

N. Guidance Notes

Overview

Guidance is provided below on the following issues:

- ◆ N.1 SATALL .UFS LPT Hanging / Corruption – prior to 11.4.07H
- ◆ N.2 SAVEIT Approximation
- ◆ N.3 Latest Advice on UFO Files
- ◆ N.4 Disappearing P1X mouse cross-hairs when using Windows 10

If you require further technical support, please do not hesitate to contact us at saturnsoftware@atkinsglobal.com

N.1 SATALL .UFS LPT Hanging / Corruption – prior to 11.4.07H

N.1.1 Overview

Prior to 11.4.07H, in certain circumstances, SATALL will appear to have successfully completed but subsequent attempts to access the resulting output UFS file (eg using P1X) will generate an exception error or fail to run.

It is an intermittent problem that has been very difficult to reproduce, investigate and resolve. The problem arises with the interaction of Silverfrost's Clearwin+ Graphical User Interface routines, as used by SATURN, and the Windows Operating System.

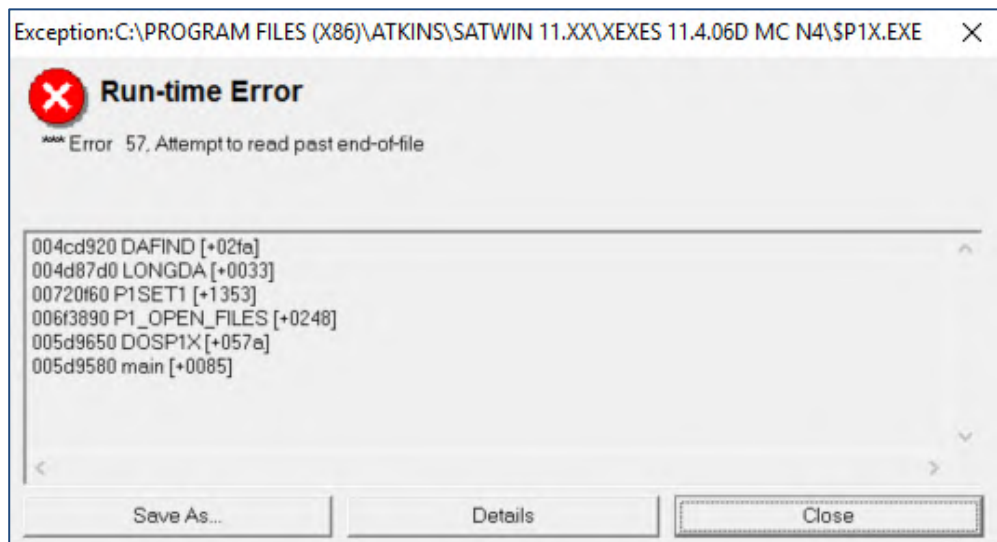
In developing the 11.4.07 release, we have reconfigured the program so that the program closes the files earlier in the process, so if it fails at the very end the files themselves should be complete and usable in subsequent processing. Following discussions with Silverfrost, we have now received updates to the compiler and libraries. We believe from SATURN 11.4.07H onwards this problem is fixed.

For earlier versions, a workaround described below should be used if you hit the problem.

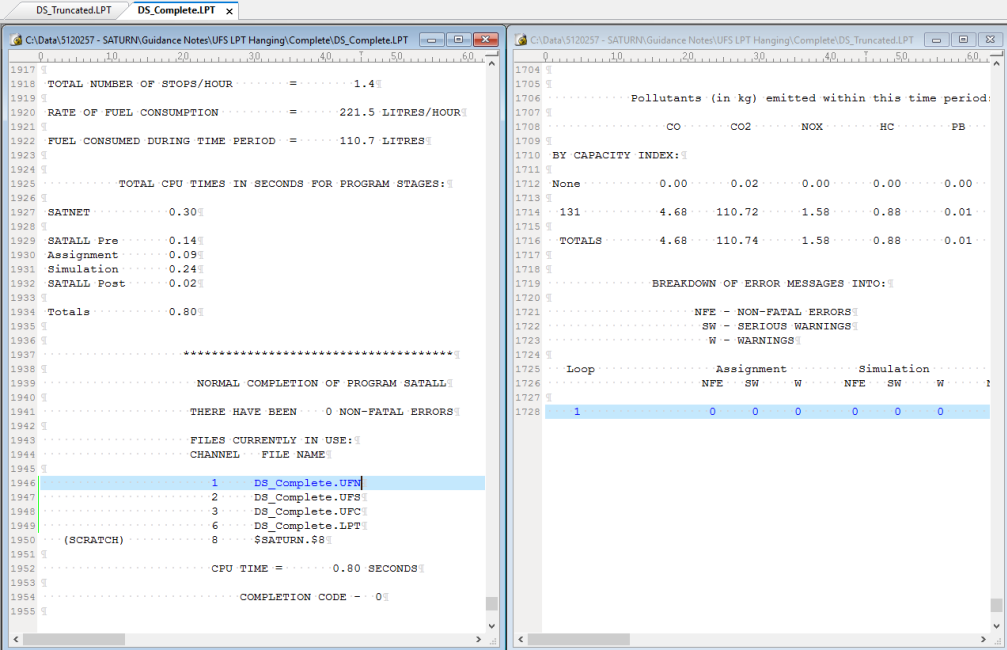
N.1.2 Examples of the Problem

Users will typically encounter the problem in one of four ways:

- 1) When trying to subsequently open or access the UFS file produced by SATALL in another software application (eg P1X or SATLOOK), a Run-time Error message is generated:



- 2) When looking at the SATALL LPT file, the file is truncated as shown on right-hand side file below:



```

1917
1918 TOTAL NUMBER OF STOPS/HOUR ..... = ..... 1.4
1919
1920 RATE OF FUEL CONSUMPTION ..... = ..... 221.5 LITRES/HOUR
1921
1922 FUEL CONSUMED DURING TIME PERIOD = ..... 110.7 LITRES
1923
1924
1925 ..... TOTAL CPU TIMES IN SECONDS FOR PROGRAM STAGES:
1926
1927 SATNET ..... 0.30
1928
1929 SATALL Pre ..... 0.14
1930 Assignment ..... 0.09
1931 Simulation ..... 0.24
1932 SATALL Post ..... 0.02
1933
1934 Totals ..... 0.80
1935
1936
1937 *****
1938
1939 ..... NORMAL COMPLETION OF PROGRAM SATALL
1940
1941 ..... THERE HAVE BEEN ..... 0 NON-FATAL ERRORS
1942
1943 ..... FILES CURRENTLY IN USE:
1944 CHANNEL FILE NAME
1945
1946 1 DS_Complete.UFN
1947 2 DS_Complete.UFS
1948 3 DS_Complete.UFC
1949 6 DS_Complete.LPT
1950 (SCRATCH) 8 $$SATURN.$$
1951
1952 ..... CPU TIME = ..... 0.80 SECONDS
1953
1954 ..... COMPLETION CODE - - 0
1955

1704
1705
1706 ..... Pollutants (in kg) emitted within this time period:
1707
1708 CO CO2 NOX HC PB
1709
1710 BY CAPACITY INDEX:
1711
1712 None ..... 0.00 ..... 0.02 ..... 0.00 ..... 0.00 ..... 0.00
1713
1714 131 ..... 4.68 ..... 110.72 ..... 1.58 ..... 0.88 ..... 0.01
1715
1716 TOTALS ..... 4.68 ..... 110.74 ..... 1.58 ..... 0.88 ..... 0.01
1717
1718
1719 ..... BREAKDOWN OF ERROR MESSAGES INTO:
1720
1721 ..... NFE - NON-FATAL ERRORS
1722 ..... SW - SERIOUS WARNINGS
1723 ..... W - WARNINGS
1724
1725 Loop Assignment Simulation
1726 NFE SW W NFE SW W
1727
1728 1 0 0 0 0 0 0

```

- 3) An unexplained crash or hang within an internal looping process (eg DIADEM-based Variable Demand Model) without any obvious failure mode. In the DIADEM instance, one of the output UFS file may have become corrupted but the problem is not immediately picked-up and DIADEM subsequently fails with an unhelpful error or simply 'hangs'.
- 4) An exception error after SATALL has tried to exit but fails to do so – this problem may still arise but we have not been able to reproduce it to date.

N.1.3 Workaround

As noted above, the problem has been fixed we believe in the majority of circumstances from SATURN 11.4.07G onwards. For earlier versions, the workaround is to change the default parameters so that the software does not use the Clearwin+ graphics libraries. This may be undertaken by either:

- 1) Setting WINDY=F in the network DAT file – this replaces the summary information panels with scrolling text windows (see section 6.3.1 of the User Manual)
- 2) Setting QUIET=T in SatWin or directly via the use of environmental variable command SET QUIET=T (see section 15.55) – this removes all on-screen reporting

Note that neither option changes the results from the assignment.

N.2 SAVEIT Approximation

N.2.1 Background

The SAVEIT Approximation is an integral part of the SATURN assignment and is used to reduce the amount of time taken (and storage space required) to undertake secondary analysis tasks including skimming, select link analysis and cordoning. However, the importance of the SAVEIT approximation (and the associated controlling parameter, NITA_S) on accuracy of the resulting outputs from SATURN is less well understood.

This perception continues to be reinforced by the examination of the SATURN assignments we often receive on the technical support helpdesk that flag inappropriate values for the key NITA_S parameter.

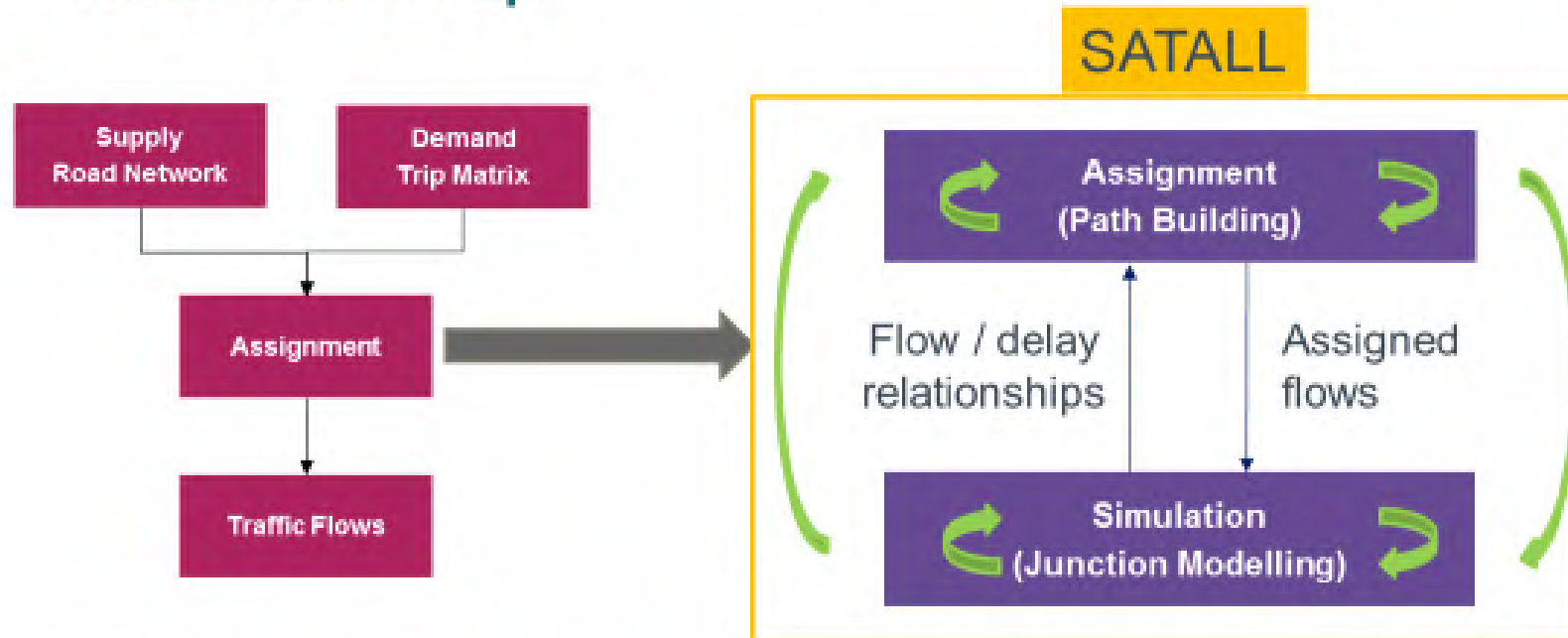
N.2.2 UGM Presentation

To assist users in understand more about the SAVEIT approximation and the possible unintended (and negative) consequences of using incorrect (low) values, Atkins gave a presentation at the 2017 User Group Meeting (with extracts also provided at the 2018 UGM). The presentation is reproduced below.

A more detailed description of the SAVEIT Approximation is provided in section 15.23 of the User Manual.

SATURN Assignment 101

- Quick recap



22 August 2018

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Assignment Process



Loop	Assignment	Simulation	Cumulative (AON) Paths
1	20 Path Builds	→ 20 Simulation Iterations	0 + 20 = 20
2	20 Path Builds	← → 20 Simulation Iterations	20 + 20 = 40
3	20 Path Builds	← → 20 Simulation Iterations	40 + 20 = 60
...			
n	20 Path Builds	→ 20 Simulation Iterations	= n * 20

Iterate until Stability (%Flow) & Proximity (%GAP) targets are satisfied

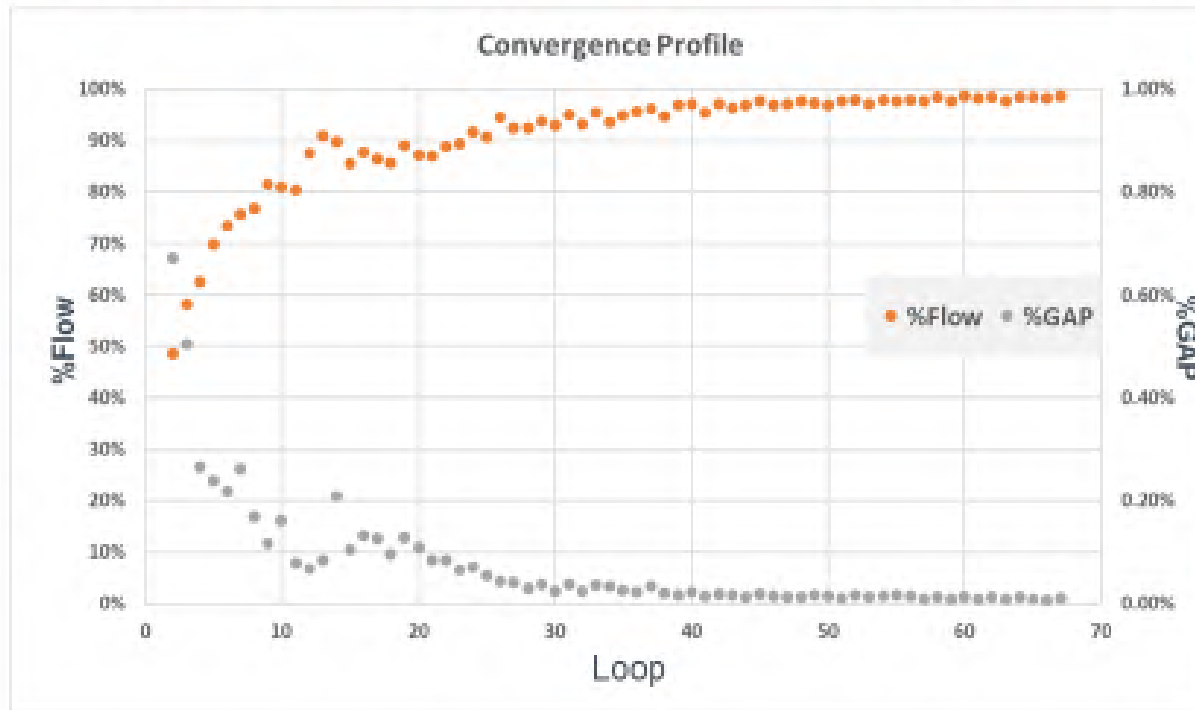
- See Table 1 in LPT file

Potentially, several hundred paths used to create the final assigned flows

- SAVEIT approximation used to reproduce but using fewer paths

Assignment Noise

- Convergence Profile: LPT Table 1 plotted

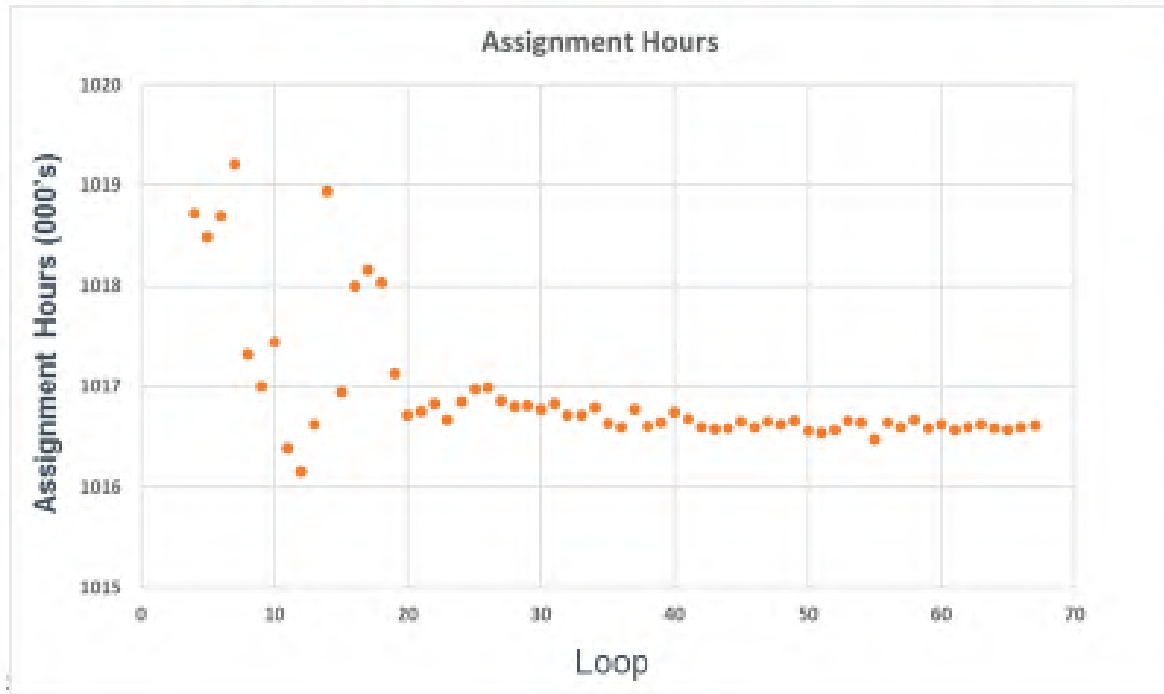


Note:

- Output at end of each loop may be a final converged solution
- NISTOP = 4 but why not 5 instead?
- Each solution will be different
- Variation in each assignment!

Assignment Noise

- Convergence Profile: LPT Table 2 Assignment Hrs



Note:

- As %GAP reduces, variation between successive loops will reduce
- Perfect convergence = identical
- Scheme Appraisal uses the time skims
- Difference of
DM v DS >>
DM (n+1) v DM (n)
& DS (n+1) v DS (n)

Impact on TUBA Scheme Appraisal



- Illustrative Example (i): Commentary

- Cost data stored in the UFC file for secondary analysis
- Recreates assignment using either:
 - the original full set of paths used or a SAVEIT approximation
- By default, **UFC109=T** & **NITA_C=256** so:
 - full set saved unless cumulative path builds > 256
 - otherwise SAVEIT used - maximum no. of path builds set by **NITA_S**
- **Value of NITA_S is very important**
 - If too small (e.g. 25!) then too few paths used in SAVEIT approximation
 - Likely that very poor Wardrop solution (Approximation %GAP >> Final %GAP)
 - **Use v11.4 default: NITA_S=256**

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Impact on TUBA Scheme Appraisal - Illustrative Example (iii)



- With & Without Scheme Scenarios, 60 year appraisal
- Shows changes in PVB arising from inaccuracies in the SAVEIT approximation

	Ref Case	Run 1	Run 2	Run 3	Run 4	Run 5
NITA_S	256	25	99	256	256	256
NISTOP	4	4	4	5	4	4
RSTOP	98.5%	98.5%	98.5%	98.5%	97.5%	94.5%
AM - %Flow	98.9%	98.9%	98.9%	98.5%	98.0%	96.7%
AM - %GAP (Main)	0.009%	0.009%	0.009%	0.008%	0.010%	0.036%
AM - %GAP (SAVEIT)	0.010%	0.164%	0.016%	0.008%	0.012%	0.036%
PVB (Index)	100	85 !!!	95	95	95	95

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NB: Scheme / scenario specific!

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N.3 Latest Advice on UFO Files

N.3.1 Overview

Over the last few years, the use of .UFO files has been recommended, particularly for larger models, to speed-up all secondary analysis processes. In response, .UFO files have been applied more widely by users across many different types of model and applications and this, in turn, has highlighted emerging concerns with their use in certain circumstances.

The current position at the time of writing (April 2020), was summarised at the 2019 Annual User Group Meeting and reproduced below.

Update on SATUFO Files

Store path (origin-based) information
Secondary analysis undertaken using UFO files

Advantages:


- › Paths **extracted** rather than **recreated** from existing link costs (UFC)
- › Secondary analysis only takes a few minutes
- › Available in SATLOOK, SATCH, SLAs & SATPIJA
- › Create during the assignment (SAVUFO=T) or post-assignment (SATUFO) especially for large models

Disadvantages:

- › Assignments will take longer (an extra process) **but available with Multi-Core (& SATGPU 11.5)**

Problems / Concerns

- › Not available with Area Charging
- › NOT recommended for demand model skimming + if you do, DO NOT mix and match
- › NOT all SLA options working - most are and quicker - but if in doubt try / revert to FW


2019 SATURN User Group Meeting – Leeds 28/11/19

Final 30/11/19
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Background details on .UFO files are available in sections 15.23.6 and 22.5 of the User Manual.

Recommendations

Users are advised to be vigilant when using .UFO files.

If any issues arise, they should report the issue, and revert to the existing UFC-based approach.

For reasons discussed below, all users should migrate to the latest appropriate SATURN release (11.4.07H and at least 11.3.12W) to take advantage of the latest functionality and corrections.

N.3.1.1 Problems and Concerns

Unless the origin-based assignment (OBA) algorithm is used (ie MET=2), the .UFO file used for the secondary analysis is created by converting the paths generated by the Frank-Wolfe (FW) assignment to the equivalent UFO-based solution. The UFO solution is an approximation of the 'main' FW assignment and there continues to be concerns namely:

- ◆ The new **Area Charging** functionality introduced with SATURN 11.5, as described in section 20, is (practically) incompatible with the mathematical processes required to reproduce the assigned area-charging paths with an equivalent UFO-based solution. Nevertheless, the requirement remains to quickly undertake secondary analysis, and this will require the adoption of GPU-based techniques to meet these substantial computational demands and negating the further development and adoption of UFO methods.
- ◆ There may be issues with the **accuracy of cost skims for zero demand OD-pairs** affecting demand models with distribution choice. The UFO-based solution stores route flow information to enable the paths to be quickly re-assembled and uses ‘splitting factors’ at each node as part of the process. These node-based splitting factors may become less reliable for OD-pairs with zero demand with a corresponding impact on the accuracy of the cost skims for these movements. In most instances, this potential reduction in accuracy is not a concern as there is no demand (eg select link and cost-benefit analyses) but there may be an impact on cost skims used in demand models where the values for all OD-pairs are used (eg destination choice).
- ◆ Not all **Select Link Analysis (SLA)** options are working with .UFO files with users reporting notable differences between the ‘main’ assigned flows and SLA outputs on specific links when analysing their model results.

N.3.1.2 Other Identified Issues

Prior to SATURN 11.4.07H in August 2018, several other issues were identified with earlier releases and several significant revisions were made to the internal processes used to generate .UFO files to address them. Further details on background to .UFO files and the specific known issues with previous versions are described below.

N.3.2 Known Issues with Older Versions

Following the release of SATURN 11.3.12U in November 2015, several inconsistencies have been identified with data stored in .UFO files and their accuracy.

Whilst the inconsistencies are believed to be relatively minor, users are strongly recommended to migrate to the latest SATURN release (11.4.07H at the time of writing) rather than continuing to use older versions, irrespective of whether they are using .UFO files or not.

In the following sections, the previously reported issues to date with the UFO files are summarised for clarity.

N.3.3 Pre-11.3.12W Release (May 2017)

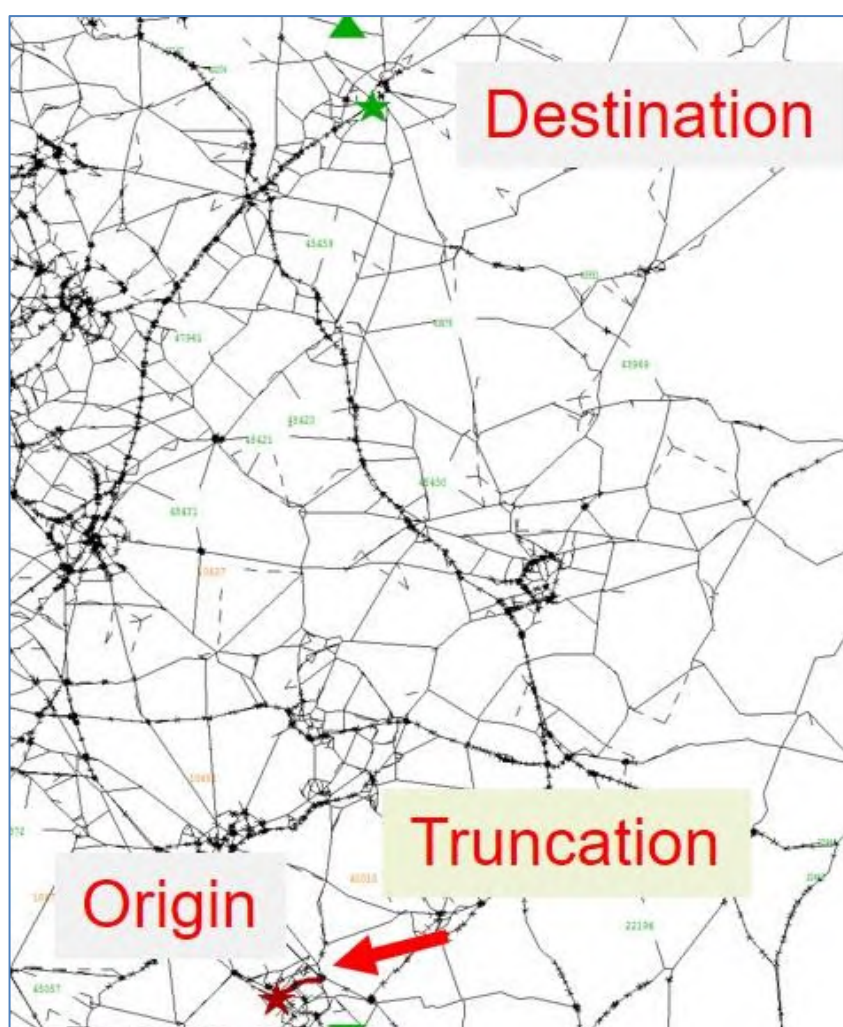
The 11.3.12W Release provided a significant revision to the creation of .UFO files to create the problem of truncated paths generated for specific cell ij pairs when there was no demand (ie $T_{ij}=0$).

Where the UFO was used for normal select link analysis or cordoning, by definition T_{ij} was non-zero, and 11.3.12W materially gave the same results. For users that used .UFO files to generate the full skimmed cost matrix, for cells

where $T_{ij}=0$, the costs in 11.3.12U and earlier could have been significantly wrong from being short from a truncated tree, or high from choice of a longer path (compared with a weighted average UFC based tree). If these were not identified, they could have caused problems, e.g. in distributional modelling and wider impacts. By definition, in many cases where Trips*Costs were used, the overall problem could have been small as the erroneous costs were weighted by a low number of trips.

The (partial) correction resolved the truncated path issue, and made all $T_{ij}=0$ skimmed costs a better match to the equivalent UFC ones. That said, however, the requirement to ensure consistency with previous assignment results precluded the full set of (theoretical) changes to be implemented and a more practical workaround was implemented. The full set of changes were introduced as part of SATURN v11.4.

An example of the truncation for $T_{ij}=0$ movements is highlighted below.



As previously noted in the 11.3.12W Release Notes, all pre-11.3.12W users were strongly recommended to migrate to 11.3.12W at the earliest opportunity – especially if they wished to take advantage of .UFO files.

N.3.4 11.4.06D Release (February 2018)

As noted above, the subsequent 11.4.06D Release in February 2018 enabled the problem of path truncation for cells $T_{ij}=0$ to be fully resolved by modifying the UFO algorithm rather than relying on the use of very small seeding values (with PLUFO) to prevent the issue being encountered.

N.3.5 11.4.07H Release (August 2018)

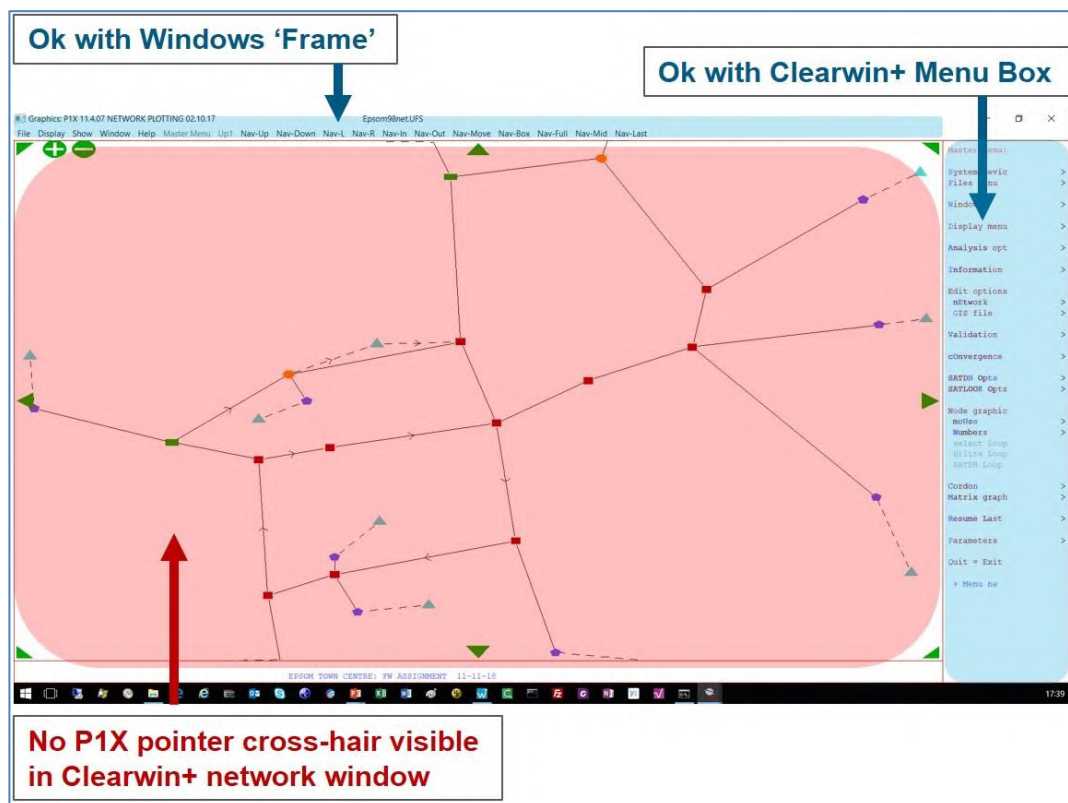
Whilst not specifically UFO related, the 11.4.06H Release in August 2018 has also resolved several recently uncovered issues in the creation of both .UFC and .UFO files, as documented in App E-Latest, and reproduced below:

- ◆ SATALL / P1X / SATLOOK – If the CLIMAX option is used at all then any .UFC file created by SATUFC or any .UFO file created by SATUFO will be compromised – but the flows etc. generated by SATALL are correct. This means that any analysis options such as SLA undertaken in P1X will also be incorrect – the margin of error will be dependent on the relative contribution CLIMAX has on the network costs (and how they subsequently accumulate over the iterative path-building process). NB: any .UFC or .UFO files generated during by the assignment are **not** affected. (see #133)
- ◆ SATUFC – the post-assignment process to generate the .UFC may produce different paths to original SAVEIT=T assignment as it was not receiving the value of UNCRTS used in the equivalent process. The problem also affected by CLIMAX and Q-node issues. Longstanding bug now resolved (see #134)

N.4 Disappearing P1X mouse cross-hairs when using Windows 10

N.4.1 Overview

Following the release of Windows 10 version 1709 (and also known as the ‘Fall Creators Update’), several laptop users have reported a problem with mouse cross-hairs disappearing in the main P1X window (the shaded ‘red’ area shown below) but the cross-hairs still appear in both the Windows Frame and Menu Box (the ‘blue’ areas). Most of the reporting users have experienced the issue on laptops running Windows 10 version 1709 (or later) when using a secondary monitor display but some have also reported that it also occasionally occurs with laptops using only their native display.



The issue was first reported in August 2018 and coincided with the SATURN 11.4.07H release but the investigations have confirmed that it also affects previous SATURN versions as well (eg SATURN 11.3.12W) and relates to the version of Windows Operating System ('Windows') in use.

The problem in P1X has arisen following changes in Windows 10 version 1703 to allow applications to obtain DPI (dots per inch) or display scaling information from Windows without needing to sign-out and sign back-in and when running applications on multiple displays¹.

¹ <https://blogs.windows.com/buildingapps/2017/04/04/high-dpi-scaling-improvements-desktop-applications-windows-10-creators-update/>

The problem has been fixed as part of the SATURN 11.5.04T Beta version. An explanation of why the issue arises and the resulting workarounds available for earlier releases are given below.

N.4.2 Why the Cursor Disappears in P1X

The disappearance of the mouse cross-hairs occurs when there is a significant difference between the level of DPI scaling used in P1X compared to the DPI scaling used by the display. The difference between the levels of scaling used arises in two specific instances as described below when running Windows 10 version 1703 or later.

Display Scaling

Display scaling enables Windows applications to be clearly viewed on a wide variety of devices irrespective of their physical size and resolution. It also enables applications to work across multiple displays with different configurations – for example, a small 15” laptop display made up of 2580 x 1440 pixels (ie 197 pixels per inch or ‘ppi’) and a 24” external monitor using 1920 x 1080 pixels (ie 92 ppi).

Windows automatically determines the default scaling level for each display so that text, for example, remains readable when viewed on both displays. For the example above, the Windows recommended scaling for the 24” monitor will be 100% whilst the smaller laptop, with approximately twice the pixel density (ie 197 ppi versus 92 ppi), will have a recommended scaling value of 200%.

When an application is opened, Windows informs the application the level of scaling in use on the main display. However, if the application is either opened on or moved to a secondary display, the main level of scaling may no longer be appropriate. The same issue may also arise if the level of scaling is changed on the main display and Windows is not able to fully update until the user has signed out.

Disappearing P1X Mouse Cursor

The disappearing cursor arises in P1X when the main display has a substantially larger scaling applied than the secondary display. The size and thickness of the cross-hairs for the mouse cursor are drawn based on the main display scaling and their dimensions are then fixed. If P1X is either moved to or opened on the secondary display, the scaling used will still be based on the main display value even though it may no longer be appropriate.

Empirical testing has shown that the P1X mouse cross-hairs ‘disappear’ – as they are effectively too small to remain visible – if the main display scaling level is between 50% (and perhaps up to 75%) higher than the secondary display level. Note that if the main display scaling level is lower than the secondary then the issue doesn’t arise.

The table below illustrates some typical combinations based on the two display examples described above and whether the cross-hairs are likely to be visible on the secondary display. The examples in table are provided as guide - users may observe different behaviours on their specific combinations of PC hardware.

ID	Main Display: Pixels & Scaling	Secondary Display: Pixels & Scaling	Difference in Scaling (Secondary - Main)	P1X Cross- hairs visible on Secondary Display
1	2560 x 1440 (200%)	2560 x 1440 (150%)	-50%	Likely
2	2560 x 1440 (200%)	1920 x 1080 (100%)	-100%	Very unlikely
3	1920 x 1080 (100%)	1920 x 1080 (150%)	+50%	Yes
4	1920 x 1080 (100%)	2560 x 1440 (200%)	+100%	Yes

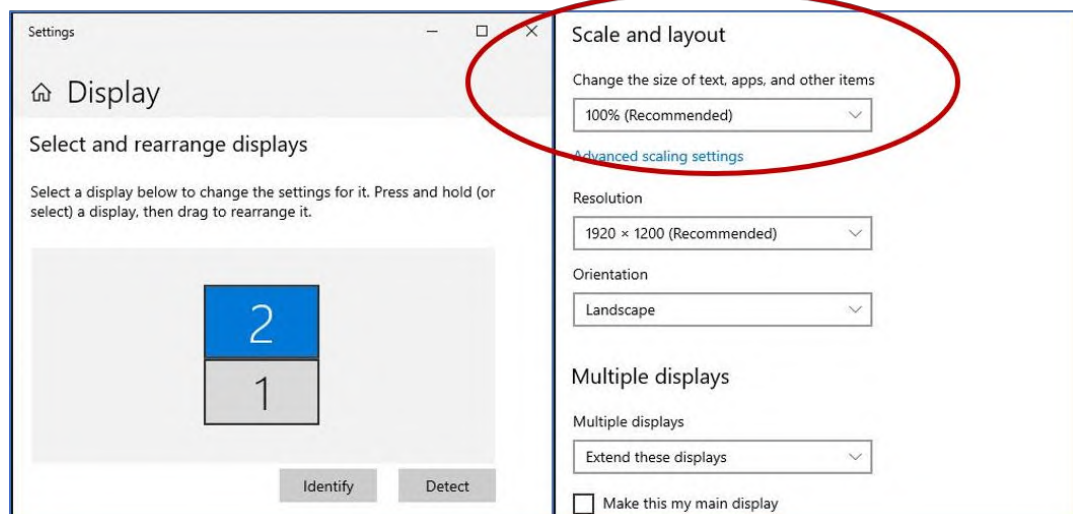
N.4.3 Workarounds

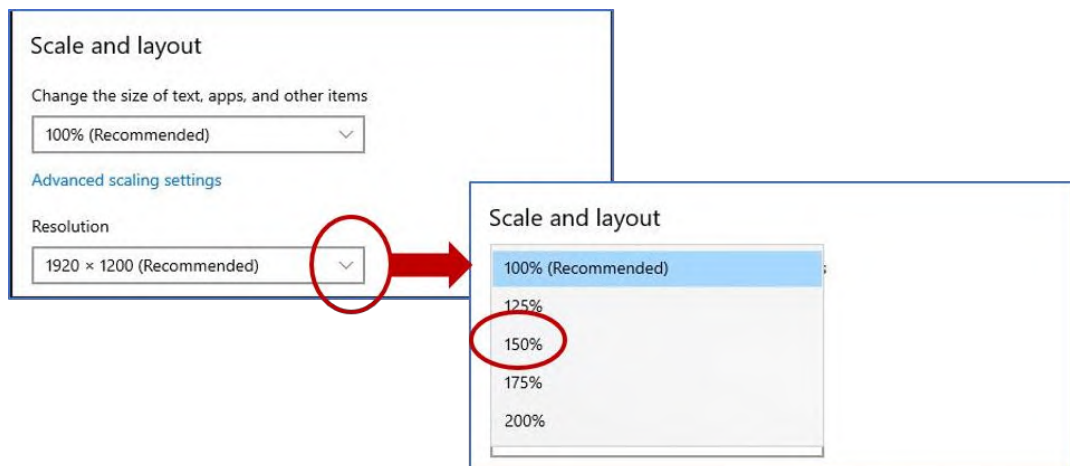
There are two workarounds based on changing the display properties – these are accessed via the display settings menu (Start Menu -> Settings -> System).

Reducing the Difference in Scaling Levels between the Main and Secondary Displays

As already noted above, empirical testing showed that the scaling level for the main display should not be more than 50% (but possibly 75%?) higher than the secondary display. So, for example, if the main display uses 200% scaling level then the secondary display should be using 150% scaling or higher for the cross-hairs to remain visible.

To change the scaling levels in the display settings menu, go to “Change the size of text, apps and other items” and adjust the scaling for each monitor so they are more closely matched. Users may need to try a few scaling values to ensure the cross-hairs remain visible and other displayed items (such as text) are still sufficiently sharp and appropriately sized.

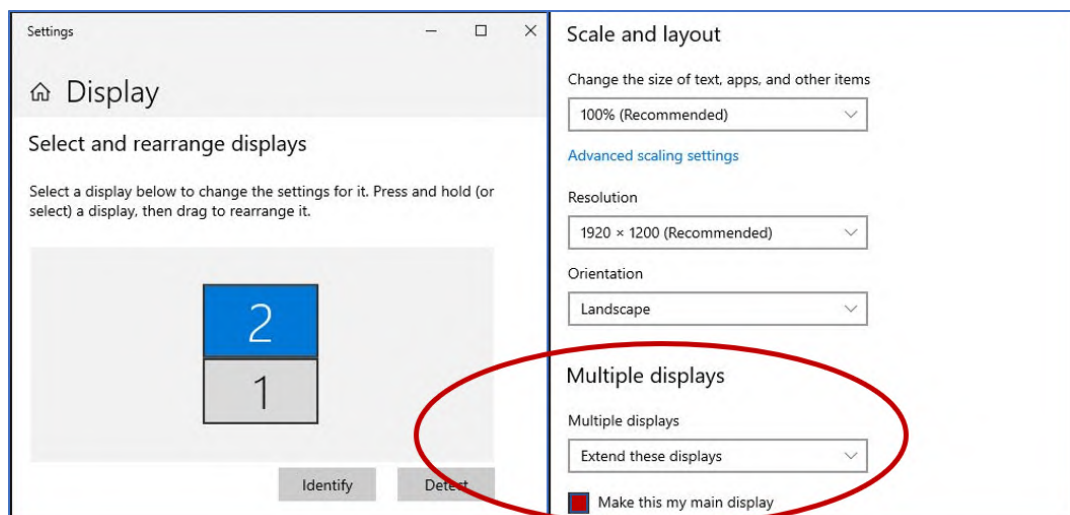




Note that 'Scale and layout' settings are defined separately for each display. To change a specific display, click on the Display symbol '1' or '2' in the 'Select and rearrange displays' area – in the example above, the highlighted display '2' has been selected.

Setting the Display with the lower Scaling Value as the Main Display

The alternative workaround is to set the display with the lower scaling value as the main display with all applications, Windows toolbars etc now appearing on the lower scaled display.




Note that 'Scale and layout' settings are defined separately for each display. To set display 2 as the main display, display '2' needs to be selected first.

The original recommended workaround achieved the above by signing out and/or re-booting with the laptop lid closed so that Windows set the secondary external monitor as the main display. The simplified method above achieves the same outcome without requiring the user to sign-out.

Note the layout of the Display settings in Windows varies between versions – the above screenshots were taken from Windows Version 1809.

N.5 Version Control

JOB NUMBER: 5197953		DOCUMENT REF: App N.doc				
Revision	Purpose / Description					
		Originated	Checked	Reviewed	Authorised	Date
10.9.10	SATURN v10.9 Release	DVV	DG	IW	IW	04/09/09
10.9.12	SATURN v10.9 Release	DVV	DG	IW	IW	22/10/09
10.9.22	Web release – Dec 10	DVV	AG	IW	IW	06/12/10
10.9.24	SATURN v10.9 Release (Full)	DVV	AG	IW	IW	06/05/11
11.1.09	SATURN v11.1 Release (Full)	DVV	AG	IW	IW	31/03/12
11.2.01	SATURN v11.2 Beta Release	DVV	JS	IW	IW	07/12/12
11.2.05	SATURN v11.2 Release (Full)	DVV	JS	IW	IW	17/03/13
11.3.03	SATURN v11.3 Release	DVV	SN	IW	IW	28/02/14
11.3.07	SATURN v11.3.07 Release	DVV	DAS	IW	IW	26/09/14
11.3.10	SATURN v11.3.10 Release	DVV	DAS	IW	IW	19/01/15
11.3.12	SATURN v11.3.12 Release	DVV	DAS	IW	IW	20/04/15
11.4.06	SATURN v11.4.06 Release	DVV	DAS	IW	IW	18/01/18
11.4.07	SATURN v11.4.07 Release	IW	DAS	IW	IW	23/08/18
11.5.05	SATURN v11.5.05 Release	IW	DAS	RJ	IW	16/07/20