

D. Changes in SATURN Version 11.5

D.23 Changes in SATURN 11.5

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SATURN 11.5 is the successor to all previous versions of **SATURN**. The main new feature of 11.5 is the modelling of Traffic Area Charging (TAC) Zones; see Section 20.6 of the SATURN Manual. This development was undertaken in collaboration with Transport for London.

The first release of 11.5.01 for purely internal TAC testing within Atkins and TfL took place early in 2017. Releases of test versions of 11.5.02 began in April 2017 and are identified by suffixed letters as 11.5.02A up to 11.5.02W on 21 October 2017, following which 11.5.03A etc. was used up to 11.5.03W (March 2019).

The test versions continued with 11.5.04A etc. up to 11.5.04T, and then from 11.5.05A. The first full release of 11.5 is 11.5.05H in July 2020.

As always, in terms of backwards/forwards compatibility, the 11.5 network .dat files may contain new features (e.g., parameter names) which will **not** be recognised by pre 11.5 versions of **SATNET** but will not cause the program to crash; however pre 11.5 .dat files will be read perfectly happily by 11.5 **SATNET**. Similarly 11.5 network .ufs files contain new arrays which older version programs will be able to read but not recognise whereas 11.5 programs will be able to read pre 11.5 ufs files. Matrix .ufm files have not fundamentally changed and should be both forward and backward compatible.

The simulation routines in 11.5.03 and 11.5.04 were virtually identical with those in the release version of 11.4.06 so they should give similar (but not necessarily identical) results. However, the opportunity was taken to introduce a collection of minor improvements for 11.5.05A and hence the release 11.5.05H does differ from 11.5.04 and earlier results though not greatly.

The following sections describe the changes made in **SATURN 11.5**. Each note should give the precise version number in which the change was introduced (e.g., 11.5.02), the date and references to relevant sections in the Manual.

D.23.1 SATNET and Network Definitions

- 1) Area Charge Zones (e.g., Congestion Charging Zones or Ultra Low Emission Zones) may be defined within the 44444 data segment. See 20.6 and, in particular, 20.6.22 which details the added options within each “minor” update. See also point 2) under D.23.2 below. Version 11.5.01. 01/02/17.
- 2) Multiple 44444 data segments may now be included. See note 11), Section 6.7. Version 11.5.01. 10/02/17.
- 3) Direct zone-to-zone centroid connectors may now be defined as buffer links under the 33333 data segment. See note (17), Section 6.8 and 15.61.1. Version 11.5.01. 15/02/17.

- 4) Furthermore a Serious Warning 194 indicates situations where two adjacent zones should **probably** be directly connected, otherwise highly unrealistic OD routings may be created during the assignment. See 15.61.2. Version 11.5.01. 15/02/17.
- 5) A binary “UFG file” which specifies all the intermediate co-ordinates for link poly-lines, previously only available in .GIS files, segment 7, may now be specified under &PARAM as FILUFG. See App Z-2. Version 11.5.02. 18/06/17.
- 6) The option to set namelist &PARAM parameters on the command line has been extended to SATNET. See 14.6. Version 11.5.02. 08/07/17.
- 7) User classes which are “twinned” (i.e. have the same assignment parameters in two or more user classes and would have the same paths) are now identified. In principle the same trees may be applied to both, thus reducing CPU times but that final step has not yet been programmed. Version 11.5.02. 19/09/17.
- 8) The default value for NITA_S if not explicitly set has been changed to 256 from 99. Version 11.5.02. 29/09/17.
- 9) New recommended values for various parameters which control the creation of Spider networks have been introduced. See 15.56.4.2. Version 11.5.02. 01/10/17.
- 10) New tests have been added to detect “Kirchoff errors” (i.e., entry flows at nodes do not equal exit flows) in pre-loaded flows. See 15.5.6. Version 11.5.03B. 05/01/17.
- 11) Duplicate buffer link records within 33333 – which currently are fatal errors – **may** be accepted if their first occurrence is in a \$INCLUDE file whose extension is either .BUF .or .MAP – a situation which may occur as part of a SBT transformation. See 15.7.1. Version 11.5.03C. 17/02/18.
- 12) The processing and checking of V data records under 33333 (maximum speeds by vehicle class) has been improved with additional .LPN outputs. See 15.47.2.3. Similarly dumping the same data via the **P1X** network re-creation option has been improved. See 11.4.2.1. Version 11.5.03J. 31/08/18.
- 13) If ATLAS = T and nodes with no (current) connections have been added under 55555 then Non-Fatal Error 278 – map nodes not connected – is not triggered by ATLAS nodes. 11.5.03P. 09/10/18.
- 14) The input of wildcard entry/exit KNOB data (e.g. tolls) to zones has been tightened up to correct various errors. See 15.14.5.3. Version 11.5.03P. 26/10/18.
- 15) Simulation centroid connector records – data set 22222 – may now be formatted with fixed column width 6 for the A,B node specifications rather than 5 by setting a new namelist parameter FREE22 = T. The main purpose is to increase the legibility for networks with 5-digit node numbers which currently run together. See 6.5.1. Version 11.5.03R. 28/12/18.

- 16) A new Namelist parameter PLDPCU sets a PCU to vehicle ratio for input pre-loaded flows. See 15.5.7. Version 11.5.03W. 14/03/19.
- 17) A table within the .LPN file lists the program limits, e.g., the total number of simulation nodes, etc, etc. compared to the maximum number allowed for your particular release level. Useful for determining how near you are to the limits. Search for "ACTUAL VRS MAXIMUM". See 15.28. Version 11.5.03X. 07/04/19.
- 18) The rules for defining "chains" of links for blocking back calculations have been extended to include signalised junctions as well as priority junctions. This has the potential to reduce blocking back on affected links. See 8.5.5.1 Version 11.5.04E. 14/06/19.
- 19) CASSINI files FILCAS, FILGAP and CASTXT may all now be 256 characters long (increased from 80). 11.5.04F. 03/07/19.
- 20) Tests to correct relatively small values of NITA_S no longer apply if CASINI=T. Version 11.5.04F. 13/07/19.
- 21) A new test has been added with Q-nodes to compare the turn saturation flow with the mid-link capacity on the entry link. A non-fatal error 297 is generated if the mid-link capacity is less than the saturation flow. See App Q. 11.5.04J. 19/10/19.
- 22) The \$INCLUDE filenames used under 11111 are saved within the .UF* files and the "active" file used for each simulation node as well as its last "inactive" file are recorded and saved within a newly created .ICF file. See 6.16.2.3. Version 11.5.04K. 21/12/19.
- 23) In addition, the "priority" rules under TOPUP = T for simulation nodes which appear more than once have been tightened up and simplified so that "LIFO" queuing discipline always applies: the first appearance of a node, whether in the main .dat file or a \$INCLUDE file, is always the "active" definition. 11.5.04J. 05/12/19.
- 24) The default value for TOPUP has been changed to T. 11.5.04K. 24/12/19.
- 25) If a zone is connected to two simulation links in series, e.g., a link A-B and B-C, and there is only a single turn from A-B to B-C then the connection to A-B is removed since traffic would always choose B-C as the least costly. See 6.5.2. Version 11.5.04S. 29/02/20.
- 26) If a signalised X-turn has been coded (incorrectly) with green in all stages then Serious Warning 148 has been changed such that rather than **all** stages being followed by a definite red phase only **one** stage ("the most obvious") is selected. 11.5.05B. 14/04/20.
- 27) The default values for MAXSPA/MAXSPB and MARGIN have been updated to 30/20/70 as the optimal values for Dijkstra on the assumption that while Dijkstra may not be used for most networks it is the very big networks where Dijkstra is used that require optimal settings to build the spider network. See 15.56.4.2. 11.5.05F. 25/06/20

- 28) A number of very old and redundant parameters have been either completely “retired” or else they still remain in certain printouts but their values are fixed. UFC109, UFC111 and SIM109 are in the latter category; Q105, M108, BB105, BB109, BB111, RB106 and RB111 in the former. 11.5.05F. 25/06/20

D.23.2 SATALL / Assignment

- 1) A problem with Warm Starts has been corrected. Previously with certain forms of warm starts (e.g., same network, different matrix) **SATALL** was not copying over the full ufc file from the update network as the starting point for the new .ufc file so it wound up doing a SAVEIT assignment at the end when it didn't need to. This then created problems with the **next** warm start using the latest UFC file. Corrected in 11.5.01. 03/03/17.
- 2) Alternative assignment algorithms which allow for Area Charging Zones have been introduced. See 20.6 and, in particular, 20.6.22 which details the added options within each “minor” update. See also point 1) under D.23.1 above. 11.5.01. 06/03/17.
- 3) The use of **SATALL** as a continuation run (i.e., SATALL net MASL n) has been improved by making the choice of NITA on the first assignment more consistent with what would have been set on a run with extra loops. (Although in most cases the value set for NITA is correct, albeit for slightly wrong reasons.) 11.5.02T. 17/08/17.
- 4) A new namelist parameter AUTONS = T allows the number of internal simulation iterations to be controlled by the overall level of convergence such that for poor convergence NITS is set to NITS_M and for good convergence it is set to the input value of NITS as a maximum. See 9.5.4(5). Version 11.5.03C. 06/03/18.
- 5) The scratch file used to store costs by FW iteration has been changed from a “true” scratch file into a standard named UFX binary file in order to avoid any problems with the same file being used simultaneously by two **SATALL** runs. 11.5.03C. 13/03/18.
- 6) The Frank-Wolfe convergence parameter UNCRPTS as used for the SAVEIT assignment to create a .UFC file and for the equivalent assignment under SATUFC has been standardised to the same value so that the two assignments – and therefore the two .UFC files – are identical. 11.5.03J. 04/08/18.
- 7) Flow convergence statistics related to ISTOP are now disaggregated by link type, e.g. simulation versus buffer, as a proxy for geographical location. They may be viewed either in the .LPT files or interactively via **P1X** (under Convergence) or **SATLOOK**. 11.5.03N. 17/10/18.
- 8) Signalised junctions with only two arms, e.g., pedestrian crossings, may be **excluded** from stage time optimisation under SIGOPT if a &PARAM parameter TOARMS is F (default T). Note that most such junctions are already excluded from optimisation by virtue of only having a single stage. See 6.4.1 and 15.31.2. Version 11.5.03P. 31/10/18.

- 9) An output .UFO file may now only contain data from the SPIDER network, not the normal network which (a) means that the UFO files are roughly 10 times smaller but (b) they may only be applied to analyses which work with SPIDER networks. Controlled by setting an input network &PARAM logical variable FLY to T for spider-only UFO files. Default = F (from 11.5.04R) as many UFO analyses recreate non-spider networks) See 15.23.6.2. Version 11.5.03Q. 20/11/18.
- 10) In addition, FLY (or no FLY) may be set as a command line parameter within the batch file procedure SATUFO. See 15.23.7.3. 11.5.03Q. 22/11/18.
- 11) If the trip matrix is too large to be stored within the available RAM (generally due to too many user classes) – currently a fatal error if SPIDER = T – then a scratch file is created to store the excess trip data to be “paged in” as required. 11.5.03W. 17/03/19.
- 12) A table of cumulative weights from Frank-Wolfe iterations is now given for a SAVEIT assignment as well as the main assignment. The same table may also be viewed within the Analysis menu in **P1X** and from the “skim a forest” menu in **SATLOOK**. 11.5.04H. 15/09/19.
- 13) The method to store monetary tolls via KNOBS data sets has been improved to avoid problems with possible lack of RAM. 11.5.04J. 08/12/19.
- 14) Zonal V/C ratios for both exits from origin simulation zones and for entries to external simulation destination zones are calculated and stored on the output .UFS file. See 11.11.19. Version 11.5.04R. 05/03/20.
- 15) If, in very extreme circumstances due almost certainly to poor coding, a very small value of lambda (i.e., \ll XFSTOP) is required in order to allow the Frank-Wolfe algorithm to continue, it is allowed despite the XFSTOP condition provided that the iteration \leq NITA_M. Previously both the assignment and the assignment-simulation loops could grind to an ignominious stop in such a situation. See 7.1.5. Version 11.5.04S. 20/03/20.
- 16) A new option “WANDER” has been introduced to force an early convergence on networks which appear to be “wandering” without any signs of ever achieving required convergence criteria. It currently works by reducing NISTOP with a future development to moderate RSTOP and/or STPGAP under consideration. See 9.2.7. Version 11.5.05C. 22/04/20.

D.23.3 Simulation

- 1) Changes in the simulation have been made to the simulation routines, in particular dealing with flares and with X-turns at signals. These have been maintained in tandem with the 11.4, so at the time of release of 11.4.06D, 11.5.03C would give similar (but not identical) results. 11.5.01 to 11.5.03C.
- 2) In particular major changes have been introduced on simulation links with a single lane but flares to **both** left and right. In previous releases it was possible for such a configuration to be simulated as over-capacity whereas in reality there should be sufficient capacities for all possible turns. 11.5.02. 01/02/2017.

- 3) An error associated with FCF (Fixed Cost Flows) applied to external simulation nodes has been corrected with minor (but non-zero) consequences. 11.5.01. 14/03/17.
- 4) A very minor update has been made to priority junctions with flares where the V/C ratio of the lane as a whole may be < 1.0 but an individual turn may have $V/C > 1.0$, in which case lane capacity is reduced to make both V/C equal and > 1.0 . This occurs extremely rarely but, if it does, the overall simulation outputs will be affected. 11.5.02L. 07/06/17.
- 5) The procedure to check that V/C ratios are the same for all turns in shared lanes, in particular when $V/C > 1$, have been tightened up. 11.5.02Q. 22/07/17.
- 6) A minor change to the blocking back of links which are fed both by direct flows from centroids downstream as well as “normal” entry flows upstream means that slightly more traffic is blocked from the upstream entries. In most cases the impact is minimal but if the flow from the zones is significantly greater than the normal entry flow (which it should **not** be) then the impact may be significant. However, in such cases, convergence should be improved. 11.4.05K and 11.5.02U. 24/08/17.
- 7) The rules have been changed in order to better deal with a potential problem of discontinuous delays on simulation links with: (a) a mid-link speed-flow curve, (b) turns which do not share lanes and (c) total arrival flow very near the link capacity. The new rules remove a potential discontinuity in turn delays and capacities where the flow is just above / just below capacity and therefore lead to improved convergence. 11.5.02. 19/09/17.
- 8) Changes have been made to the rules which allocate blocking-back factors in situations where a blocked link has both flows entering upstream, from centroid connectors and from previously queued flows. See ??? Version 11.5.03C. 25/01/18.
- 9) The simulation of a link with a single lane with 2 X-turns has been improved. 11.5.03C. 25/01/18.
- 10) The rules by which turns may or may not be aggregated into “rivers” have been updated for links with a single lane, one or more flares and at least one exit link which blocks back. The difference in outputs is expected to be minimal but there is a pious hope that it will (marginally) improve convergence. 11.5.03P. 28/10/18.
- 11) The rules as to when the geometric delay TDEL (default 3 seconds) is included in the total turn delay have been tightened up, in particular an error whereby TDEL was sometimes excluded for minor priority arms with flares has been corrected. See 8.4.1. Version 11.5.04C. 11/05/19.
- 12) A bug has been corrected for the (somewhat rare) situation of a filtered (100% green) turn at signals from an entry arm which includes a flared lane. The previous methods tended to under-estimate the capacity which, in most cases, should be virtually 100% of its saturation flow. 11.5.04C. 15/05/19.

- 13) The rule for calculating delays at Q-nodes has been altered in the case where the mid-link capacity on the input link is (illogically) **less** than the saturation flow. The V/C ratio is now always taken using the saturation flow as C, **not** the link capacity. See App. Q. 11.5.04J. 15/05/19.
- 14) New rules introduced for TAX for signals with extended green / late cut-off stages. See 8.2.4.1. Version 11.5.04J. 07/11/19.
- 15) New rules introduced for gap acceptance at signals which apply in very rare circumstances, e.g., turns with clear exits. See 8.2.2.3. Version 11.5.04J. 07/11/19.
- 16) Both the new rules described under 14) and 15) above may currently be ignored by setting a Namelist parameter SIM114 = T. The default currently is F. 11.5.04J. 05/12/19.
- 17) The simulation of a signalised arm with two main lanes and two flares has been improved. 11.5.04P. 16/02/20.
- 18) The lane-choice rules for a signalised link with an X-flared lane and multiple straight ahead lanes have been improved when $V > C$ with consequent changes to the capacities per turn. 11.5.04Q. 20/02/20.
- 19) The calculation of delays for turns which enter a blocked-back link have been changed for two situations: (1) transient delays for give-ways at priority junctions and (2) random delays at both priority and signalised junctions. See 8.5.9 and 8.6.6 respectively. 11.5.05A. 30/03/20.
- 20) Blocking back has been suppressed on simulation links where 100% of the entry traffic upstream goes directly to simulation zones while it is still possible for large queues to form downstream due to new traffic entering from zones. See 8.5.8.2. Version 11.5.05A. 30/03/20.
- 21) The calculation of cost-flow curves for simulation turns into a link which (a) is blocking back and (b) has traffic entering from zones at the downstream end of the link has been modified to reflect the fact that both the zonal entry and the upstream entry “share” the same limited capacity. In effect this means that the V/C delays for the upstream entry turns increase less rapidly than their normal capacity would imply. See 8.5.8.5. Version 11.5.05A. 01/04/20.
- 22) A minimum entry flow upstream into a blocked back link has been introduced in order to resolve problems where very large zonal entry flows at the downstream end of a link effectively reduce the **upstream** entry flows and capacities to near zero. See 8.5.8.4. Version 11.5.05A. 01/04/20.
- 23) If a flare is fed by an “exclusive” lane in which only one turn is allowed, then that turn can use both the lane itself and the flare at the same time, potentially doubling its capacity. If the same turn could **also** use a shared lane (e.g., lane 1 is shared by straight ahead traffic and right turners, lane 2 is right turners only and there is a right-turning flare from lane 2) then previously the increased capacity was missed. This has been corrected in 11.5.05E. 13/05/20.

- 24) The defaults for the simulation parameter RAGS has been changed to .TRUE. to reflect the long held recommendations. A similar switch for simulation parameter SIM111=T has been deferred to 11.6 but our recommendation remains unchanged there. NB: With SIM111=F remaining, RAGS will be forced to 'F' by SATNET during the network build process. 11.5.05H. 13/07/20

D.23.4 P1X and/or SATDB

- 1) A new link data variable has been added which identifies those links which are either inside or on the edge of a Traffic Charging Area. See 20.6. Version 11.5.01. 24/02/17.
- 2) The poly-line or curved link data may now be “detached” from a text .GIS file and stored as a binary .UFG file which may be referenced from the .GIS file. UFG files may be created from an original GIS file either interactively within P1X (Files/Outputs menus) or via batch file DUMP_UFG. See App Z.2 and Z.3. Version 11.5.02. 17/06/17.
- 3) In addition DUMP_UFG may also optionally create an updated .GIS file in which the 77777 poly-line data has been deleted and a reference to the equivalent .UFG file included. 11.5.02. 18/06/17.
- 4) The colour(s) used to highlight “selected links” may now be set by the link-specific values stored in a particular data base column rather than being fixed for all links. For example, if you wish to select links based on the criterion that LANES > 1 you may have different colours for links with 2 lanes, 3 lanes etc. See 11.6.1.6. Version 11.5.02. 11/04/17.
- 5) The option to dump a full listing of all bus routes within Files/Outputs has been extended to allow three alternative levels of detail: the mini, midi and maxi levels. See 11.4.2.4. Version 11.5.02. 06/06/17.
- 6) “Bus lane triangles” (i.e., two extra links plus one extra pseudo node added in a very “flat” triangle to represent bus lanes) may now be optionally excluded from plots. See 11.6.4(10). Version 11.5.02. 08/06/17.
- 7) An “arboretum” of all used OD paths for a specific O-D pair may now be dumped in numerical format to the LPP file. See 11.8.3.7. Version 11.5.02. 20/05/17. The table has been later extended to include excess costs whenever a route diverts from a minimum cost route plus any queued traffic at over-capacity simulation turns en route. 24/07/18.
- 8) TAC toll charges may now be included as outputs from a Joy Ride. 11.5.03. 30/11/17.
- 9) The list of standard link properties which may be selected for link annotation has been extended to include, e.g., extra TAC flows, initial V>C queues under PASSQ and the capacity for traffic from CCs. See App_I. 11.5.03C. 27/01/18
- 10) Two new options have been added to output “sub-files” from network .dat files from within Network Edits/PMAKE: (a) an option to output a “sorted” 11111 file where all the simulation nodes are in numerical order and (b) an

option to output a “cleaned” 33333 data set where all redundant records which refer to simulation links have been removed. See 11.9.2.9 and 11.2.9.10. Version 11.5.03C. 01/02/18.

- 11) The V over C ratio for a turn with zero flow and zero capacity – which means that it must share lanes with an over-capacity flow – now takes its V/C ratio from the shared turn. 11.5.03C. 03/03/18.
- 12) The option to build a single O-D minimum cost path now allows an individual link to be either banned or penalised (by adding a time penalty to its current cost) prior to building the tree. At a somewhat later date the same option was applied to forests. See 11.8.3.8. These give an indication as to what might happen following an “incident”; see 15.62.2. Version 11.5.03F. 14/06/18.
- 13) In addition the procedures “One Song to the Tune of Another” and SATRAP within **SATDB** now allows one or more links to be banned and/or penalised during the loading process. This may be a particularly useful feature for reassigning SLA matrices to illustrate where trips may divert to if a particular link is closed. See 11.10.7.4, 11.10.7.7 and 15.62.2. Version 11.5.03F. 15/06/18
- 14) Equally SATRAP also now allows banned and/or penalised links. See 11.10.7.7. Version 11.5.03H. 10/07/18.
- 15) The text data for an arboretum as displayed in the banner now includes both the demand flow per path and the actual arrival flow at the destination. 11.5.03J. 24/07/18.
- 16) A “QUICK Forest” facility has been introduced as a “quick’n’dirty” method to drastically reduce the CPU time required to carry out analyses such as SLA or skims by considering just a single tree based on final costs as opposed to a full repetition over all FW iterations. See also note 40) below. See 15.23.10. Version 11.5.03K. 28/08/18.
- 17) If the network contains “ATLAS” nodes, i.e., nodes defined under 55555 in **SATNET** but which currently have no network connections, then these may be optionally displayed as nodes in the network plots; see 18) below. 11.5.03N. 09/10/18.
- 18) The menu to set node notation parameters has been extended to include a “part 2” which new options to plot all nodes regardless of whether certain links are not plotted and an option (see 17 above) to include “ATLAS nodes”. 11.5.03N. 09/10/18.
- 19) Problems with calculating a SLA trip matrix from a screen line with restrictions on the number of crossings (e.g., include only trips with two or more crossings) and using the SPIDER network have been corrected. 11.5.03N. 17/10/18.
- 20) SLA is now permitted for TAC networks but, to date, only for a single link. 11.5.03P. 05/11/18.

- 21) The “Resume” option to re-set conditions from the previous run may now be invoked from within the Windows menu which only re-sets the window, not the parameters. See 11.4.4. Version 11.5.03R. 19/12/18.
- 22) The options to define the modelled flow under Validation have been extended to include the choice of the flow for a single vehicle class. See 11.7.1. Version 11.5.03R. 29/12/18.
- 23) The editing of simulation centroid connectors within PMAKE now includes an option to convert a list of nodes in 5-column blocks into 6-column blocks as specified by setting FREE22 = T. See 11.9.4. Version 11.5.03R. 29/12/18.
- 24) Extensive changes have been made to the definition of modelled flows within the Validation of Counts. For example, they may now be set by a specific vehicle class as opposed to a user class, PASSQ flows may be included within user/vehicle class flows, etc. etc. See 11.7.1. Version 11.5.03S. 02/01/19.
- 25) An option to annotate flows by bus company has been added with options for units in either vehicles per hour or PCUs per hour. See App. I-1-4 #157 and 158. Version 11.5.03S. 06/01/19.
- 26) PASSQ flows disaggregated by either a single user class or a single vehicle class may now be annotated. See App I-1-2 #159 and 160. Version 11.5.03S. 07/01/19.
- 27) Queued flows disaggregated by either a single user class or a single vehicle class may now be annotated. See App I-1-2 #161 and 162. Version 11.5.03S. 08/01/19.
- 28) The “rules” used to identify “bus lane triangles” have been extensively tightened up. In addition, the annotation of triangular links has been updated such that, if the triangular links have been removed then the flow annotated on the main (remaining) link will be the **sum** of the flows on the main link plus the flow on the bus lane. However, for “qualitative” annotation, e.g., distances, the annotated distance is simply that on the main link, assuming that the same value applies to the bus lane. 11.5.03T. 13/01/19.
- 29) By default the network filename is used as the optional title for including in node graphics plus it may be selected as the title as an alternative to text input. 11.5.03U. 31/01/19.
- 30) Annotating differences in simulation node data between networks 1 and 2 in node graphics may use either net1 – net2 or vice versa. 11.5.03U. 01/02/19.
- 31) As an alternative to suppressing bus lane triangles a new method has been added to suppress “bus plus one” links where any link which (a) has buses and (b) is banned to all user classes bar one (presumably taxis) can be removed from network plots. See 15.65.2. Version 11.5.03U. 05/02/19.
- 32) A new automatic node-graphics loop has been added based on an ordered column of **node** data in the **SATDB** node data base – in addition to the current option to loop over sorted link data. See 11.12.6. Version 11.5.03W. 23/03/19.

- 33) A new link-based variable has been added equal to the average number of PCUs per vehicle as averaged over all the various components of flows; e.g., individual user/vehicle class flows, bus flows, etc. See 15.17.3. Version 11.5.03W. 24/03/19.
- 34) In addition three new variables have been added to the list of flows for annotation: demand flows in vehicles/hour, actual flows in vehicles/hour, and capacity flows in vehicles/hour, 11.5.03W. 25/03/19.
- 35) A very limited number of variables (i.e., one – pcus per vehicle as noted in 33)) may now be annotated numerically with decimal places rather than rounded off integers. 11.5.03W. 27/03/19.
- 36) Annotated node data now includes a limited number of zonal items, in particular % V/C which should be very useful for detecting zones with overloaded centroid connectors. (Regional models please note!) 11.5.03X. 06/04/19.
- 37) The table listing program limits, e.g., the total number of simulation nodes, etc, etc. compared to the maximum number allowed for your particular release level – see 17) under D.23.1 above – may also be displayed from within the System/Device menu. 11.5.03X. 08/04/19.
- 38) A **SATDB** node data base option under “Create new data columns” allows one to aggregate the out-bound and/or in-bound link data totals per zone; i.e., the zonal trip origins and/or destinations if the link data is flow-based. See 11.10.5. Version 11.5.04E. 02/06/19.
- 39) The same option may also be applied in the **P1X** Display banner under ZoneTripEnds to annotate the O/D totals for the annotated link data as block rectangles as is done for matrix row and column totals. See 11.6.5.5. Version 11.5.04E. 02/06/19.
- 40) The QUICK (Forest) facility – see note 16) above – has been extended such that the forests can be constructed from more than one FW iteration but still fewer than the total number. See 15.23.11. Version 11.5.04F. 09/07/19.
- 41) Two new time-based link annotation choices have been added: (a) the total link travel for a given user class to include both the travel time on the link including CLICKS times plus the average delay at the junction and (b) the corresponding speed. See App I.1.3, entries 168 and 169. Version 11.5.04F. 23/07/19.
- 42) SLA flows may now be factored up or down so that they match the “correct” assigned flows on the selected link(s). The default is .TRUE. See 11.8.1.17. Version 11.5.04H. 17/08/19.
- 43) In addition SLA may now use the “QUICK Forest” and/or the “QUICK L” options in order to reduce CPU time by building one or a small number of “representative” trees rather than the full FW forest. See 11.8.1.16. Version 11.5.04H. 17/08/19.
- 44) If an input DA code request for link annotation does not exist a toggle option (NODAOK = T) allows the data column to be created with full default values

DAFAIL, 0.0 by default but the values may be reset interactively or in P1X0.dat. See 11.10.2(5). Version 11.5.04I. 07/10/19.

- 45) The options SATRAP and One Song within **SATDB** now allow the assigned O-D routes to be recreated using (a) spider links and (b) Dijkstra or d'Esopo tree builds which will speed up the process significantly. 11.5.04J. 13/11/19.
- 46) In addition SATRAP (but not yet One Song) allows for a re-assignment of TAC networks (which in turn use Spider plus Dijkstra/d'Esopo as above). See 20.6.17. Version 11.5.04J. 21/11/19.
- 47) The Assignment/Tree build options within **SATDB**, including SATRAP and One Song, allow the QUICK N option to be set interactively. See 15.23.10 and 11.10.2(7). Version 11.5.04J. 21/11/19.
- 48) Zonal V/C ratios may now be displayed as a node property, either for origin simulation zones or external simulation destination zones. See 11.11.19. Version 11.5.04R. 05/03/20.
- 49) The parameter NIJKST (AKA NIKSTRA or DIJKSTRA) may now be set interactively within the Analysis Menu in order to use Dijkstra or d'Esopo tree building within, e.g., SLA, independently of what was used in the original assignment. 11.5.04S. 22/03/20.
- 50) The standard node table that prints flows and delays now has an alternative version which includes GIS-input street names rather than node numbers and slightly less data. Intended for use by non-modellers. It may also be output as CSV format rather than fixed columns for easier input to, say, Excel. 11.05.04D. 28/04/20.
- 51) The "BUS SLA" option within Information now includes a list of the bus route names and frequencies in both an on-screen window and in the .LPP file. 11.5.05D. 04/05/20.

D.23.5 MX

- 1) Matrix filenames M1.UFM and RUNM1.UFM are now valid matrix names and may be used within standard batch files. Previously they got confused with "special" keywords used in batch files. (But MXM1.UFM may **not** be used.) 11.5.01. 03/03/17.
- 2) A matrix of trips which have paid tolls within a Traffic Charge Area may be created with the choice, if there are more than one charge systems, of which tolls are paid. See 20.6. Version 11.5.01. 08/03/17.
- 3) Matrix transposition for a stacked matrix is now done "correctly" by separately transposing each distinct level of the matrix internally. 11.5.01. 03/03/17.
- 4) The comparison of row and/or column totals within MXM2 for matrices with multiple levels and/or blocks may now be based on the total row and/or column totals aggregated over all levels/blocks. See 10.9.2. Version 11.5.02. 11/04/17.

- 5) The seed value used to create randomised matrices based on Fortran equations using a sequence of pseudo-random numbers may now be explicitly user-set within the General Parameters sub-menu, option 99 within the Files menu. This enables randomised matrices to be more truly random. See item 5 in D.23.9. Version 11.5.02. 02/10/17.
- 6) A number of standard procedures, e.g., the printing of row and column totals, have been extended to work with matrices which have **both** levels and blocks; e.g., skimmed matrices from TAC networks. 11.5.03C. 18/03/18. Further extensions in 11.5.03I mean that **all** options **should** now work for matrices with both levels and/or blocks. 15/07/18.
- 7) A new procedure MXUNBLOCK has been created to automatically split a .UFM matrix with blocks into its constituent sub-matrices. See 10.20.29. 11.5.03C. 18/03/18.
- 8) The batch file procedure MXM1 has been extended to make it easier to create .ufm files from, e.g., CSV-formatted files, and also possible to create stacked and/or blocked .ufm files directly from a single data file. See sections 4.4 and 10.5.2. Version 11.5.03C. 10/04/18.
- 9) The batch file UFM2TBA2 has been extended so that: (a) zero cell values are not included and (b) stacked matrices – either vertically by levels or horizontally by blocks – may be handled. Equally TB22UFM can cope with stacked matrices. Version 11.5.03F. 13/06/18.
- 10) Row and column totals are updated immediately after a Fortran equation is used to redefine the internal matrix so that if a second equation is then applied which involves ROW(0) or COL(0) the latest totals are applied. 11.5.03P. 08/10/18.
- 11) The batch files UFM2CSV and CSV2UFM now allow extra parameters NAMES and SEQ to be included on the command line to control whether or not the data for each matrix row includes 1 or 2 initial entries specifying the “name” of the row zone and/or its sequential number. 11.5.03P. 30/10/18.
- 12) The maximum number of levels which may be handled within **MX** has been increased from 9 to 11. Version 11.5.04C. 15/05/19.
- 13) The batch file MXAGG which aggregates levels has now been extended to aggregate blocks. See 10.20.21. Version 11.5.04F. 19/06/19.
- 14) The batch file STACK will now stack a set of “partial” or “rectangular” sub-matrices which each contain a subset of all origins/rows into a full matrix. See 10.20.11. Version 11.5.04F. 29/06/19.
- 15) The rules used to set the .LPX line printer filenames for the automatic batch files MXAGG, MXUNBLOCK, TACTRIPS and TACCHARGES have been changed such that the LP filename is based on either the input or the output matrix rather than having a fixed name such as UFMAGG.LPX for MXAGG. 11.5.04I. 08/09/19.
- 16) Several of the MX batch procedures, e.g., STACK, have been rewritten so that they do **not** use internal RAM to store a trip matrix but do all the calculations one row at a time using external .UFM files. This means that

they are not restricted to matrices with relatively small rows and/or columns. 11.5.04J. 19/10/19.

- 17) Updates to the OMX implementation to provide compatibility with the v0.2 OMX specification (see section 10.2.8). 11.5.05B. 15/04/20.

D.23.6 DALOOK

- 1) An option has been added to produce a set of univariate statistics, e.g., mean, min, max etc. for the selected DA code. 11.5.02. 16/07/17.

D.23.7 SATLOOK / Skimming batch files

- 1) A table of totals for all input KNOBS data multiplied by flows is now included in the simulation totals as calculated "in situ". 11.5.01. 11/02/17.
- 2) The batch file SATCOST which produces a minimum cost OD matrix now allows for the costs to include Area Charging Tolls as appropriate. See 15.27.7 and 20.6.17. Version 11.5.02. 26/05/17.
- 3) The batch file SATC_AV which skims average costs now takes note of the preferences parameter USELSD to produce matrices in either generalised time units in seconds (USELSD = F) or costs in pence (T). 11.5.02U. 04/09/17.
- 4) Procedures such as SKIMDIST etc. have been extended so that if the network contains area charging (TACs) then the output skimmed matrices are "blocked" with one block for each possible charge regime. See 20.6.20. Version 11.5.03D. 17/03/18.
- 5) A new "skim" procedure SKIMTIJ calculates, for networks that contain Area Charging (TACs), the split of the original trip matrix into two or more sub-matrices corresponding to drivers who pay a certain set of tolls. It therefore mimics the use of TODTAC within **SATALL** but has the advantage that it may be run post assignment. 11.5.03D. 17/03/18.
- 6) Options have been introduced into the various skim options such as SKIMDIST, SKIMALL, SATTUBA etc. within **SATLOOK**: (a) to allow the trees to be built using Dijkstra rather than d'Esopo and (b) to allow easier access to multi-core versions. Both may lead to potentially significant reductions in CPU. See 15.27.7.6. Version 11.5.04C. 12/05/19.
- 7) A new option 22 within **SATLOOK** calculates the ratio of total entry traffic at the downstream end of simulation links from origin zones relative to the total link capacity of those links. A ratio greater than 1.0 implies that there will always be queued traffic along these links with consequent problems for route choice and convergence and that the user should be thinking carefully of adding extra simulation connectors. In addition V/C ratios for traffic entering external simulation **destination** zones is also calculated. See 11.11.19. Version 11.5.04Q. 22/02/20.
- 8) SATTUBA matrices of penalty times are now output in units of **hours** rather than seconds (to agree with what it says in the Manual in Section 15.41.2). 11.5.04R. 28/02/20

D.23.8 New SPIDER Network Applications

- 1) Two new user-set parameters have been added: (i) MAXSPB which controls the maximum number of arms for a buffer node to be aggregated and (ii) MARGIN which defines the maximum number of new spider links to be added in order for a node to be aggregated. Both may be set under &PARAM in network .dat files. See 15.56.3 and 15.56.4.2 for recommended values. 11.5.02. 07/07/17.
- 2) An option to use SPIDER tree-building in SATPIJA by setting USESPI = T in the control file has been formally added and documented although it was available in previous releases but not fully tested and therefore not documented. 11.5.03J. 14/08/18.

D.23.9 SATPIJA/SATME2

- 1) The option to choose between d'Esopo and Dijkstra tree building algorithms – as currently applied within **SATALL** based on the parameter NIJKST – has been extended to **SATPIJA**. See 13.5.15. Version 11.5.04A. 17/04/19.
- 2) The parameter USESPI to use an aggregated SPIDER network rather than the normal network, which previously was “experimental” is now fully functional and should reduce CPU times by factors of between 5 and 10. See 15.56.7.1. Version 11.5.04A. 23/04/19.
- 3) PIJA analyses (**SATPIJA**) may now be carried out on networks which contain Area Charging (except Group-based analysis). 11.5.04A. 23/04/19.
- 4) The default value of XAMAX changed from 5.0 to 2.0. Version 11.5.04J. 29/11/19.
- 5) Group-based PIJA analysis on TAC networks is now permitted. 11.05.05D. 29/04/20.
- 6) The default option for USESPI is now TRUE but if SPIDER were not used in the original network it reverts to F. 11.5.05D. 29/04/20.

D.23.10 SATCH

- 1) The default option for USESPI is now TRUE but if SPIDER were not used in the original network it reverts to F. 11.5.04E. 31/05/19.
- 2) If a .UFM trip file is created by **SATCH** its name is included in the &PARAM Namelist data within the output network .KP file replacing any existing reference to a trip matrix. 11.5.05D. 02/05/20.

D.23.11 Utilities

- 1) Significant updates to **CASSINI** to handle DIADEM v7.0 output convergence results, simplification of the existing code, removal of unused options and improved documentation (see section 15.54). 11.5.05G. xx/07/20
- 2) Update to SATSTAT to enable model data columns to be hidden/unhidden (see section 15.49). 11.5.05G. xx/07/20

D.23.12 General Changes

- 1) Numerical input of the form, e.g., 6E+1 which does not satisfy the Fortran rules for E Formats (which would be 0.6E+2) is now “correctly” read as 60.0. This occurs with CSV inputs generated by Excel. 11.5.01. 07/03/17.
- 2) The “search” procedure to locate the folder in which a file specified only by its “filename” (i.e., not the full path definition) is located has been extended to include, e.g., the folder within which the .dat file is located. 11.5.02. 06/04/17.
- 3) At the conclusion of each program run all internal files which are still “open” at the end of the run are explicitly “closed” by the program itself rather than relying on the operating system to do the job once the program has terminated. It is hoped that this may eliminate certain apparently random problems of programs hanging at the very end. 11.5.02. 05/06/17.
- 4) When defining namelist parameters on a Command line – see 14.6 – the convention of using &PARAM has been replaced by \$PARAM since the ampersand tends to be ignored by current operating systems. But not the almighty dollar! 11.5.02. 12/07/17.
- 5) The seed value used to initialise pseudo-random number sequences – previously fixed at 12345 – may now be user-set within the General Parameters sub-menu available from within P1X, SATDB, SATLOOK and (now) MX. In addition to setting an explicit seed value the seed may also be generated from a one-off random value based on the current time in order to give a more “truly random” random number sequence. 11.5.02. 02/10/17.
- 6) KEY files now allow the filename of an input or output file to be up to 256 characters long; the previous limit was 76. See 14.5.11. Version 11.5.03C. 11/03/18.
- 7) If a filename or pathname is defined externally enclosed by double quotes(“), e.g., “space file.dat”, then both the initial and final “ are removed from the name before opening the file. 11.5.03C. 11/03/18.
- 8) The screen error message generated when a program crashes now contains the name of the program and the release version for ease in diagnosis. 11.5.03D. 29/03/18. In addition, if the error is number 10, an array size is too small, then additional information as to which array (which already is included in the .LP file) is included in the screen message. 11.5.03V. 24/02/19.
- 9) The order in which open files are closed at the end of each **SATURN** exe has been changed so that any windows are closed at the very end **after** all uf*, text files etc. have been closed. In particular if the previous problems in **SATALL** occur where it occasionally hung at the end, at least the files may be completed. 11.5.03F. 13/06/18.
- 10) The “view-only” programs MXV and P1V have been “tightened up” to prevent any possible output of UF* files (so that they cannot be used to carry out any “active” modelling) and have been documented in Section 15.63 of the Manual. 11.5.03J. 24/06/18.


- 11) Namelist parameters may now exceed 6 characters as input but are truncated to 6 for identification purposes; e.g. NIJKSTRA becomes NIJKST. See Appendix A, SATURN namelist input, note 20). Version 11.5.03P. 12/11/18.
- 12) The convention that output files which have been disaggregated by user class have a "." (full stop) inserted in their filenames has been changed so that a _ (underscore) is used instead. See, for example, SATTUBA and SATMECC. 11.5.03Q. 23/11/18.
- 13) The option (a) to use either d'Esopo or Dijkstra tree building algorithms to recreate min-cost routes from a .UFC file and (b) to base the d'Esopo/Dijkstra choice on the namelist parameter NIJKST is being gradually introduced into "most" analyses. E.g., **SATPIJA**, skim routines in **SATLOOK**, etc. 11.5.04A. 26/04/19.
- 14) Checks are carried out on Preferences Files (e.g., P1X0.DAT, MX0.DAT etc.) to detect if a parameter value defined in the preferences file differs from that set by the initial program defaults which may be an indication that the file being read is out of date and the default values set by the program are those currently recommended. 11.5.04L. 15/01/20.
- 15) Control and/or Preferences files set on command lines which are now assumed to have an extension .DAT either explicitly included or automatically added (e.g., either CONTROL.DAT or CONTROL) may now have an alternative extension included (e.g., CONTROL.TXT). See 14.6 and 15.2. Version 11.5.05B. 11/04/20.

D.23.13 SatWin

SatWin has been refreshed to be more consistent in operation, and give access to the new batch files introduced for area charging. 17/07/20.

IJW / DVV / DAS – 17/07/20

D.24 Version Control

JOB NUMBER: 5197953		DOCUMENT REF: App D-Future.doc				
Revision	Purpose / Description					
		Originated	Checked	Reviewed	Authorised	Date
10.9.10	SATURN v10.9 Release (absorb App D17)	DVV	DG	IW	IW	04/09/09
10.9.12	SATURN v10.9 Release (Full)	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
11.01.09	SATURN v11.1 Release (Full)	DVV	AG	IW	IW	31/03/12
11.2.01	SATURN v11.2 Beta Release (absorb App D19)	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	EN	IW	IW	28/03/14
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	22/01/15
11.3.12	SATURN v11.3.12 Release	DVV	DAS	IW	IW	22/04/15
11.4.06	SATURN v11.4.06 Release	DVV	DAS	IW	IW	18/01/18
11.5.05	SATURN v11.5.05 Release	DVV	DAS	IW	IW	17/07/20