SATURN ELEVEN – Version 11.3

First of all, I wish you a warm welcome to the first full release of SATURN 11.3, 11.3.03.

SATURN 11.3 will be the successor to all previous versions of SATURN. It will represent a direct evolution from its predecessors whilst offering significant enhancements from the strong existing base. Following the full release of SATURN 11.2.05 in March 2013 a series of largely internal releases appeared numbered from 11.2.06 up to 11.2.12 in January 2014 (these release numbers are referred in App. D.21 which tracks the changes). In late January 2014, Version 11.3.01 (effectively 11.2.13) was created followed by 11.3.02 in February 2014 and finally culminating in the full release of 11.3.03 at the end of March 2014.

This full SATURN 11.3 release provides access to some of the latest development features as highlighted at the Autumn 2013 User Group Meetings. These features are released in pre-full 'Beta' release form and we encourage users to try them and provide feedback.

The most visible advance from 11.2 onwards is the heavily-revised SATWIN11 interface that provides a new way of working with SATURN modules, introducing a new concept of a 'model-centric workspace' called the 'Model Complex'. The user-editable Model Complex keeps track of the user's working folders, the SATURN version and their own tool folders (specifically batch files created by the user) as well as keeping a log of the commands that have been executed while using the given Model Complex. Further enhancements have been undertaken since then and now fully released as part of 11.3.

Beyond the SATWIN11 interface, there are also other key developments as described in the User Group Meetings which we now make available. These include:

- UFO path files with development work focused on speeding-up the secondary analysis processes by encouraging the use of UFO path files rather than the traditional link-based UFC files[1]. To assist the move towards UFO files, the time taken to generate them has been substantially reduced by extending the existing multi-core functionality (for those with the Multi-core add-on) to both the SAVUFO and SATUFO processes (see section 15.53). *Note that the development of the SPIDER-based version of the OBA algorithm continues and should be used for evaluation purposes only.*

- Sector-based matrix estimation (ME) that enables matrix estimation to be undertaken at a more aggregate level, smoothing the adjustments made to the prior matrix and reducing 'outliers'. The expanded process provides the user with additional control and could be used to provide an initial 'first-pass' update of a prior matrix or reduce the impact of matrix estimation for example. The main development has been completed but the new code changes have not yet been incorporated into the main SATURN suite. The processes are released as a set of variants to the existing programs. *We encourage users to try them and report*

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[1] *Note that the generation of UFO files introduces some further approximations in the recreated paths and there can be some differences between those created by the UFO-based and FW-based algorithms. In most cases the differences are small but users should ascertain the extent and location of the differences and whether the use of the UFO-based files would compromise the analysis undertaken. This may be undertaken by examining the differences between the assigned demand flow and the equivalent flow resulting from using the UFO paths; these "UFO-FLOWS" are created in the SAVUFO/SATUFO process and stored in the UFS files in DA 4948. The ten biggest differences in the flows are reported in the SAVUFO/SATUFO output (LPT).*

ATKINS

back (see section 15.59 for more information) but users need to remember they remain in Beta form.

- Group statistics options enable the outputs from the assignment to be aggregated (or 'grouped') either using hierarchic node systems (using TFL=T) or user-defined lists of nodes or links (using ".N2G" or ".L2G" files respectively). They provide a very useful way of summarising detailed network statistics in a readily digestible form (see section 15.59).

1. Changes in Output Results in 11.3

In terms of results there have been a large number of both relatively major and minor changes to the simulation so that one might expect 11.3 to give different – possibly significantly different – results to pre 11.3. For this reason the opportunity has been taken to change the default values of a number of parameters, typically options that were introduced in recent releases but "turned off" by default are now "turned on" having been verified in practice. E.g., see the notes under SATNET in Appendix D.21.1 and in Section 2 below.

As always, our strong advice in order to both avoid compatibility issues and to ensure that new defaults are adopted, would be to re-run old networks "from scratch" starting with your original network .dat files fed through SATNET. (On the other hand matrix .ufm files probably do not need to be re-created.)

And while we would strongly encourage you to compare output .ufs files from, say, 11.2 with the latest outputs from 11.3 in order spot the differences – and possibly identify any not-so-desirable differences - we would certainly **not** recommend doing evaluation comparisons of different scenarios by mixing outputs from both 11.3 and pre 11.3 releases.

2. New General Features with SATURN v11.3

SATURN 11.3 adds many new features affecting simulation-assignment functions and network displays and editing. A summary of some of the key changes are outlined below with the full (and more detailed) list available in Appendix D21.

SATWIN11

- A new SATWIN11 graphical user interface (GUI) was developed (using Microsoft WPF) to replace the existing SATWIN(10) version, and released as part of 11.2 last spring. In August 2013, SATWIN11 Service Pack 1 was released providing:

  - An improved quick start screen providing access to your most recent Model Complex files in a single click as well as a prompt to save prior to exit;

  - Restructuring of the groups of SATURN modules and new icons;

  - Major updates to SATWIN command line calls to provide full integration with the existing SATURN batch files; and

    Increased stability and resilience.

- With 11.3, a further restructuring of the groupings have been undertaken to improve clarity and usability. A new searchable version of the User Manual has also been created to make the existing documentation more accessible –CHM versions of the Manual may be accessed via "SATURN Help" on the Quick Access toolbar or via the Support Ribbon.

  Note that the existing SATWIN(10) has been replaced by SATWIN11 as part of the SATURN 11.3 release

SATNET

- There have been increases to some of the array limits in response to user-requests, namely: (i) the maximum number of count sets under 77777 increased to 405 from 120; and (ii) the maximum number of records contained in the network "history file" has been increased from 20 to 101.

- Certain error messages related to links, not nodes (e.g., warning 42 for counted links which are bridged by centroid connectors) are now associated with the nodes at either end of the link too to enable easier tracking in P1X.

- Free-flow and capacity times as input on simulation link speed-flow records may now be input as pure delays which are to be added to the normal link cruise times as opposed to inputting total travel times as previously (see 6.4.12.2).

- New advice has been provided on how to model mid-link pedestrian junctions as simulation nodes or, preferably, as part of link capacity-restraint curves (see 6.4.3.6 and 6.4.12.2).

- The default convergence parameters have been updated to reflect the latest recommendations in DfTs' WebTAG Unit 3.19 'Highway Assignment Modelling' (or Unit M3-1 in the latest January 2014 version) (see D21.1.9 for more information).

SATALL

- The algorithms used to calculate .UFO files from Frank-Wolfe were substantially improved both in terms of their accuracy but also in terms of the required CPU time as part of 11.2.05. At the same time, a multi-core element was introduced and enabled when MULTIC=T (see 15.53) to substantially reduce the CPU time required to create them. Further significant improvements have been introduced as part of this release.

Simulation

- A number of small alterations / corrections to the simulation code – mostly to do with flares – means that 11.3 gives different outputs from 11.2. So, for example, the 'rules' by which a flared lane is modelled have been altered in terms of what happens to capacities if both the flared lane and the main lane have queues back to the flare point. This means that the simulation will give different results, especially when the V/C ratio for the lane is high and/or the flare is relatively short.

- Further revisions to the modelling of flares have been made, in particular to deal with the situation where the "straight ahead" traffic that shares with the flared turn can use two or more lanes such that traffic from the "outer" lane can move over into the "inner lane" when the queue in the flare exceeds the flare length.

- Flow-weighted average link times which include the effect of CLICKS on certain user classes are calculated and stored as either DA code 4008 (weighted by vehicles) or 4018 (or weighted by PCU) in output .ufs files from SATALL.

- Output simulation summary statistics (as output by either P1X or SATLOOK) may now be disaggregated either by traffic borough (using TfL conventions) or by explicitly defined node "groups" defined by a .N2G file (see 5.1.7 and 11.11.4).

SATPIJA / SATME2

- Increased efficiency in the processing of very large count datasets with combined counts (6666 data sets) producing substantial reductions in runtimes.

- A Namelist option USEUFO allows SATPIJA to use a .UFO file – assuming that one has been created for the network in question either by using OBA in the first place or by SAVUFO/SATUFO with Frank Wolfe – in preference to a .UFC file, potentially resulting in very much reduced CPU times (see 13.3.14).

- The output .ME2 file has been extended so that it contains, e.g., target flows, errors, etc., per combined constraints but associated with each of the individual links. Thus in P1X all the links within the same combined set will have the same attributes displayed which makes it easier to identify combined sets (see section 13.8).

- Additional functionality to calculate the PIJA factors at the **sector-**level rather the existing zonal-level and to undertake matrix estimation at a more aggregate (or strategic) level (see 15.59 and Appendix X). **NB: sector-based matrix estimation is made available only in <u>Experimental</u> form for users to test and provide-feedback.**

MX

- Setting a new Logical parameter TFL = T in matrix .dat files indicates that zone (and node) names obey the hierarchical rules appropriate to Transport for London networks to aid analysis and reporting. E.g., that the first one or two digits of a 5-digit zone name gives its sector and/or borough depending on the aggregation option selected. Equally an internal matrix within MX may be designated as a TfL matrix via a toggle option 16 under Main Menu Option 1, following which certain new options become available.

- Options have been created to automatically "compress" or "aggregate" a matrix based on, e.g., TfL zoning conventions to a 45 x 45 traffic borough matrix or, more generally, to compress any zone-to-zone matrix into a "group-to-group" matrix based on a .Z2G control file which maps zone into larger groupings. Examples of groups include sectors, traffic boroughs, etc. etc. See sections 10.4.4 and 10.16.4.

- Conversely a different set of options "expands" or "decompresses" a matrix defined in terms of group-to-group movements into one defined by zone to zone movements whereby all zone-to-zone values take the same corresponding group-to-group cell value. This could be applied to a matrix of, say, OD costs or factors as opposed to a trip matrix where the group-based trips would need to be factored down when disaggregated to a zonal level. See 10.4.5 and 10.16.5.

- A "reboot" option allows the original command line to be re-processed if the zonal structure has been transformed in some way, for example compressed. The idea is that if you input a zonal matrix and then compress it to a group in order to "view" the matrix in terms of group-to-group you may return to the original zone-to-zone version. This therefore gets around a "feature" of **MX** whereby you cannot store a zonal matrix and a group matrix in internal memory at the same time but this way you can swap between them. See 10.4.6.

SATLOOK / Skimming batch files

- A new batch file SKIMDA has been created in order to do a forest skim on **any** DA code as opposed to, say, SKIMDIST which operates using a specific DA code (see 15.27.7)

- Network summary statistics, which previously could be output disaggregated by link capacity indices, may now also be disaggregated either by "traffic boroughs" defined by TfL zonal name definitions or, more generally, into "groups" as defined by an input file FILN2G as set in the original network .dat file or interactively defined within SATLOOK (see 11.11.4).

P1X and/or SATDB

- A new batch file, P1XDUMP, similar to DBDUMP will also dump selected data from a .UFS file to text files but using the P1X internal codes (see Appendix I) rather than DA codes (see section 15.46.2)

- Two new options under Information list (a) the "History Records" (6.2) on their own and (b) all the "must have" files, i.e. all the files such as the trip matrix file which are essential to run this network plus a list of all the $INCLUDE records from the original .dat file which also are "essential" files (see sections 11.8.4.10 and 11.8.4.11 respectively).

- TfL Traffic Boroughs and/or Groups per node/zone may be selected as node data for display either in P1X plots or in SATDB node data bases.

3. Compatibility with Previous Versions

In terms of compatibility with previous releases, there are a number of points that users need to be aware of:

- There have been no changes to the format of binary matrix (.ufm) files so that matrix files from previous releases (within reason!) may still be used within 11.3 and, conversely, previous releases of programs such as MX should be able to happily read and process .ufm files produced under 11.3.

- The formats of network ASCII data files (.dat) and (a few) control files have evolved marginally (e.g., new &PARAM parameters and/or options have been added) such that there is no absolute guarantee that a text file created under 11.3 "rules" will be backwards compatible with pre 11.3 programs nor that 11.3 binary files (e.g., .UFS) will be correctly read by pre 11.3 exe's. However 11.3 programs should be able to correctly read all data and binary .ufs files created by previous SATURN releases – with the caveats that: (i) the defaults for certain missing parameters in .dat files may have changed; and (ii) very large networks may have been created whose network dimensions in .UFS files now exceed current limits due to restructuring of the internal array dimensions (see section 5 below). In this specific situation, the user should either revert back to the earlier version that the original files were created in or continue to use 11.3 P1X but without using certain options.

- The number of error checks, both fatal and non-fatal, remain broadly unchanged from 11.2. It is therefore likely that network data files which previously "passed" the more stringent checks introduced, under the WRIGHT=T parameter in SATNET 11.1.09 (say), will continue to 'pass' in SATNET 11.3. However, it is **probable** that networks from prior to 10.9.24 will fail and the necessary corrections will need to be made before that network will run under 11.3. Alternatively, the user may turn this 'off' by setting WRIGHT=F (but we do not recommend using this option).

As previously noted in section 1 (and worth re-iterating again), there have been a number of both relatively major and minor changes to the simulation so that one might expect 11.3 to give different – possibly significantly different – results to pre 11.3.

4. Compatibility with Windows 7/8 & 64-bit

SATURN v11.3 Beta is fully compatible with Windows 7 and should work equally as well under Windows 8 (but very little testing has been undertaken). Whilst SATURN continues as a 32-bit application, it will run equally well in both the Windows 32-bit or 64-bit versions.

5. SATURN Licence Levels (v11.2 onwards)

With the continuing development of the London HAMs, there has been a steady increase in the number of incremental revisions made to the (current) largest 'N3' array dimensions to accommodate growing size of the models. Consequently, there were a significant number of bespoke 'N3' versions released to squeeze out more capacity within the current configuration.

With the introduction of 11.2 last year, the opportunity has been taken to do some much-needed housekeeping and restructure the internal array dimensions, reduce memory requirements and enable all the bespoke 'N3' customizations to be withdrawn and replaced with a new 'N4' level. The new 'N4' level accommodates all the current (2013) London sub-regional HAMs (i.e. 23,000 simulated junctions, 4000 zones and 200,000 assignment links).

6. Technical Support

If you require technical support, please do not hesitate to contact us at _saturnsoftware@atkinsglobal.com_.

If you have any suggestions for what you would like to see in future versions of SATURN and SATWIN, please let us know. Let us know of any problems you have or features you would like and we will look into them.

In the meantime, we wish you a successful continuation with SATURN 11.3.03 and thank you for your support over the last 12 months.

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