc or not

- The list also gives the priority date and notice type.

If you type "Ctrl + C" you can select window 2 and this list will be copied into the clipboard. You could then open Excel and paste the list in such as this:

This can be used within a process that tracks each IFIC and how they were processed.

## 3.4    *Satellite Map*

Another way to see the GSO satellites in the IFIC is using the satellite map. Click on the "maximise a pane" button and then select "Satellite Map" or "1":
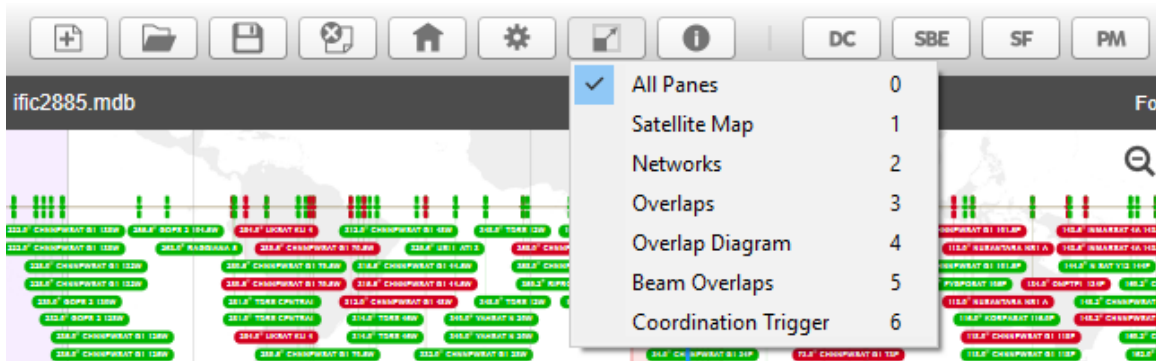


This will show the GSO networks in the IFIC graphically in full-screen mode, such as this:
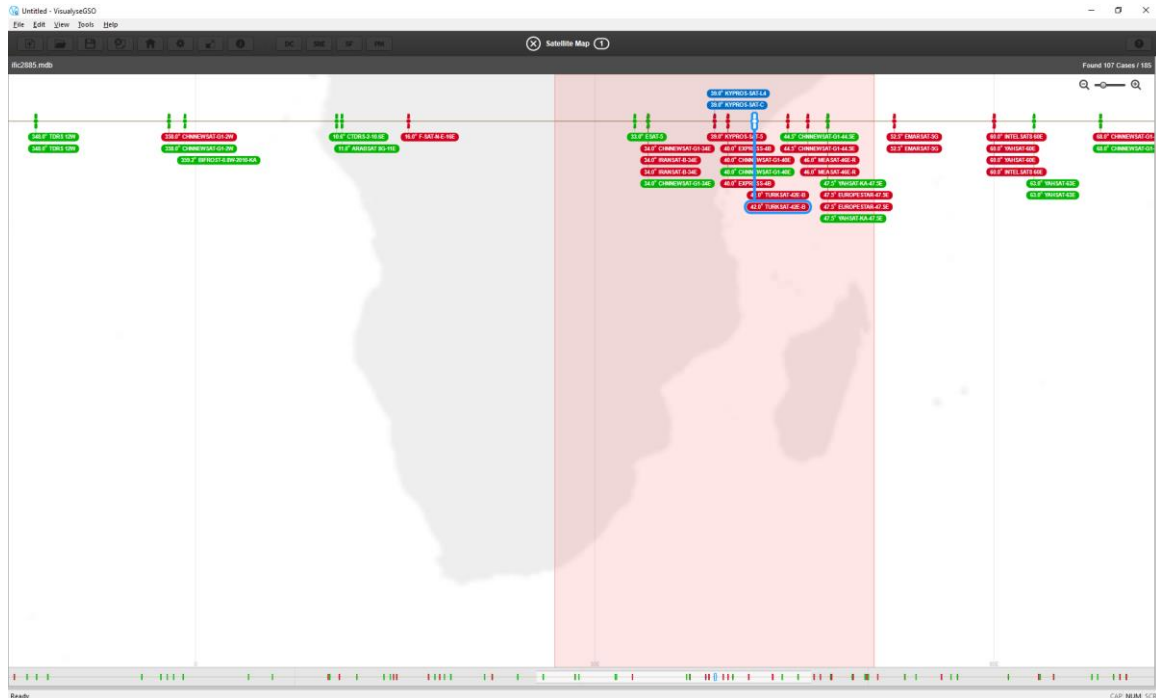
It is then possible to zoom in for more detail or scroll left and right. This is helpful for identifying which are the problem networks and which are in the coordination arc: often – but not always – there is significant overlap between these two cases.

To close this view, click on the cross button:



## 3.5    Selecting a Network

To get further information about a particular case, we can select it on the Network List. For example, select "TURKSAT-42E-B" and the other four views will update with more information about that case:
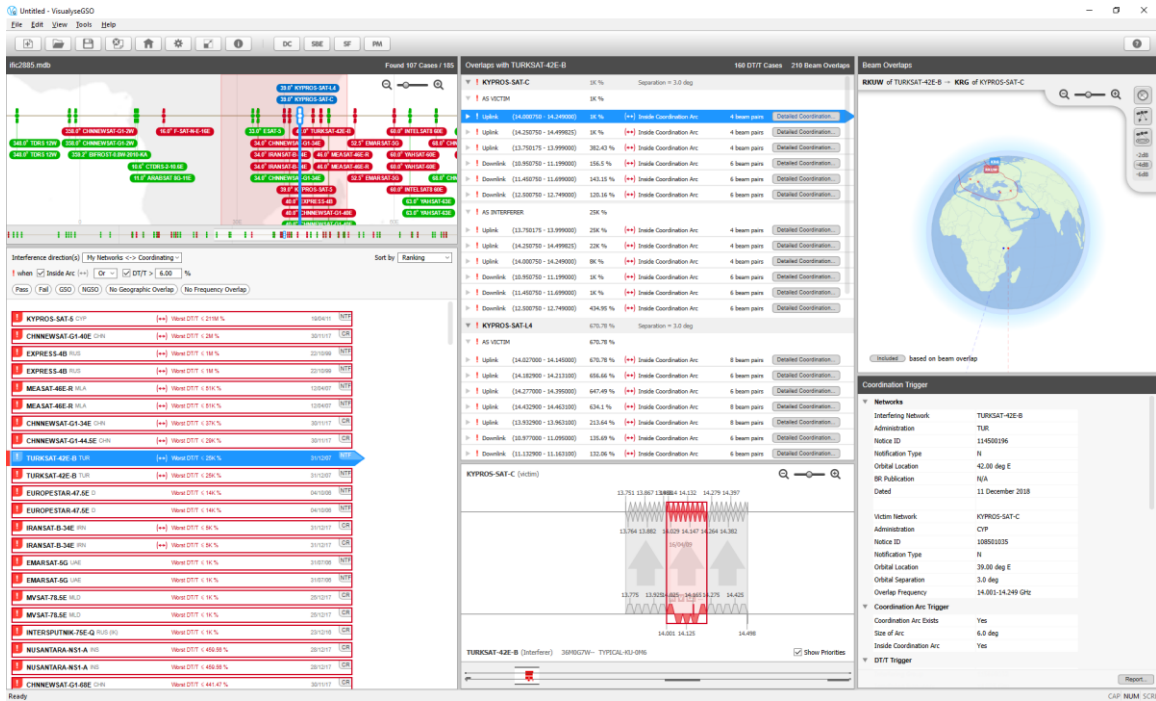
The various views can be identified as follows (using Ctrl+C to copy a view):
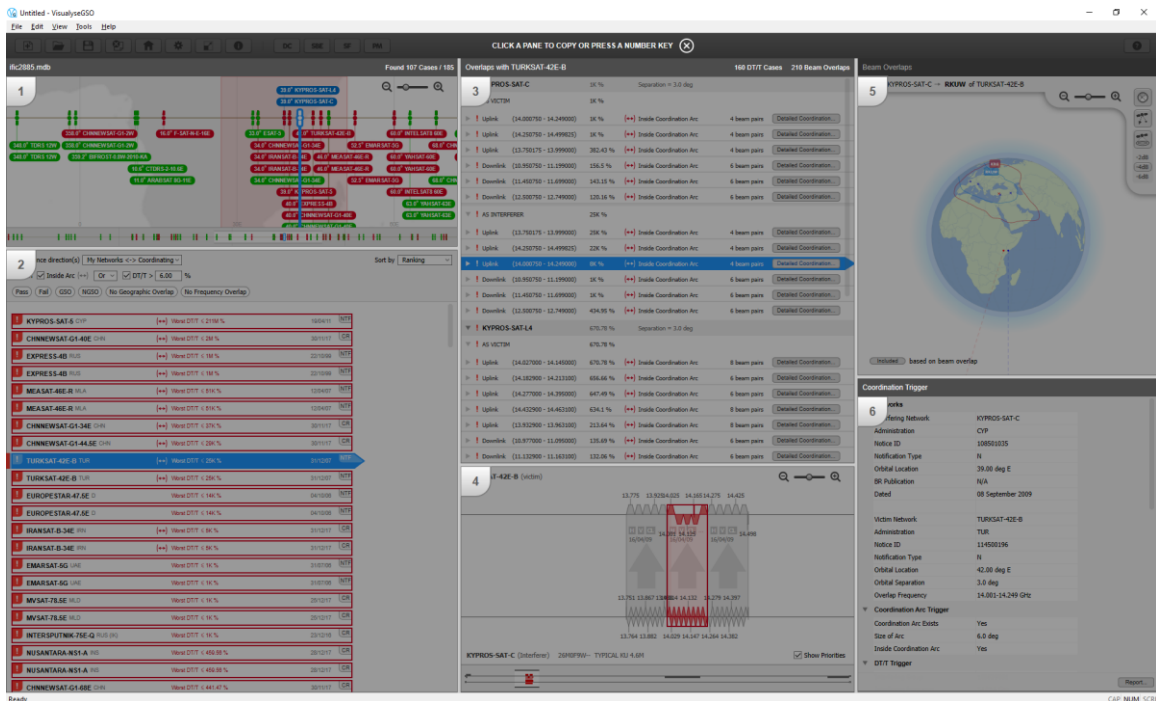


3) Overlaps

4) Overlap diagram

5) Beam overlaps

6) Coordination Trigger

These are described further below:

## 3.6 Overlaps View

For the network selected from the IFIC (or SRS or other database), this shows results of the analysis to/from the networks in "My Networks". At a top level it is shown:

- For each of the networks in "My Networks"

- For each of the directions i.e. one or both of into or from "My Networks".

The list can be rolled up to show this high level:



This shows the highest DT/T over all cases in each category and the separation on the GSO arc. Within each of these categories there are then likely to be sub-categories, broken down by:

- Direction (uplink or downlink)

- Frequency band

- Beam pair

These can be seen by expanding the tree, for example as follows:



Hence it can be seen that the worst-case DT/T for the case of TURKSAT-42E into KYPROS-SAT-C for the downlink direction is between the KTE and TKUW beams in Ku band.

If you select one of these combinations, as in the figure above, then the Overlap Diagram, Beam Overlap view and Coordination Trigger views update as described below.

## 3.7 Overlap Diagram

Having selected a case on the Overlap List, more information about the frequency overlaps is shown in the view below. An example would be this:
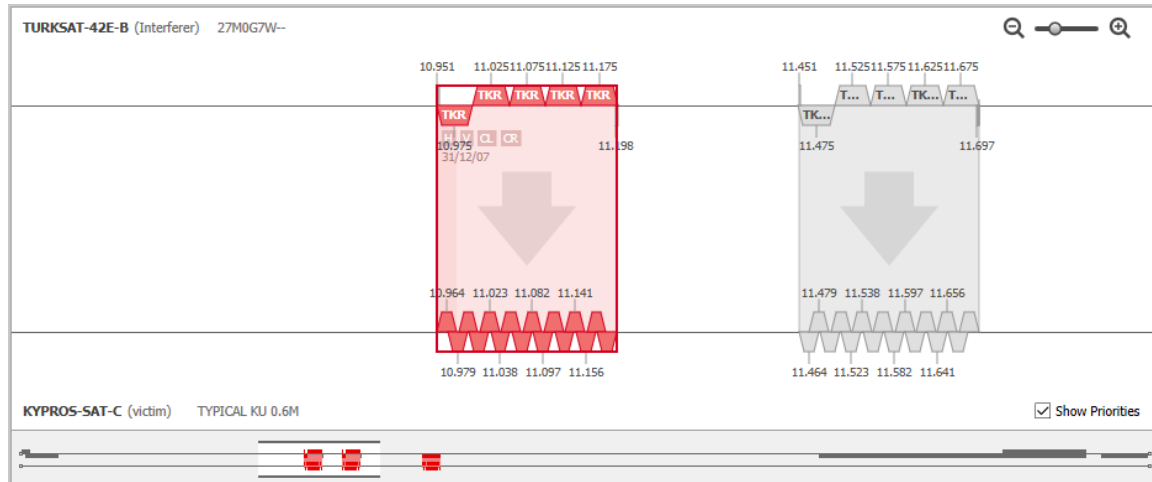


Here the following can be seen:

- The top half shows the groups, beams, frequencies etc. of the interfering satellite (in this case TURKSAT-42E-B)

- The lower half shows the groups, beams, frequencies etc. of the victim satellite (in this case KYPROS-SAT-C)

- At the bottom is an overview of the frequency bands which can be scrolled left and right. The view can be zoomed in and out using the control on the top right

There are likely to be many combinations of emissions and victim Earth stations: the one selected is the one that causes the highest DT/T as shown in the coordination trigger view.

## 3.8 Beam Overlaps

This view shows the selected beams of the interfering (drawn in red) and victim (drawn in blue) satellites in a 3D view, together with additional information such as location of the satellites, as in this example:
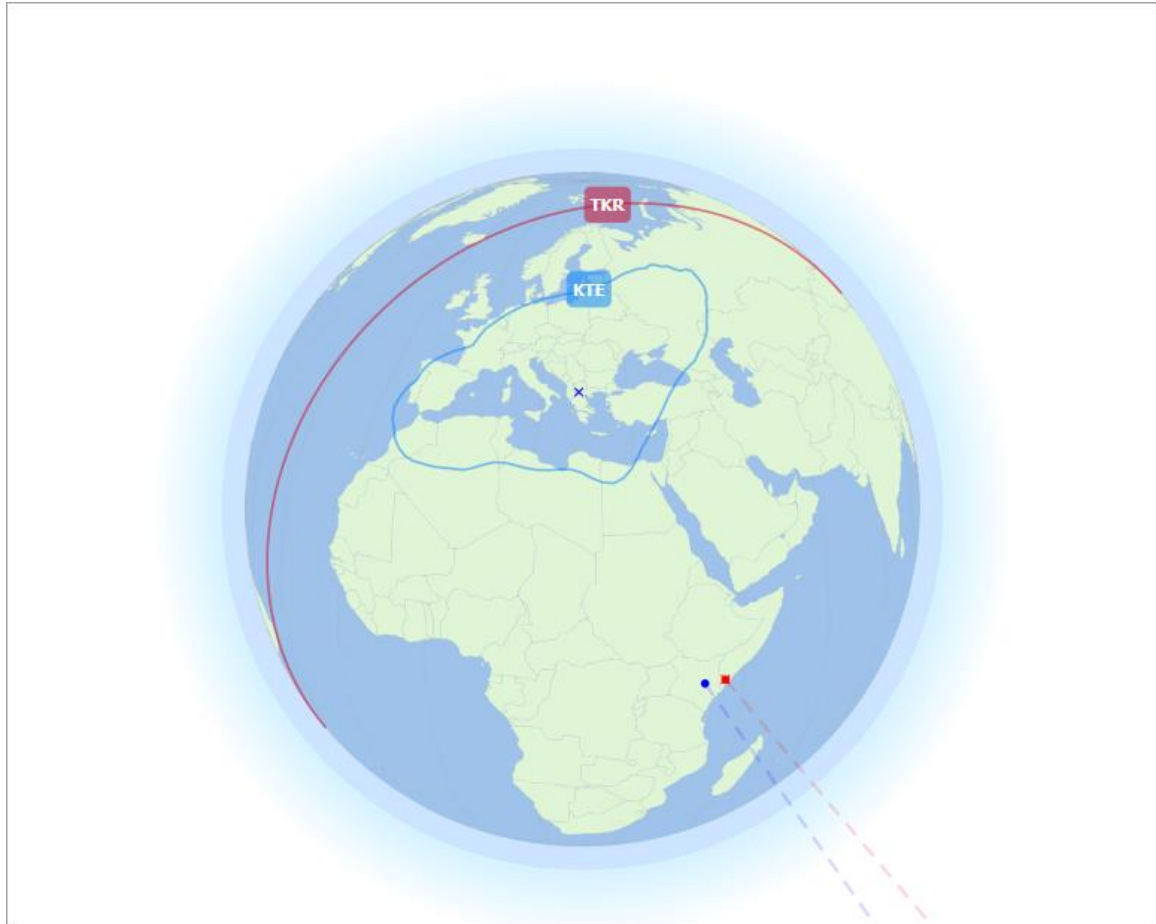
This is useful as it not only gives a greater understanding of their network, it also allows cases where there is no overlap of service areas to be excluded (see following section on the assumptions made in the calculation of DT/T).

This view, like all the views, can be expanded to be full screen or copied to clipboard and then pasted into other applications such as Microsoft Word.

## 3.9 Coordination Trigger

The final view is the Coordination Trigger calculation which gives more information about how the DT/T was calculated. This can be useful to:

- Double check a coordination request from another administration
- Provide evidence as to why coordination is required to another administration

It gives all the information behind the calculation and can be exported in one of two ways:

a) Copy the view to paste into other applications e.g. Microsoft Excel

b) Click on "Report…" to generate a Microsoft Word document.

Examples of these are shown below:

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**Coordination Report**

**Networks**

| | |
|---|---|
| Interfering network | TURKSAT-42E-B |
| Administration | TUR |
| Notice ID | 114500196 |
| Notification Type | N |
| Orbital Location | 42.00 deg E |
| BR Publication | N/A |
| Dated | 11 December 2018 |

| | |
|---|---|
| Victim network | KYPROS-SAT-C |
| Administration | CYP |
| Notice ID | 108501035 |
| Notification Type | N |
| Orbital Location | 39.00 deg E |
| Orbital separation | 3.0 deg |
| Overlap Frequency | 10.951-11.199 GHz |

**Coordination Arc Trigger**

| | |
|---|---|
| Coordination Arc Exists | Yes |
| Size of Arc | 6.0 deg |
| Inside Coordination Arc | Yes |

**Delta T/T Trigger**

| | A | B | C |
|---|---|---|---|
| 1 | Networks | | |
| 2 | Interfering Network | TURKSAT-42E-B | |
| 3 | Administration | TUR | |
| 4 | Notice ID | 114500196 | |
| 5 | Notification Type | N | |
| 6 | Orbital Location | 42 | deg E |
| 7 | BR Publication | N/A | |
| 8 | Dated | 11-Dec-18 | |
| 9 | | | |
| 10 | Victim Network | KYPROS-SAT-C | |
| 11 | Administration | CYP | |
| 12 | Notice ID | 108501035 | |
| 13 | Notification Type | N | |
| 14 | Orbital Location | 39 | deg E |
| 15 | Orbital Separation | 3 | deg |
| 16 | Overlap Frequency | 10.951-11.199 | GHz |
| 17 | | | |
| 18 | Coordination Arc Trigger | | |
| 19 | Coordination Arc Exists | Yes | |
| 20 | Size of Arc | 6 | deg |
| 21 | Inside Coordination Arc | Yes | |
| 22 | | | |
| 23 | DT/T Trigger | | |
| 24 | Interfering Group | 115697956 | |
| 25 | Interfering Frequency | 10.975 | GHz |
| 26 | Emission | 27M0G7W-- | |
| 27 | Satellite | TURKSAT-42E-B | |
| 28 | Satellite Location | 42 | deg E |
| 29 | Satellite Power | -52.6 | dBW/Hz |
| 30 | Satellite Off-axis Gain | 33 | dBi |
| 31 | Beam | TKR | |
| 32 | Antenna Sidelobe Type | Using peak gain | |
| 33 | Satellite Peak Gain | 33 | dBi |

### Note on Calculation Method

There can be a very large number of combinations of {beam, group, frequency, emission, earth station} between the {victim, interferer} networks to be checked and so a number of simplifying assumptions are made.

In particular, a worst-case geometry assumption is made in which the angle at the Earth station (topocentric angle) is 1.1 times the angle at the center of the Earth between the GSO satellites (geocentric angle) as per Recommendation ITU-R S. 728.

## 3.10  Conclusion

This section has shown how an IFIC can be checked to identify which networks require detailed coordination. The following section uses this scenario as the basis of detailed coordination, so it can be useful to save this file.

# 4 Undertaking Detailed Coordination Analysis

## 4.1 Introduction

This section looks at how to undertake Detailed Coordination and starts with the Coordination Trigger file created at the end of the previous section.

The scenario to consider will be:

- Network to coordinate with: TURKSAT-42-B as victim (select on the Network List view)

- Interfering network: KYPROS-SAT-C, downlink direction (expand on the Overlaps List view)

- Frequency range: 10.95075 – 11.199 GHz (select on the Overlaps List view).

Having made the selection, click on "Detailed Coordination…" to start the relevant application.

The Detailed Coordination tool should look like this:
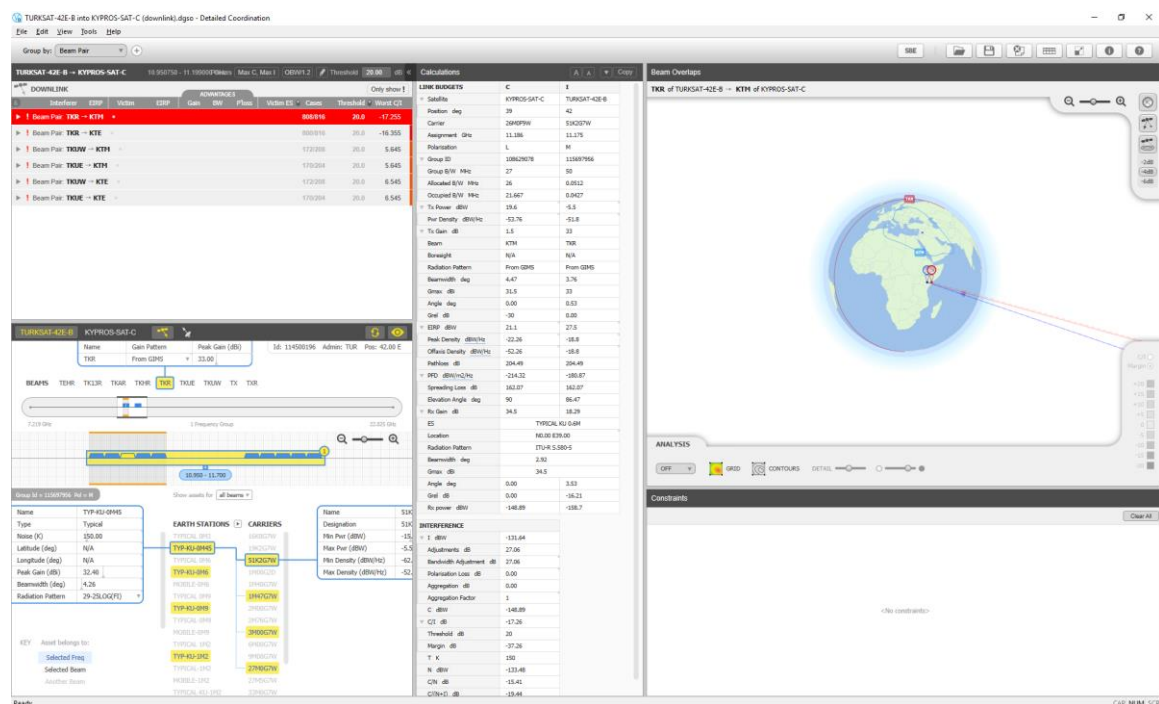


It could be useful to save the default state for future reference.

The following views are open:
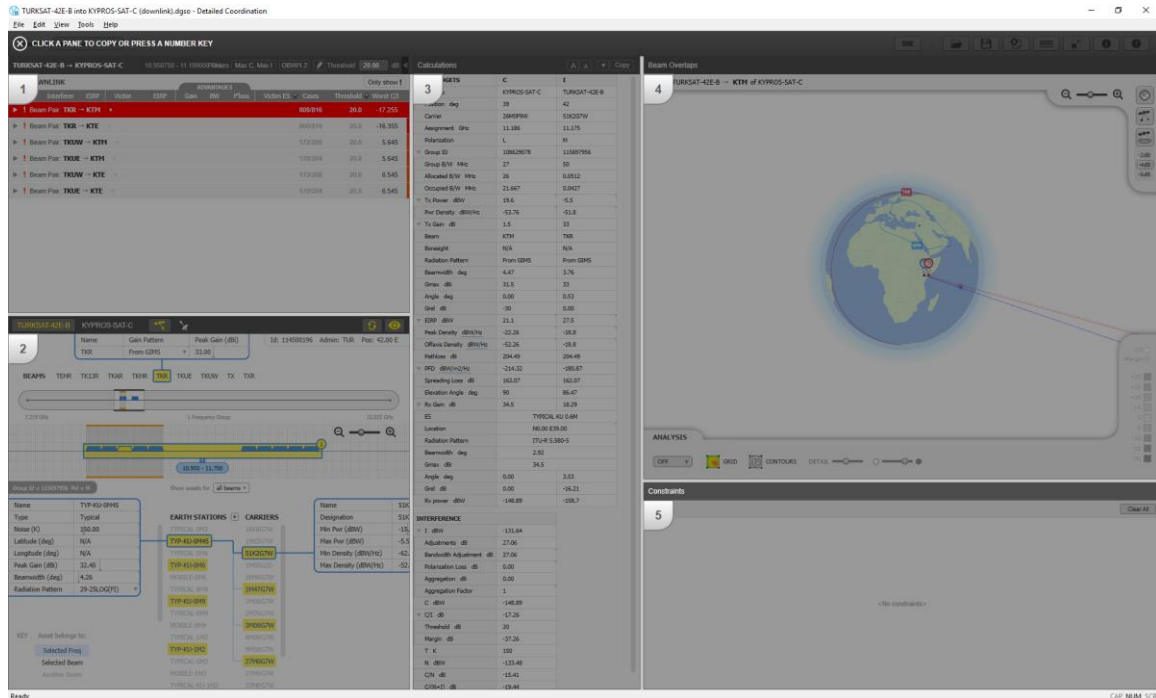
View:

1) Interference Cases view

2) Network Editor

3) Calculations view

4) Beam overlaps

5) Constraints

These are described further below.

## 4.2    Interference Cases View

In the given frequency band there are a large number of combinations of {beam, group, emission, frequency, Earth station} for each of the {victim, interfering} satellites. To a degree this can be simplified, so that only critical cases are shown, but there are still a large number to consider – here there are 2456[1].

To make analysis more understandable, the list can be grouped together by attributes such as {beam, emission, Earth station} for both the victim and interfering network. This assists coordination strategies such as:

A.   Start analysis by considering a typical sharing case with victim and interfering satellite using the smallest sized Earth stations

B.   Start analysis by considering a typical sharing case with victim and interfering satellite using similar sized Earth stations with similar carriers.

This grouping can be done using the "Group by" control at the top, and a typical approach might to group by:

1) V beam

---

[1] This can be identified by removing all groupings, copying the data and then pasting into Excel

2) I beam

3) V ES

4) I ES

5) V Carrier

6) I Carrier

Having done that, the scenario to consider first can be selected: here it is:

- V beam = KTM (the first beam)

- I beam = TKR (the first beam)

- V ES = TYPICAL KU 0.6M (the smallest)

- I ES = TYP-KU-0M6 (the smallest)

- V carrier = 26M0G7W (the other carrier is very similar)

- I carrier = 27M0G7W (a similar carrier to the victim one)

This shows seven sub-cases, as in the screenshot below:



If you click on each of the seven cases, the other views should update – in particular, see how:

- The selected channel on the Network Editor overlaps view changes

- The frequency varies on the Calculations view and the resulting C/I.

This view gives a summary of the coordination problem, showing the worst C/I and also the dish size needed to achieve coordination. Note at this point the ES

will not be located correctly so the values are not representative of a real scenario.

To find out more, we need to look at the other views, starting with the Network Editor.

## *4.3    Network Editor*

This view allows us to browse the victim and interfering filing data to get a better understanding and also to make changes, such as those that could be required to reach a coordination agreement.

If you make this view full screen it can be easier to see the range of information available, as in this screenshot:
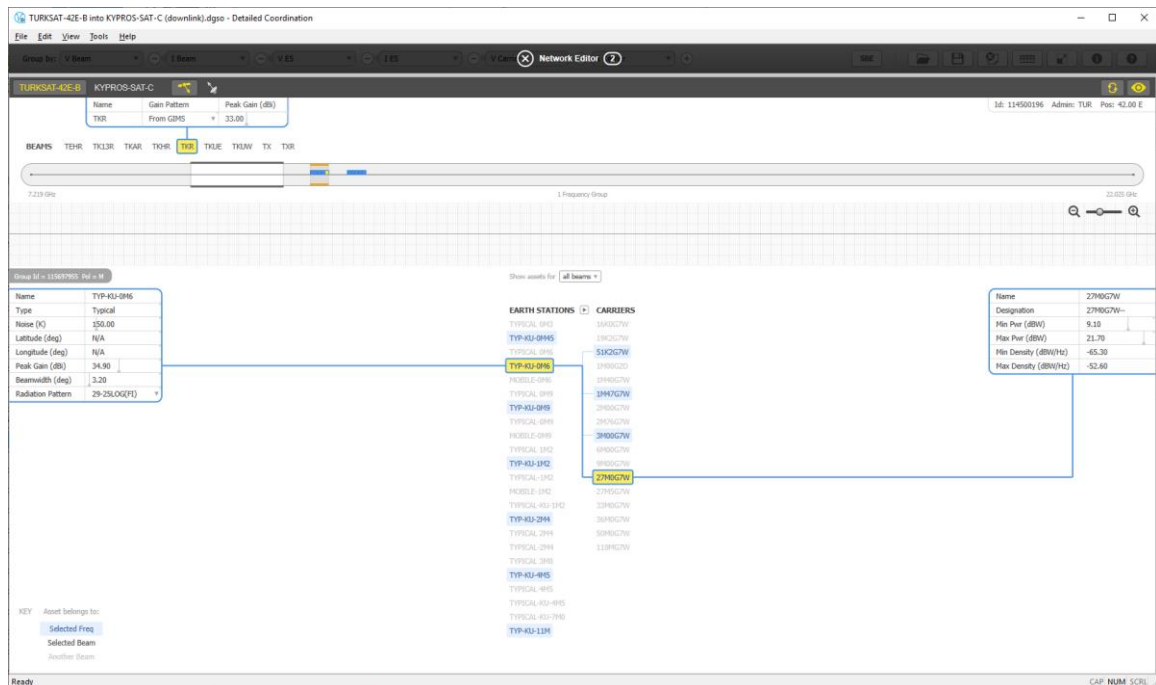


At the top left, there are the names of the interfering and victim satellites: you can select these to switch between the two networks. It is also possible to switch between downlink and uplink.

Note, however, that some fields are shown in yellow: this identifies that they are beam, group, ES and emission used for the case selected in the Interference Cases view. Hence if you select uplink then no fields are shown in yellow as this is a downlink file.

A key at the bottom right also shows how to distinguish if an item belongs to the selected frequency or beam.

Also visible are:

- On the line below the names of the satellites is the selection of the beam and control to change the beam characteristics. At the far right is the administration, ID and location.

- Below the list of beams is the frequency view, showing the groups and emissions: this view can be zoomed in and out and the overview used to move up/down in frequency

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- In the main section in the centre are the list of ES and Carriers over all beams: only the ones relevant for this case will be highlighted

- As you select an ES, its attributes will be shown to the left

- As you select a carrier, its attributes will be shown to the right

If, after browsing a network a lot, you want to return to showing the selected assets, click on the  button at the top right.

## 4.4    Calculations View

This is at the heart of Visualyse GSO Detailed Coordination tool, showing the wanted and interfering link budgets and resulting metrics such as C/I and DT/T. It also is the place where key coordination agreement metrics such as offaxis EIRP are derived and can be set, as well as the PFD.

| LINK BUDGETS | | C | I |
|---|---|---|---|
| ▼ Satellite | | KYPROS-SAT-C | TURKSAT-42E-B |
| | Position   deg | 39 | 42 |
| | Carrier | 26M0F9W | 27M0G7W |
| | Assignment   GHz | 11.186 | 11.175 |
| | Polarisation | L | M |
| ▼ Group ID | | 108629078 | 115697955 |
| | Group B/W   MHz | 27 | 50 |
| | Allocated B/W   MHz | 26 | 27 |
| | Occupied B/W   MHz | 21.667 | 22.5 |
| ▼ Tx Power   dBW | | 19.6 | 21.7 |
| | Pwr Density   dBW/Hz | -53.76 | -51.82 |
| ▼ Tx Gain   dB | | 1.5 | 33 |
| | Beam | KTM | TKR |
| | Boresight | N/A | N/A |
| | Radiation Pattern | From GIMS | From GIMS |
| | Beamwidth   deg | 4.47 | 3.76 |
| | Gmax   dBi | 31.5 | 33 |
| | Angle   deg | 0.00 | 0.53 |
| | Grel   dB | -30 | 0.00 |
| ▼ EIRP   dBW | | 21.1 | 54.7 |
| | Peak Density   dBW/Hz | -22.26 | -18.82 |
| | Offaxis Density   dBW/Hz | -52.26 | -18.82 |
| | Pathloss   dB | 204.49 | 204.49 |
| ▼ PFD   dBW/m2/Hz | | -214.32 | -180.89 |
| | Spreading Loss   dB | 162.07 | 162.07 |
| | Elevation Angle   deg | 90 | 86.47 |
| ▼ Rx Gain   dB | | 34.5 | 18.29 |
| | ES | | TYPICAL KU 0.6M |
| | Location | | N0.00 E39.00 |
| | Radiation Pattern | | ITU-R S.580-5 |
| | Beamwidth   deg | | 2.92 |
| | Gmax   dBi | | 34.5 |
| | Angle   deg | 0.00 | 3.53 |
| | Grel   dB | 0.00 | -16.21 |
| | Rx power   dBW | -148.89 | -131.5 |

If a field has a grey triangle in the top-right it can be edited by selecting it and then typing a new value. Some fields have units that can be altered – for example the EIRP density can be defined by reference bandwidths of {1 Hz, 4 kHz, 1 MHz}.

Note that the DT/T calculated here could be different from the DT/T in the Coordination Trigger tool as the Detailed Coordination tool is using full 3D geometry with beams and ES at specific locations, rather than simplified geometry with assumptions on how the topocentric angle was calculated.

The calculations are performed at the location of the ES shown in the Beams Overlap view, so let's look at that next.

## 4.5    Beam Overlaps View

This shows graphically the Earth with the victim and interfering beams and ES. The ES can be moved using drag and drop – so for example, for the selected scenario, move the ES to the following positions:
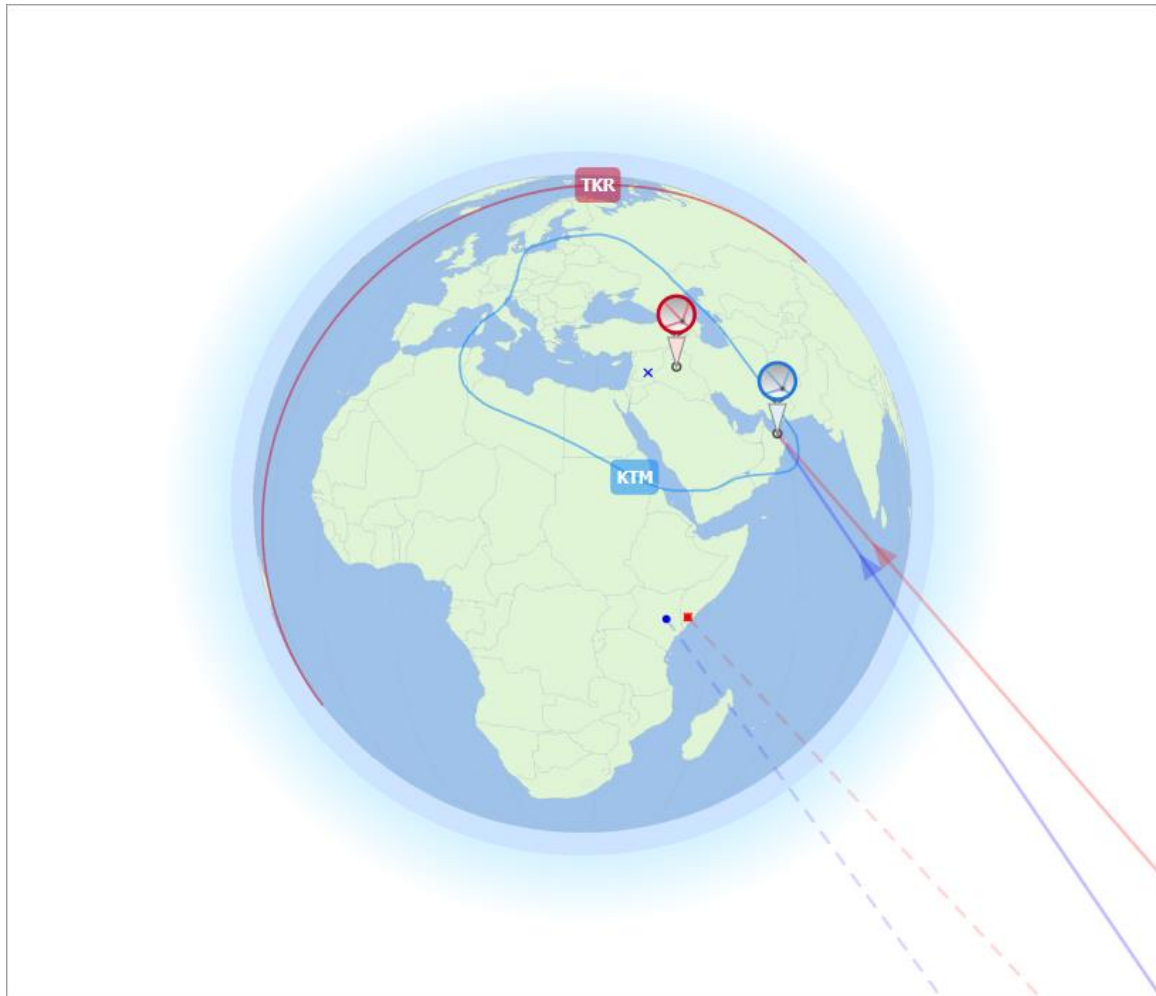


The Calculations View will then update with the values at these positions. Note that for downlink calculations the interferer ES position will not have an impact, so it is only as the victim ES is moved that the C/I will vary.

A specific location can be entered on the Calculations View as follows:

| ES | TYPICAL KU 0.6M |
|---|---|
| Location | N23.59 E58.41 |
| Radiation Pattern | ITU-R S.580-5 |

As well as moving ES, the view can also be used to move steerable spot beams. This is necessary as this scenario has two types of beam:

- The KYPROS KTM beam is using a shaped GIMS .GXT style to cover eastern Europe and the Middle East.

- The TURKSAT TKR beam is identified as having global field of view but with a peak gain of 33 dBi. In practice this means it's a steerable spot beam.

To model this, go to the Network Editor and change the TURKSAT beam:

From:



To:



Note how multiple views are updated:

- Interference Cases, showing this case is now ok with large C/I

- Calculations View, showing the new calculations in detail and resulting C/I

- Beams Overlaps, showing the spot beam at a default position pointing sub-satellite

- Constraints view, listing the change that has been made to the scenario.

The beam boresight can be moved using drag and drop until it covers (say) the Middle East, as in this screenshot:
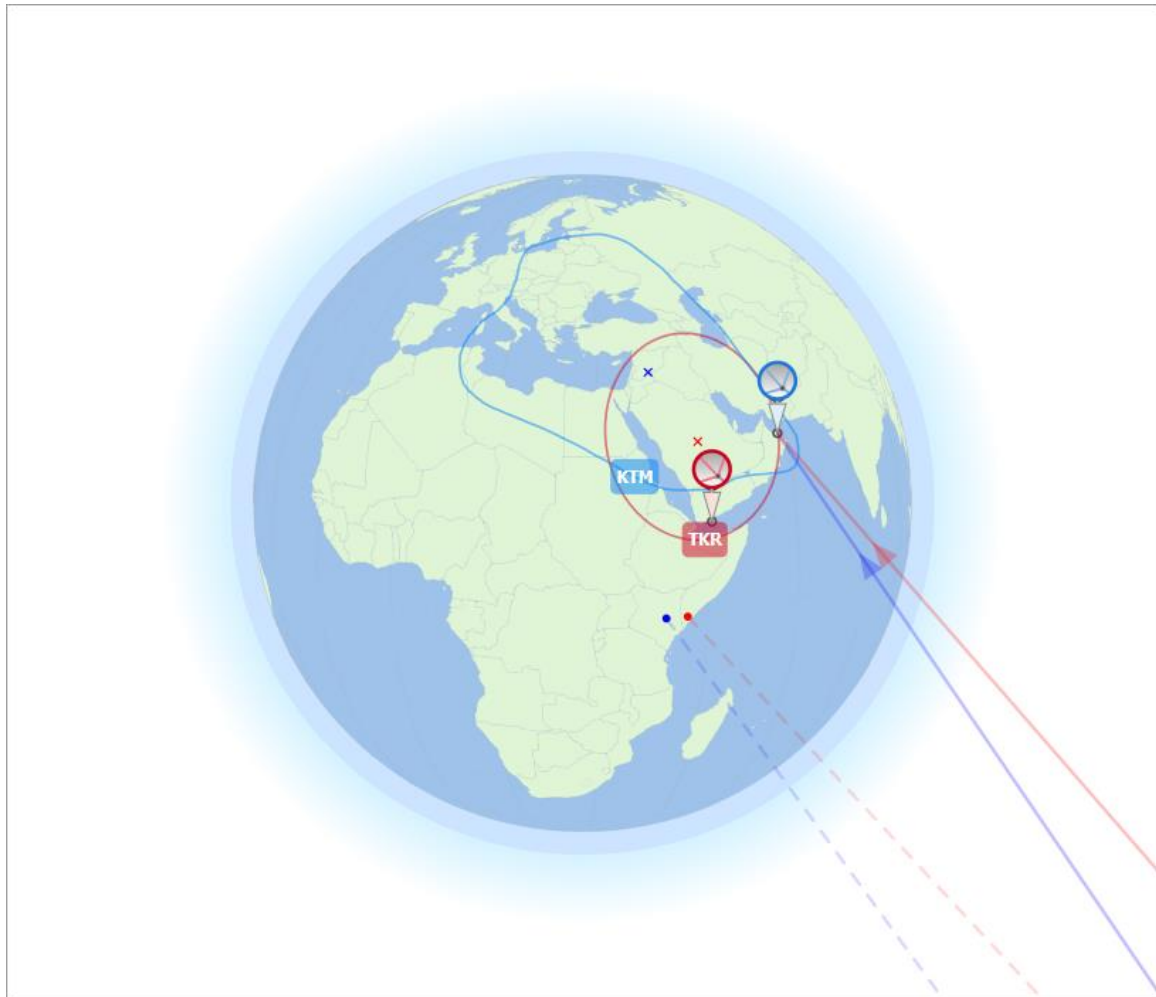
If you do this, then the C/I will change to be below the threshold.

A useful question is then: how close can the TURKSAT TKR beam be steered and avoid interference into the KYPROS KTM beam?

Before we address that, lets consider how the C/I varies across the KYPROS service area. This can be done using the C/I contouring tool. On the Beams Overlap view click on the Grid icon and then click around the blue line to make the following area analysis:
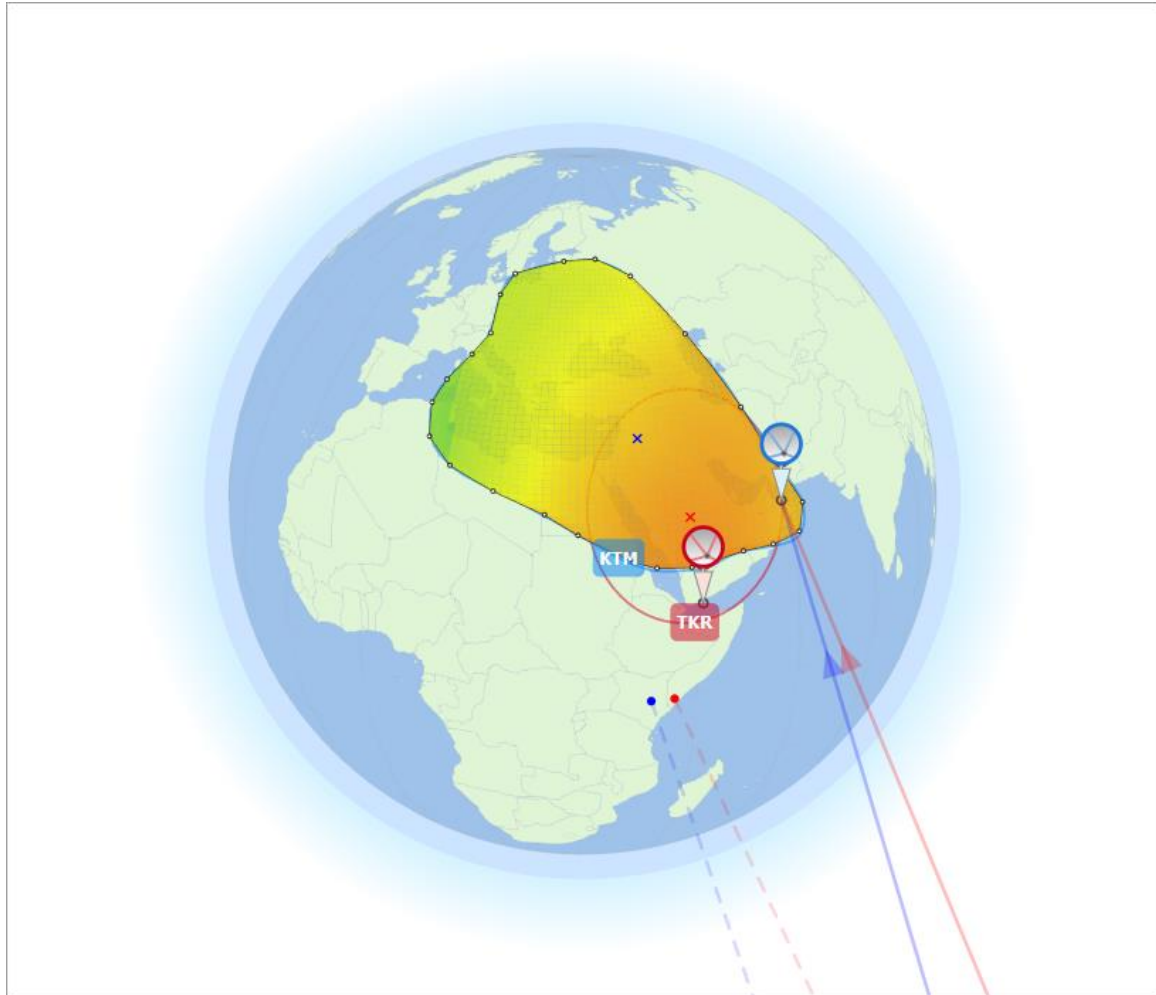
It can be useful to zoom in to allow a closer match between beam and C/I analysis area.

This area analysis approach is important, as in practice want to protect the whole service area, not just the test point where calculations are being shown.

## 4.6    Constraints

The final view is the Constraints view which shows the major changes or constraints that have been entered. In this case there are two:



These can be switched on/off to show impact of each of them. In this case they are both required to model the TURKSAT TKR beam as a steerable spot.

## 4.7    Coordination Analysis

Having configured the baseline scenario, it is possible to undertake coordination analysis. This typically involves modifying the scenario until the victim is able to provide the required service, and a wide range of techniques could be used.

This example includes a few techniques, including:

- Adjusting transmit power

- Taking account of polarisation

- Taking account of aggregation

- Moving the spot beam.

From this the offaxis EIRP density is identified that could be used as a coordination constraint.

### 4.7.1    Step 1: Adjust Transmit Power

The Network Editor shows that the TURKSAT carrier has a 12.6 dB difference between maximum and minimum power:

| Name | 27M0G7W |
|---|---|
| Designation | 27M0G7W-- |
| Min Pwr (dBW) | 9.10 |
| Max Pwr (dBW) | 21.70 |
| Min Density (dBW/Hz) | -65.30 |
| Max Density (dBW/Hz) | -52.60 |

It is also noted that the power density (and EIRP density) of the interfering beam is greater than that of the victim beam:

| Calculations | | A A ▼ |
|---|---|---|
| **LINK BUDGETS** | **C** | **I** |
| Satellite | KYPROS-SAT-C | TURKSAT-42E-B |
| Position   deg | 39 | 42 |
| Carrier | 26M0F9W | 27M0G7W |
| Assignment   GHz | 11.186 | 11.175 |
| Polarisation | L | M |
| Group ID | 108629078 | 115697955 |
| Group B/W   MHz | 27 | 50 |
| Allocated B/W   MHz | 26 | 27 |
| Occupied B/W   MHz | 21.667 | 22.5 |
| Tx Power   dBW | 19.6 | 21.7 |
| Pwr Density   dBW/Hz | -53.76 | -51.82 |
| Tx Gain   dB | 27.77 | 25.73 |
| Beam | KTM | TKR |
| Boresight | N/A | N6.82 E22.78 |
| Radiation Pattern | From GIMS | REC-672 Ln25 |
| Beamwidth   deg | 4.47 | 3.76 |
| Gmax   dBi | 31.5 | 33 |
| Angle   deg | 3.95 | 2.93 |
| Grel   dB | -3.73 | -7.27 |
| EIRP   dBW | 47.37 | 47.43 |
| Peak Density   dBW/Hz | -22.26 | -18.82 |

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Hence one starting point would be to set the interfering power density to be the same as the victim power density, i.e. to set the EIRP peak density of the interferer to be -22.25 dBW/Hz (Visualyse GSO will determine what power that implies).

### 4.7.2  Step 2: Polarisation Adjustment

It could be that a coordination agreement could include constraints on polarisation i.e. one network uses (say) linear horizontal and the other linear vertical. This could give a significant benefit if the carriers polarisation vectors align, decreasing if not.

In this case assume that there is 3 dB of benefit and so set the Polarisation Loss to 3 dB.

### 4.7.3  Step 3: Aggregation Adjustment

The two steps above helped decrease the interference, but it is worth noting that sometimes we must take account of factors that would make the scenario worse.

For example, consider the C/I threshold. This is set at the field at the top:
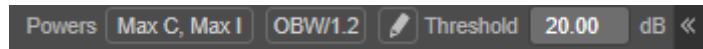


Here the default C/I is 20 dB, but what is this? Is it a single-entry C/I or aggregate C/I?

The answer to this question will depend upon link design assumptions, but for this example let's assume it's an aggregate threshold, i.e. it's actually $C/I_{agg}$. This means we must consider aggregation effects.

The scenario as configured only includes one interferer, namely TURKSAT, but aggregation can be included via the aggregation factor. For example, if there could be 4 entries with interference similar to this then enter 4, which equates to increasing the interference by 6 dB.

### 4.7.4  Step 4: Move Spot Beam

The final step in this short example is to move the spot beam until the whole of the service area has an acceptable C/I i.e. C/I > 20 dB for all locations.

Try moving the beam until something like this is observed:
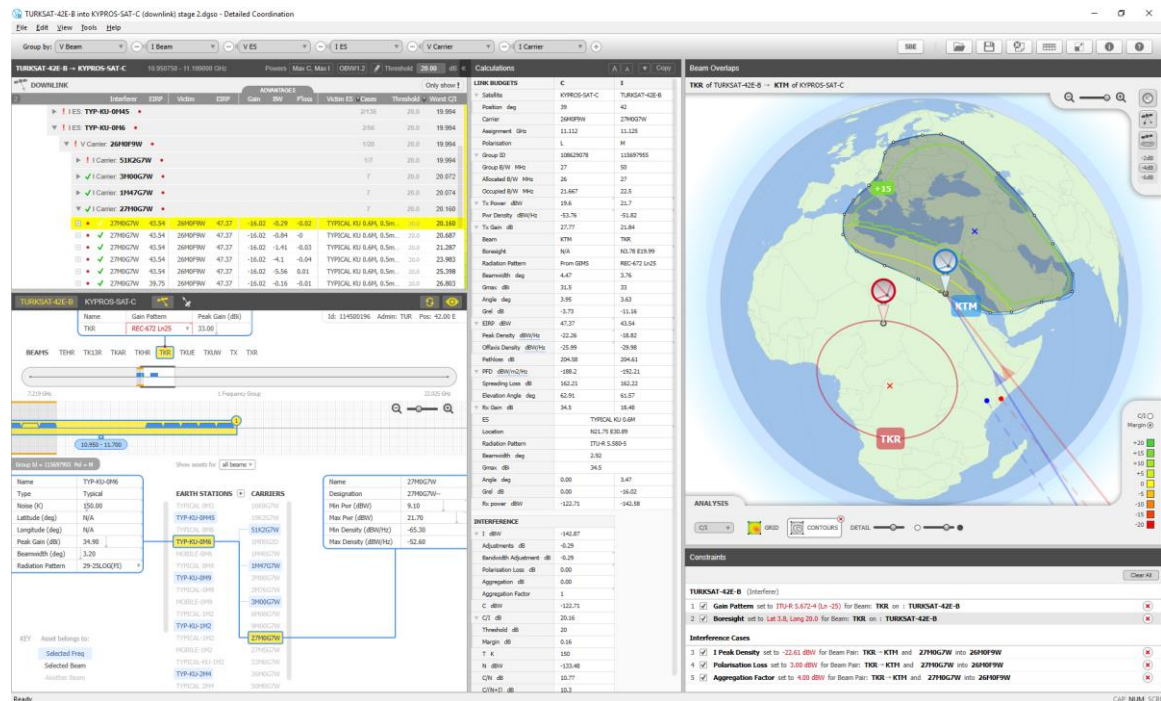
Here for all six cases in the Interference Cases view, for all of the service area as shown in the Beam Overaps view, the C/I > 20 dB. This configuration could be the basis of a coordination agreement.

Looking at the Calculations View the key constraint is:

*TURKSAT offaxis EIRP density towards KYPROS beam $\cong$ -30 dBW/Hz*

This could be the basis of a coordination agreement, combined with other factors such as use of alternate polarisations.

# 5 Conclusions

This document has shown how to use Visualyse GSO to:

- Identify which GSO networks are to be protected
- Analyse an IFIC to identify where detailed coordination is required
- Undertake detailed GSO to GSO satellite coordination.

There are many additional features and techniques that could be used to provide regulatory support to GSO satellite operators.

For more information, please contact us at:

Email: info@transfinite.com

# 6 Acronyms and Abbreviations

| | |
|---|---|
| ES | Earth station |
| GSO | Geostationary orbit |
| IFIC | International Frequency Information Circular |
| ITU | International Telecommunications Union |
| MDB | File extension used by Microsoft Access databases |
| PFD | Power flux density |
| SRS | Space Radiocommunications Stations |

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