SATURN

2019 User Group Meeting - Introduction

November 2019

UNIVERSITY OF LEEDS

FVVB Ltd

ATKINS
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Programme
- Morning Session

10:30 - SATURN News

11:00 - SATURN Area Charging
› *Atkins*

Experiences with TfL HAM P4
› *Atkins / TfL*

SATURN 11.5
› *Dr Dirck Van Vliet*

12.30 - Lunch

- Afternoon Session

13:30 - SATURN Analysis 102
› Part 1 – Matrix Estimation
› Part 2 – Skimming

15.00 - Tea / Coffee

15:20 - SATURN Analysis 102 *continued*
› Part 3 – UFC & UFO files explained

15:30 - DfT Software Update
› TUBA, TEMPro, WITA & DIADEM

15.45 - User Requests

16.00 - Close

Software Releases

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Release Schedule – SATURN 11.4 & 11.5 Beta

Current full release 11.4.07H (Aug'18)

› Subsequent ad-hoc updates to specific users:
› Notable issues:
  › SATPIJA – inconsistencies using UFO files (#152 - ongoing)
    › *Advice to use UFC for matrix estimation*
  › P1X - Disappearing cross-hairs (#146 – ongoing)
  › P1X - Resume not working (#141 – fixed in ad-hocs)
› Cumulative updates incorporated into latest 11.5

Focus on SATURN 11.5 Development

› Existing core version + new Area Charging functionality
› Collaborative development with TfL
  › Available under Beta via SATURNnext FY19/20 Programme

Version	Date	Comment
11.3.12W	May'17	**Ancient!**
11.4.06D	Feb'18	Using new style installer & sub-folder names & locations
11.4.07H	Aug'18	New SAT10KEY
	Followed by	Ad-hoc updates
Under SATURNnext FY19/20 Programme		
11.5.02 series	Apr'19	With new Area Charging functionality
11.5.03 series	Jul'19	
11.5.04 series	Oct'19	

See "Appendix E Latest"

› Provides detailed summary   › Latest version on website

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SATURN 11.5 Development (i) - Status

Undertaken as part of the FY19/20 Programme

› Collaborative working with TfL and HAM P4 consultants
  › *Supplementary testing with Cambridgeshire CC*
  › *Applied for congestion charging & ULEZ-type schemes*
› Development of new <u>assignment-based</u> area charging algorithm
  › Optional to travel through charging area
    › *Extension of existing MUC algorithm*
  › Represent one or two charging areas
    › *Either 'separate' or 'overlapping'*
  › Model differential charges levels (or exclusions) by user class
  › Compatible with matrix estimation & secondary analysis
    › *Average or separate costs skims by charging regime*
    › *Available with SATURN Multi-Core*
› Substantial development exercise

SATURN 11.5 Development (ii) – Next Steps

Beta Release for HAM P4 – Dec'19

› Substantive development work complete – 'mopping up' required:
  › Includes some further (non-TAC) simulation updates
  › Extend P1X-based secondary analysis (eg more SLA options + summary statistics)
› As a SATURN v11.5 Beta Release
  › Available to all users under existing standard User Agreements
    › *Focus shifting towards more general testing*
  › Coincides with TfL HAM P4 launch

First full release - target Mar'20

› Incorporate feedback from beta testing
› Speed up by sharing path-builds for User Classes with same PPK/PPM definitions
› Release to all supported users
› New licence level 'X?' to accommodate HAM P4 LoHAM (5750 zones, 16UCs, 2TACs)

Update SATGPU for 11.5 & Area Charging - TBC

SatWin 11.5 Updates (i)

Housekeeping – incorporate new Area Charging options

Main Changes

› Post Assignment split into two for

  › 'Classic' networks

 › 'Area Charging' networks

› Tidy-up tool tips

SatWin 11.5 Updates (ii)

Other Changes

Within each Modules

› Standardised parameter entry
  › Description over subject
  › Suggestion over entry box

› Tool icons

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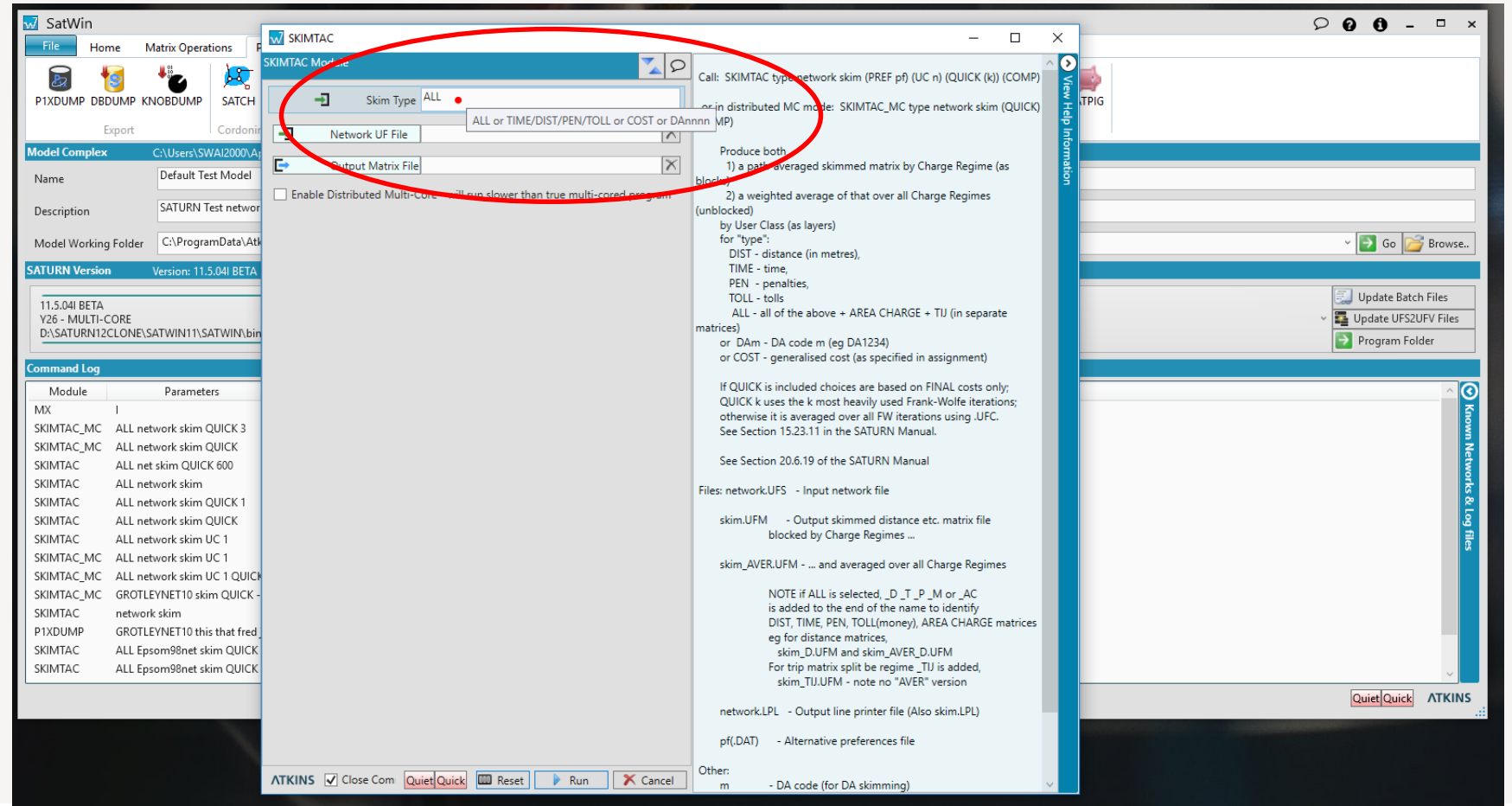
Other Software Updates

# Updates to SatView (i) – Current Status

SatView

› Previous Release v1.20 (Apr'18)

› **Latest release – SatView v1.30 (Dec'19)**

    › Response to user feedback

        › *Faster loading with cleaner interface*

        › *Restructured layer operations*

        › *Updated Style Manager*

        › *PDF print and GIS export*

        › *Open new networks in same session*

    › Updated UFS2UFV to access SATURN 11.5 Area Charging Data

SatCoder

› Current Release v1.3 (Oct16), v1.5 Beta (May'17)

    › Continued development focus with SatView

Latest SatView v1.30 Release

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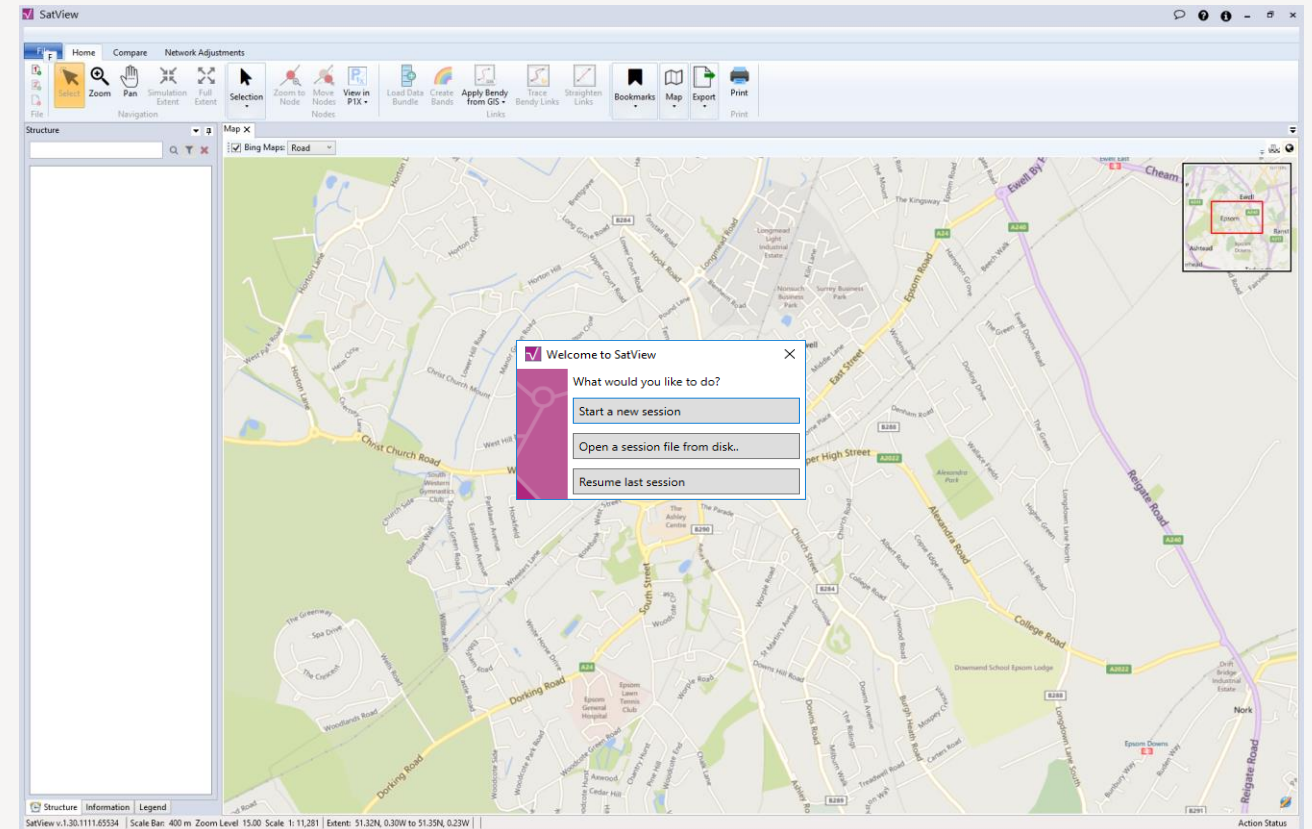
SATVIEW

SatView v1.30 (ii) – A Cleaner Interface

› Refreshed UI

› Reworked Structure Browser
  › shows all loaded network layers
  › new options to control visibility, Selection and Styles all from one place

› New bookmark functionality to store *zoom extents* and *selection*
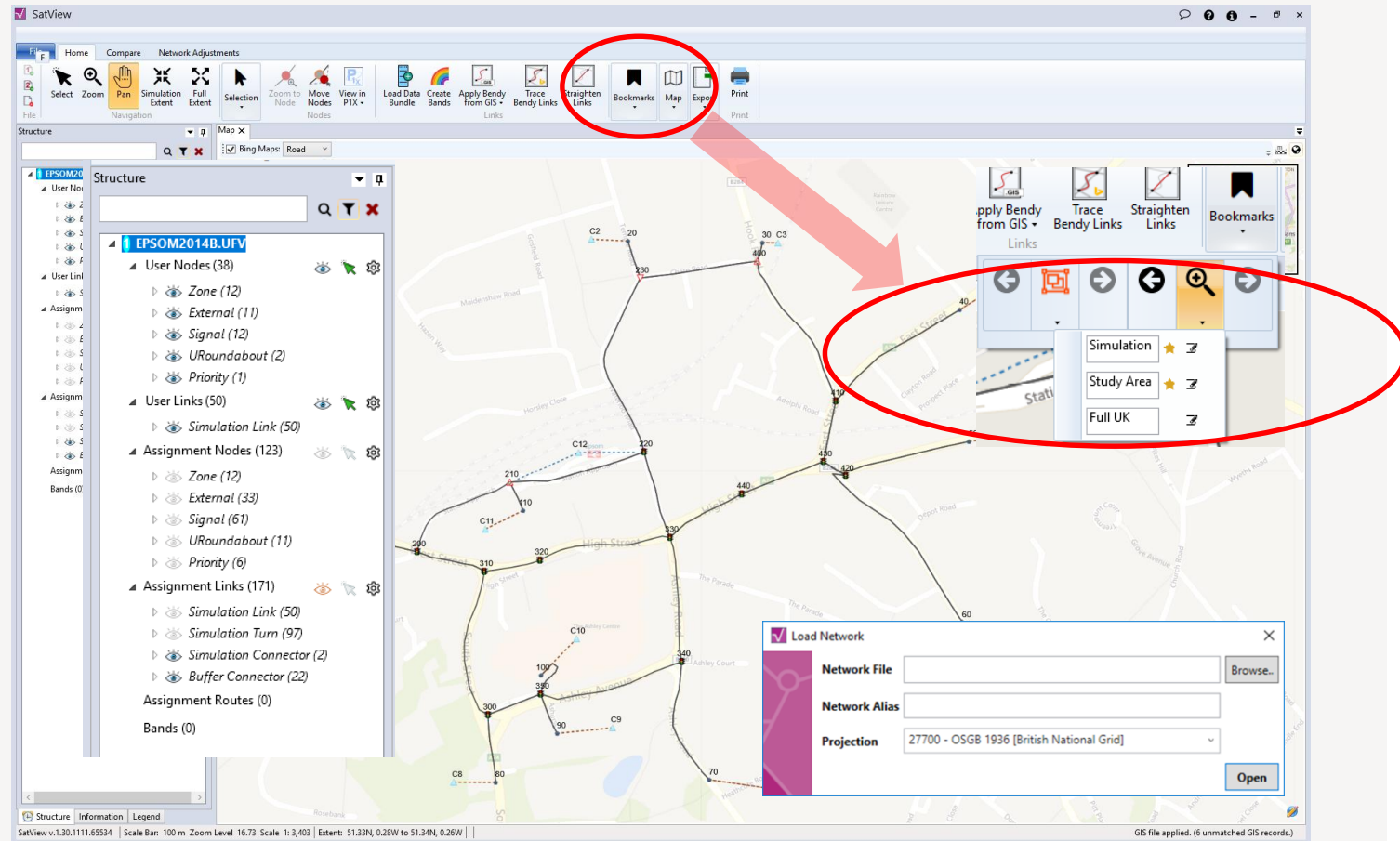
SATVIEW

SatView v1.30 (iii) – Updated Style Manager

› New Style Manager

› to change Node/Link Style

› to control display settings of Label

› to manage display of Legend
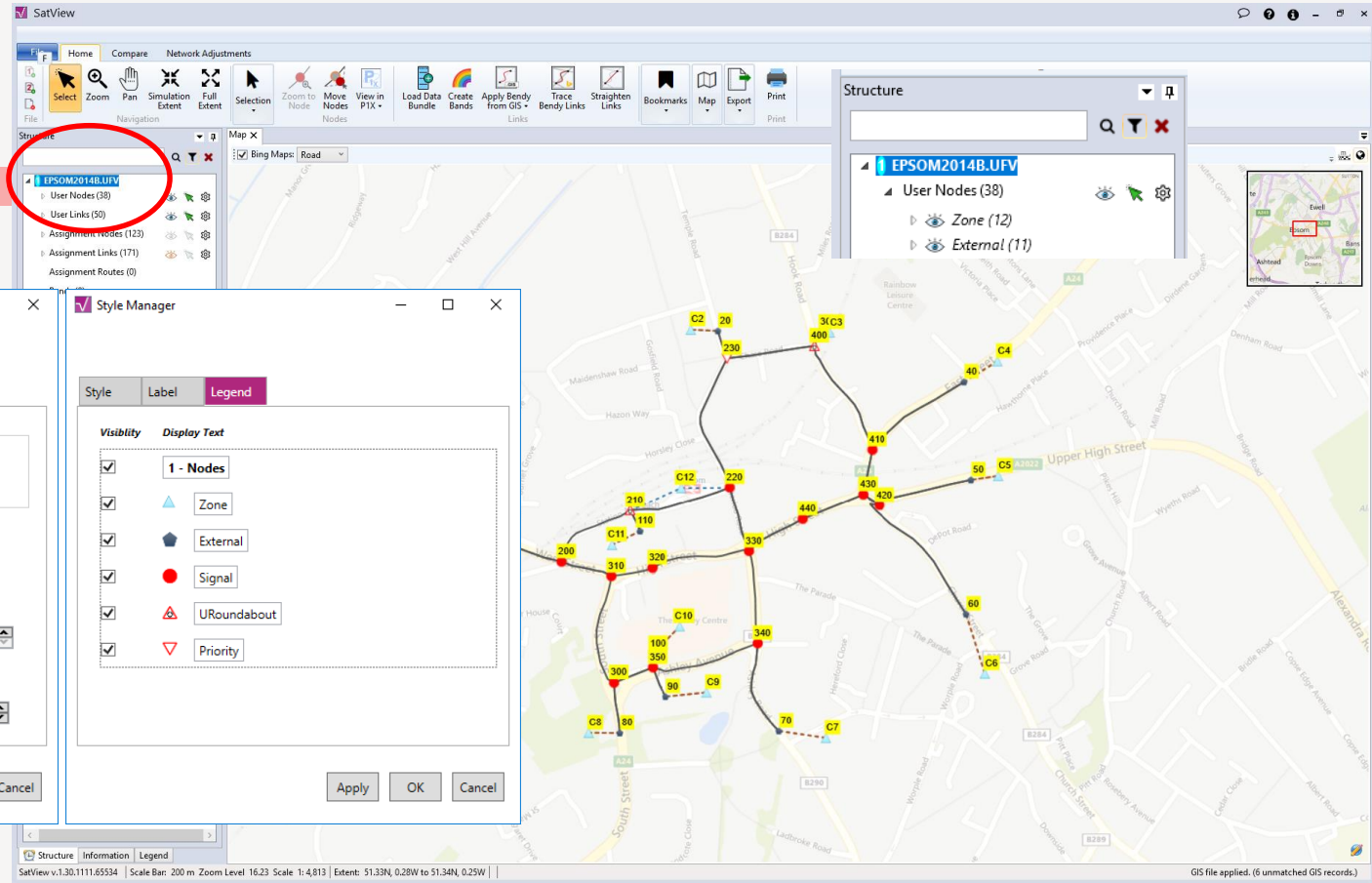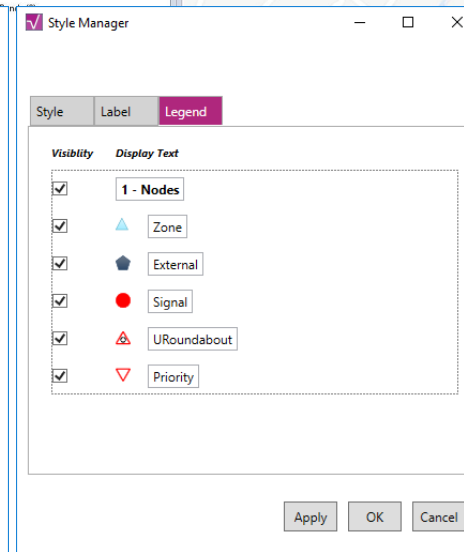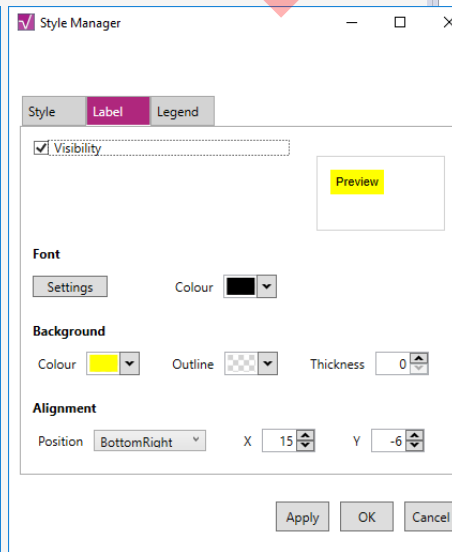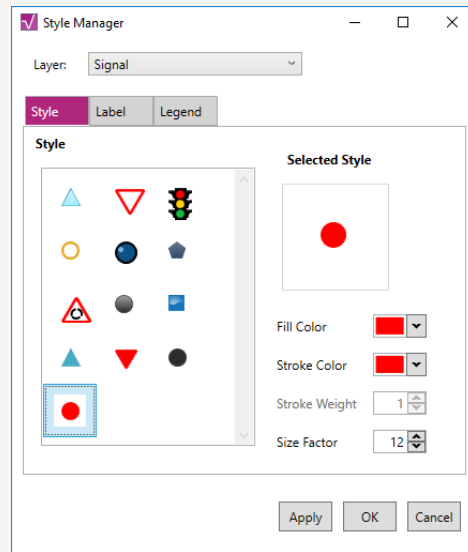
SatView v1.30 (iv) – Revised Bands

› Improved Bands
  › Ability to create multiple bands
  › Edit created bands
  › Delete created bands

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SatView v1.30 (v) – New Print Options

New Print Options

› to choose what objects to be printed

› add text labels to annotate

› save as image or pdf

› send to print directly

› save/open created layout as template

Various Other improvements & bug fixes

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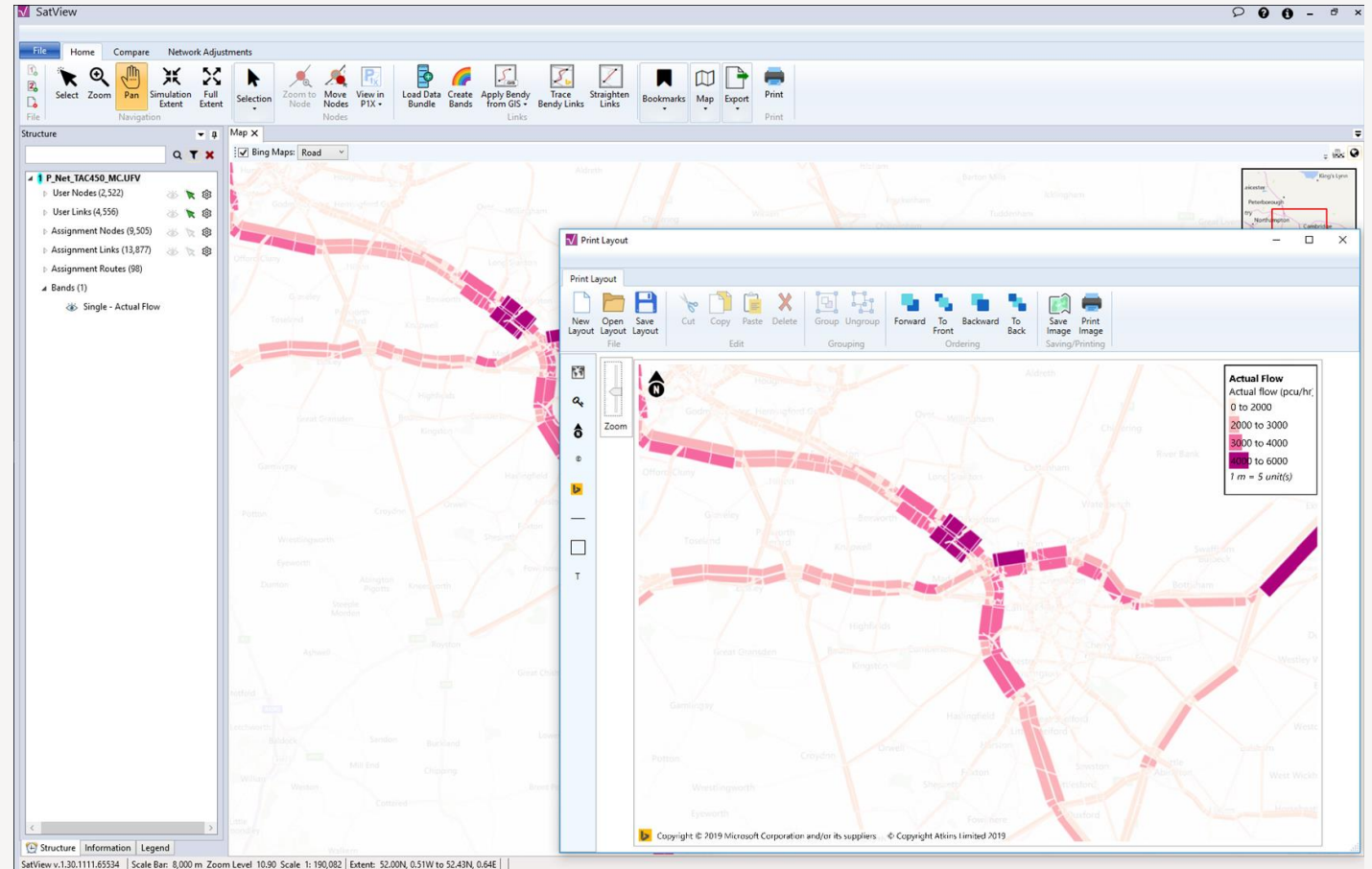
Update on SATGPU – Current Status

Previously developed in SATURN 11.3

› Available under SATURNnext: testing & evaluation only

› SATGPU 11.3.26W = 11.3.12W + GPU algorithm

> › Stable, robust & optimized for Nvidia Pascal + Volta GPUs

› Performance benchmarking: TfL P3 HAMs, Highways England RTM & Trans-Pennine South VDM

› Development paused – current focus on Area Charging

Next Steps

› Development restarts in the new year:

> › Further performance optimisations:
>
> > › *Memory management + Turing GPUs + faster simulation*
>
> › Extend to Area Charging algorithms

› Revisit proposed licensing model

> › *Will be a separate add-on*

› Commercial release as part of SATURN 11.5 family

Performance on Nvidia Titan V (Volta) GPU Hardware

Total SATURN Runtime for TfL LoHAM (AM Peak)

Configuration	Time (in mins)
Multi-Core (12C/24T)	140
1 x Titan V GPU	33
2 x Titan V GPU	25
3 x Titan V GPU	24

■ Assignment   ■ Simulation   ■ UFC Creation

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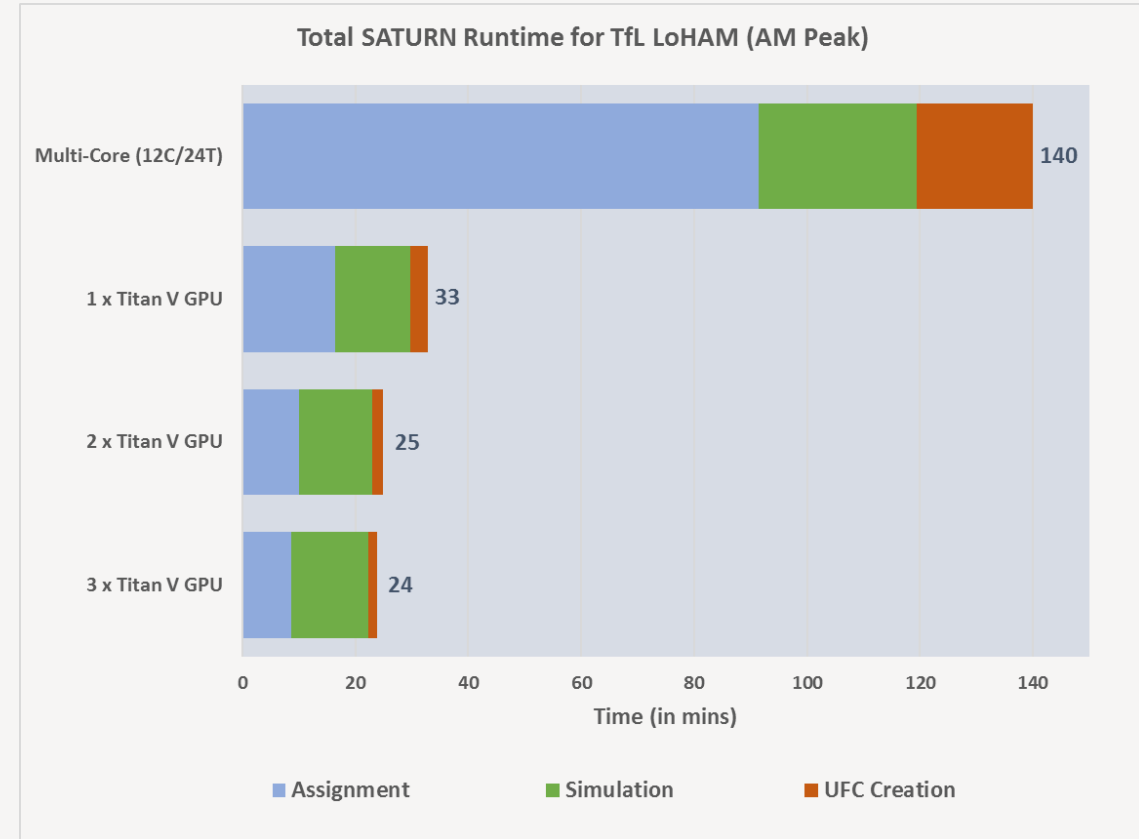
Update on SATOMX – Current Status

Compatible with OMX v0.2 Specification

What is OMX?

› Open Matrix Data Format standard using HDF5 compression standard

Benefits of OMX versus CSV

› Smaller file sizes & faster read/write

  › Testing shows: > 3x reduction in file size, >4x read-in time

› Accommodates stacked matrices

› Increased data precision (i.e. not fixed dp!)

Growing pains …

› Incompatible formats between software packages

  › SATOMX 11.3.12W – 11.5 Beta ⇔ CUBE 6.4.2 only

  › Already in use as part of TfL's MoTION Demand Model system

Next Steps

› For final SATURN 11.5 - update to OMX v0.2 specification

› Embed within TUBA and WITA for May 2020 releases (as TUBA Matrix Format 4)

PTV VISUM — the mind of movement
Release: 14+

Cube
Release: 6.4.4+

Matrix / Data

For full 11.5 release

Emme
Release: 4.6.7+

DfT Software
WITA v2.0:
- As part of the full release
TUBA
- As part of May 2020 update

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SAT OMX

Technical Support

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Windows 10, P1X & disappearing cross-hairs

Continues as 'Work-in-Progress'

Symptoms:

› Missing P1X cross-hairs on network display

Characteristics:

› Using P1X on Windows 10 Build 1709 or later

› Principally certain laptop users using 2nd (external) monitor

Tech Details:

› Caused by new Win10 feature for dynamic display scaling

› Fix is not straightforward (for 11.5 Release)

Workaround – see Appendix N.1

› Boot / sign-in with laptop lid / display closed with external monitor as main display

› Ok thereafter with dual monitor usage

Ok with Windows 'Frame'

& Clearwin+ Menu Box
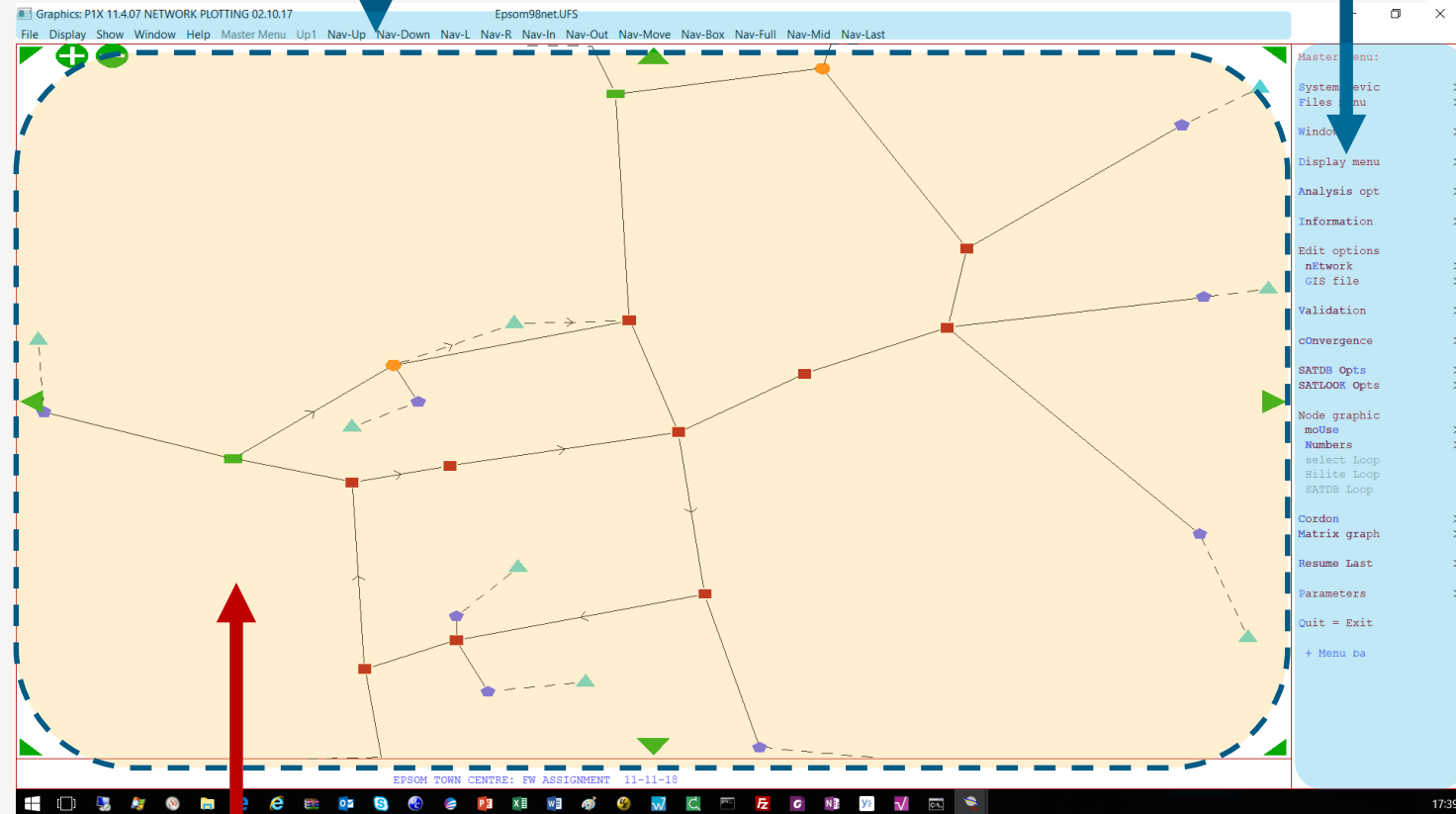
No P1X pointer cross-hair visible in Clearwin+ network window

Using Excel to edit CSV files (i) - Do NOT use

No! No! No! CSV UTF-8 (Comma delimited) (*.csv)

› It inserts an extra byte at the start of the text file to tell "modern" programs that it is encoded in UTF-8.

› Breaks all the old rules that it was up to the user to know how his text file was encoded

› Non-printing character so not readily visible

› Generates 'odd' reading-in & data processing errors (eg SATNET)

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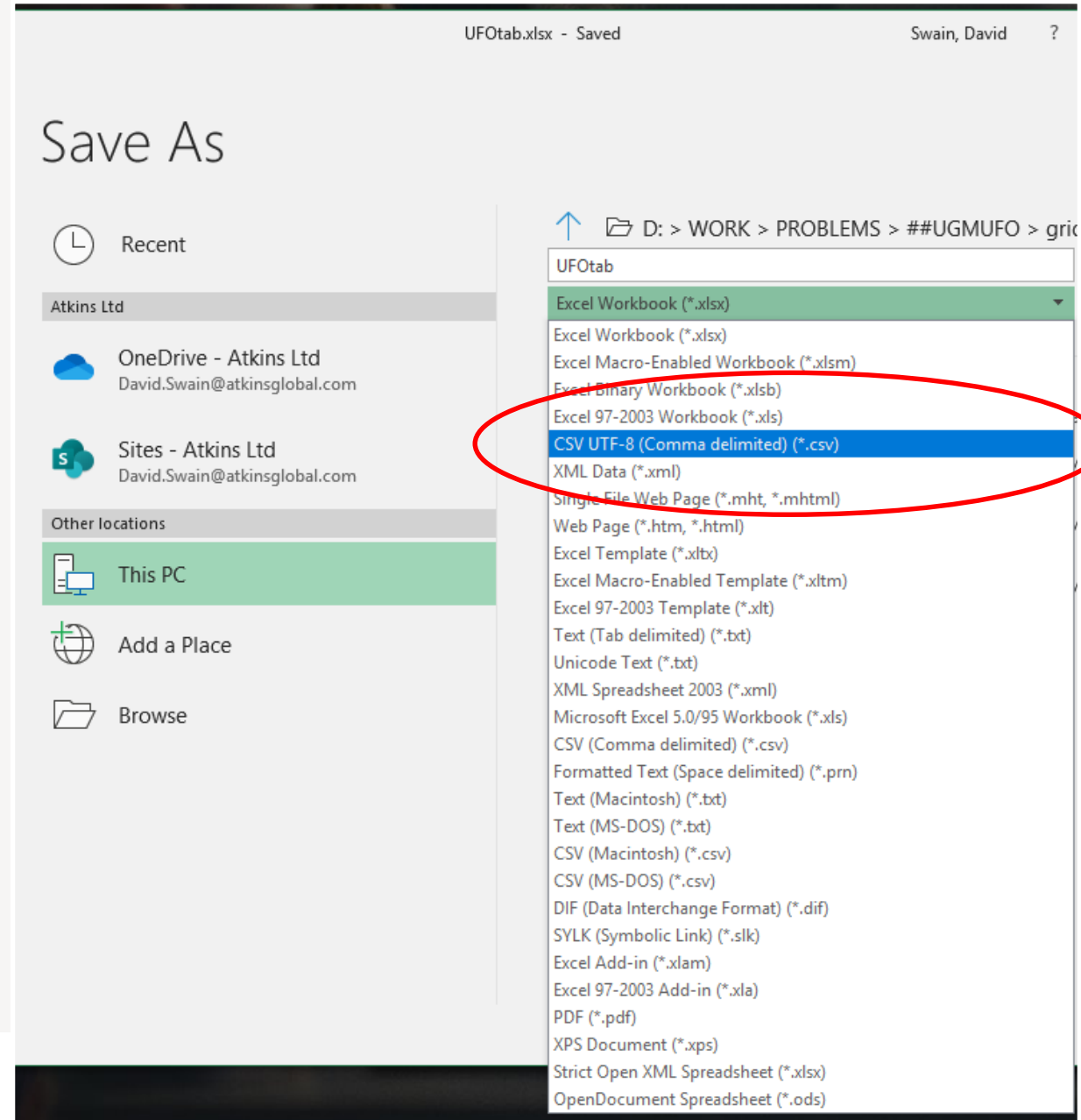
Using Excel to edit CSV files (ii) - Do use

CSV (Comma delimited) (*.csv)

› This writes a good old clean text file, just as SATURN expects, and has expected since the dawn of computing!

› Or it does at the moment – normally an ANSI (also known as ASCII) encoded file

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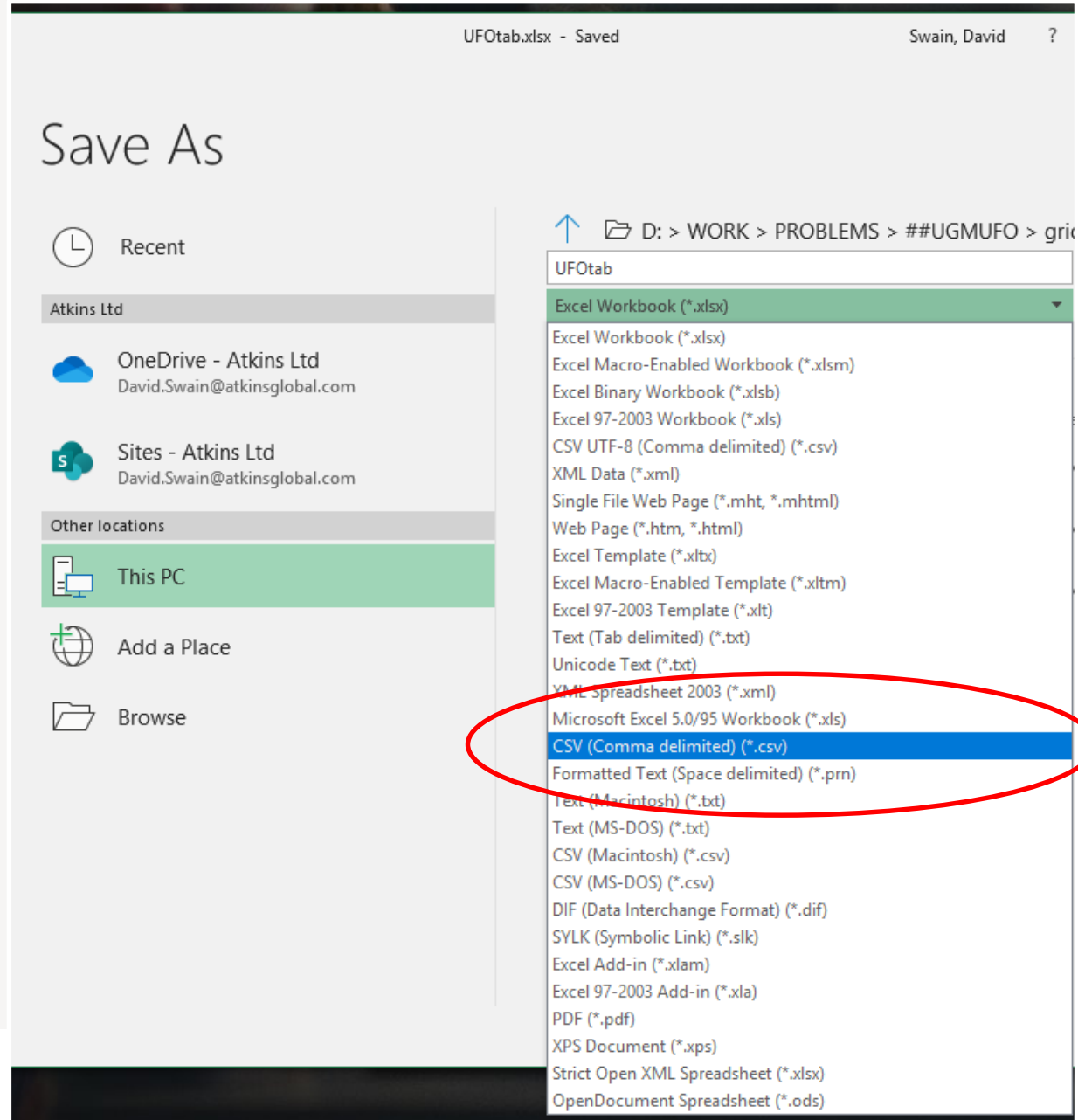
Updated Documentation (A reminder)

Appendix E – Latest SATURN Bugs in 11.3, 11.4 and 11.5

List of all known issues and if/when fixed & the release version(s)

› Published spreadsheet with column filters

Latest version on the website (support => FAQ)

Appendix F – Feedback & Technical Support

Helping us to help you ….

› Quickly raising a support query

› Sending all the files we need in advance !!!

Appendix N – Guidance Notes

Expanding series:

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

› *N.2 – SAVEIT Approximation*

› *N.3 – UFO Files & Pre-11.4.07H Release*

› *N.4 – Disappearing P1X Missing mouse crosshairs in Windows 10*

Extract from Appendix E – Latest

Users should regularly check the website
- Access via SATWIN

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Training & Administration

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Training Courses & Materials

Introduction to SATURN Courses

3-day course for new and beginner users

Forthcoming Dates:

› 3rd – 5th March 2020
› November 2020
› June 2021

Further details on the SATURN Website: www.saturnsoftware.co.uk -> Events

Webinars

Previously published:

› Area Charging: Introduction to Area Charging (Dec'18)
› SatView: Full set of "How to …" series created in Apr'17
› SatCoder: Basic introduction

Requests?
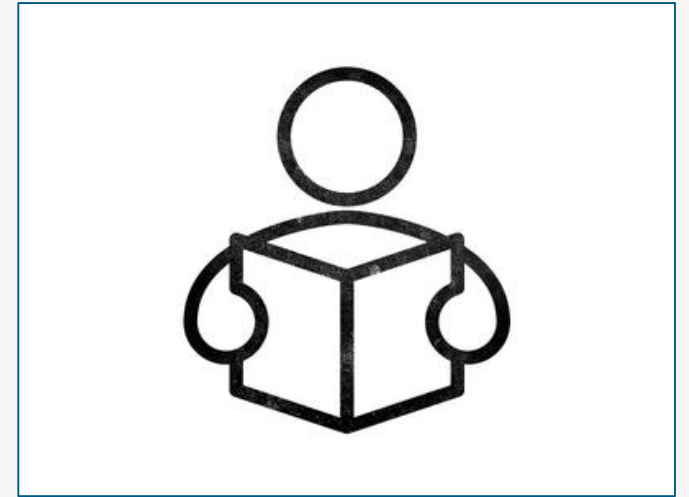
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Administrative Details

Housekeeping

E-mails:

› Support e-mail: saturnsoftware@atkinsglobal.com

› Outbound Mailing List only: saturnmail@atkinsglobal.com

› SATURNnext programme: saturnnext@atkinsglobal.com

SATURN support telephone number +44(0)1372-756755

FTP site available to exchange model files for support queries

Key Dates

Christmas Break: Close end of **Thu 19th Dec**, Re-opening **Mon 6th Jan**

November 2019:   User Group Meetings - Epsom (Fri 15th Nov) & Leeds (Thu 28th Nov)

December 2019:   SATURN 11.5 **Beta** Release & SatView v1.30

February 2020:   Introduction to SATURN Course

Spring 2020:   SATURN 11.5 Release

SATGPU 11.5 Add-on

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Morning Session

Programme
- Morning Session

10:30 - SATURN News

11:00 - SATURN Area Charging
› *Atkins*

Experiences with TfL HAM P4
› *Atkins / TfL*

SATURN 11.5
› *Dr Dirck Van Vliet*

12.30 - Lunch

- Afternoon Session

13:30 - SATURN Analysis 102
› Part 1 – Matrix Estimation
› Part 2 – Skimming

15.00 - Tea / Coffee

15:20 - SATURN Analysis 102 *continued*
› Part 3 – UFC & UFO files explained

15:30 - DfT Software Update
› TUBA, TEMPro, WITA & DIADEM

15.45 - User Requests

16.00 - Close

Supplementary Information

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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

›

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Updates to SATOMX (ii) – Performance Comparison

Example using TfL ELHAM

› Stats: 2,358 zones, 4 Time Periods, 5 User Classes, 2 Forecast Years, 2 Scenarios

Measure		TUBA Format 2	CSV (as TUBA Matrix Format 1)	OMX (as future TUBA Matrix Format 4)	UFM (SATURN)
# of Files		400	400	80	80
Time Taken (mins)	Export	59	28	6	
	Import	517	9	2	
	Total	**576**	**36**	**8**	
Time Ratio		**71.1**	**4.5**	**1.0**	
Total Size (Gb)		50.0	16.4	5.1	6.4
Size Ratio		**9.9**	**3.2**	**1.0**	

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SATGPU 11.3: Performance Benchmarking (i) – TfL HAMs

Total Runtimes (<u>minutes</u>) for P3 2021 Ref Case <u>AM Peak Hour</u> assignment (SAVEIT=T)

Platform	Hardware	CLoHAM	NLoHAM	ELHAM	SLoHAM	WeLoHAM	LoHAM
HPZ840 (Win10, 128Gb RAM, 1 x Xeon E5-2687W v4 3.0GHz)	MC (12C/24T)	51	77	*112*	93	85	140
	1 x 1080Ti GPU (£650)	28	17	18	22	15	51
	Speed-up Factor	*1.8x*	*2.9x*	*3.9x*	*2.8x*	*8.9x*	*2.8x*
	1 x Titan Xp GPU (£1,000)	25	23	25	30	21	45
	Speed-up Factor	*2.0x*	*3.3x*	*4.5x*	*3.1x*	*4.0x*	*3.1x*
	1 x Titan V GPU (£1,850)	19 (2.7x)	17 (4.6x)	18 (6.3x)	22 (4.2x)	15 (5.6x)	33 (4.3x)
	2 x Titan V GPU (£3,700)	15 (3.5x)	12 (6.4x)	12 (9.1x)	17 (5.5x)	11 (7.7x)	25 (5.6x)
	3 x Titan V GPU (£5,550)	14 (3.6x)	11 (7.0x)	11 (10.2x)	16 (5.8x)	10 (8.9x)	24 (5.9x)
	Speed-up Factor	**2.7x -> 3.6x**	**4.6x -> 7.0x**	**6.3x -> 10.2x**	**4.2x -> 5.8x**	**5.6x -> 8.9x**	**4.3x -> 5.9x**

Note: (i) Performance will vary between models and hardware; (ii) All times for equivalent # of MC loops – varies +/- between algorithms; (ii) All prices exclude VAT

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SATGPU 11.3: Performance Benchmarking (ii) – Highway England RTMs

Total Runtimes (<u>minutes</u>) for 2031 Ref Case <u>AM Average Hour</u> assignments (SAVEIT=T)

Platform	Hardware	TPS	SERTM	NOR	MRTM	SWRTM
HPZ840 (Win10, 128Gb RAM, 1 x Xeon E5-2687W v4 3.0GHz)	MC (12C/24T)	48	22	7	7	7
	1 x 1080Ti GPU (£650)	27	13	3	5	5
	Speed-up Factor	*1.8x*	*1.7x*	*2.2x*	*1.5x*	*1.4x*
	1 x Titan Xp GPU (£1,000)	25	12	3	5	4
	Speed-up Factor	*1.9x*	*3.3x*	*2.3x*	*1.6x*	*1.5x*
	1 x Titan V GPU (£1,850)	22 *(2.2x)*	10 *(2.2x)*	3 *(2.5x)*	4 *(4.2x)*	4 *(1.9x)*
	2 x Titan V GPU (£3,700)	21 *(2.3x)*	10 *(2.3x)*	3 *(2.8x)*	4 *(5.5x)*	3 *(1.9x)*
	3 x Titan V GPU (£5,550)	21 *(2.3x)*	9 *(2.4x)*	3 *(2.8x)*	3 *(5.8x)*	3 *(2.1x)*
	Speed-up Factor	*2.2x -> 2.3x*	*2.2x -> 2.4x*	*2.5x -> 2.8x*	*2.0x -> 2.2x*	*1.9x -> 2.1x*

Note: (i) Performance will vary between models and hardware; (ii) All times for equivalent # of MC loops – varies +/- between algorithms; (ii) All prices exclude VAT

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SATGPU 11.3: Performance Benchmarking (iii) – Microsoft Azure Cloud Platform

Total Runtimes (minutes) for P3 2021 Ref Case <u>AM Peak Hour</u> assignments

(i) Similar performance between physical PC and MS Azure Virtual Machines with / without GPU; (ii) Changes arise from differences in hardware

Platform	Hardware	CLoHAM	NLoHAM	ELHAM	SLoHAM	WeLoHAM	LoHAM
HPZ840 (Win10, 128Gb RAM, 1 x Xeon E5-2687W v4 3.0GHz)	MC (12C/24T)	51	77	*112*	93	85	140
	1 x Titan V GPU	19	17	18	22	15	33
	2 x Titan V GPU	15	12	12	17	11	25
	3 x Titan V GPU	14	11	11	16	10	24
	Speed-up Factor (3GPUs)	*3.6x*	*7.0x*	*10.2x*	*5.8x*	*8.9x*	*5.9x*
MS Azure NC24S_v3 (Win10, 448Gb RAM, 2 x Xeon E5-2690W v4 2.6GHz)	MC (24C/48T)	45	68	100	80	76	124
	4 x V100 GPU	12	9	9	15	8	22
	Speed-up Factor (4GPUs)	*3.6x*	*7.2x*	*10.8x*	*5.5x*	*9.3x*	*5.7x*

Note: (i) Performance will vary between models and hardware; (ii) All times for equivalent # of MC loops – varies +/- between algorithms

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SATGPU 11.3: Performance Benchmarking (iv) – TPS VDM (SATURN + DIADEM)

Identify updated processes & software to reduce runtimes

› Focus on TPS RTM 2031 Ref Case Forecast

› Performance will vary between scenarios & hardware

Reviewed individual modules

1) Optimised SATURN Assignment Parameters
2) # of DIADEM Loops for *pragmatic* convergence
3) UFO-based skimming
4) OMX Binary Data File Exchange
5) DIADEM Optimisation
6) SATGPU

Delivery:

› Combination of revised settings, new products & software development

› **Estimated runtimes reduce from 38hrs to ~10-15hrs**

Group	Process	Time (hrs)	%Time		Time (hrs)	
					All 6 Mods	Mods 1,3,4,6
SATURN	Assignment	**21.8**	**57%** ① ⑥		2.9	**4.0** ① ⑥
	Skim Time	3.0	8% ③		0.9	1.3 ③
Process	Reading Skims	**6.1**	**16%** ④		1.0	**1.4** ④
	Reading Demand	0.4	1%	②	0.1	0.1
	Writing Demand	0.2	1%		0.0	0.1
DIADEM	VDM Loop	**5.7**	**15%** ⑤		3.0	5.2
Process	Other Background	1.0	3%		0.2	0.3
Total		**38.2 hrs**	**100%**		**8.2 hrs**	**14.5 hrs**
(11 VDM Loops)					8 Loops	11 Loops

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