SATURN

2024 USER GROUP MEETING

UNIVERSITY OF LEEDS

FVVB Ltd

AtkinsRéalis

Introduction

Ian Wright Memorial Prize

- Best Performance in Transport Modelling – ‘Post Grad’ Course

- Joint Sponsorship of the Ian Wright Memorial Prize at ITS Leeds

2023/24 WINNER

YUXUAN CHENG

The SATURN Core Team

CRAIG SHIPLEY
Director

RAJESH JAYAPALAN
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Technical Lead

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Technical Expert

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GEMMA MOSS
Admin Support

LUKE DAVIS
Training Lead / Technical Support

UMAR YAQUB
Technical Support

KIRSTY BARNETT
Technical Support

SATURN Training Courses and Support

Two- and Three-Day SATURN Training Courses available

Introduction to SATURN

- Intro
- Matrix Building
- Network Building
- Assignment and Convergence
- Model Outputs
- Extra tools

Course held Feb 2024

Next Course Autumn 2024

Bespoke and Advanced Courses

Available on request

SATURN Support

Got a query / issue?
E mail us at:
saturnsoftware@atkinsrealis.com

“How To” Videos

How to" Videos designed to get users up and running quickly on SatView and SatCoder features

Is there something else that would help? Let us know

SATURNnext

Access to pre-release ‘Beta’ versions of SATURN with the latest functionality

Recent Developments

David Swain

SATURN 11.7 (i)

Major themes

- **3-TAC Area Charging**
    - to extend capability
    - higher memory demands require...
- **64-bit SATURN**
    - which may also give speed improvements, and...
    - extended capability on machines with more than 32 "core"
    - and frees us up for bigger models
- **Roundabouts**
    - lane discipline
    - blocking back

Status

3-TAC Area Charging

- - *basic 3-TAC assignment coded in single core*
        - *and works (tested by TfL)*
    - *analysis steps*
        - *some require 64-bit*
- *64-bit SATURN*
    - *11.6 assignment/simulation working fine*
    - *11.6 screen input / output restructured (including key files)*
        - *largely solved*
    - *11.6 P1X graphics working*
- *Roundabouts*
    - *see Dirck's presentation*

SATURN 11.7 (ii)

Tidying

- SATDCF - area charge analysis
  - move creation of analysis data from assignment to speed up iterative steps
- SATUFF - handling of compliant trips
  - completion of more complex handling left over from 11.6
- UFM files
  - efficient handling of "empty" level/block combinations (generated in TAC processing).
  - means that some UFM files will not be readable by older programs
- and others like...
  - extending error/warning code
    - so new ones not all grouped together in catch all *99 codes

Other

- Warm Starts
  - now using UFF files
    - replacing UFO files
  - available for TAC networks

Bug fixes

- Ensuring any reported for 11.6 are correctly handled in 11.7
  - some bugs cannot be simply "fixed" within 11.6, but need more major "tidying" of code
- Minor corrections during tidying
  - mis-spellings
  - labelling inconsistencies
  - layout inconsistencies

SATURN 11.6 (i)

SATURN 11.6.03A Full Release

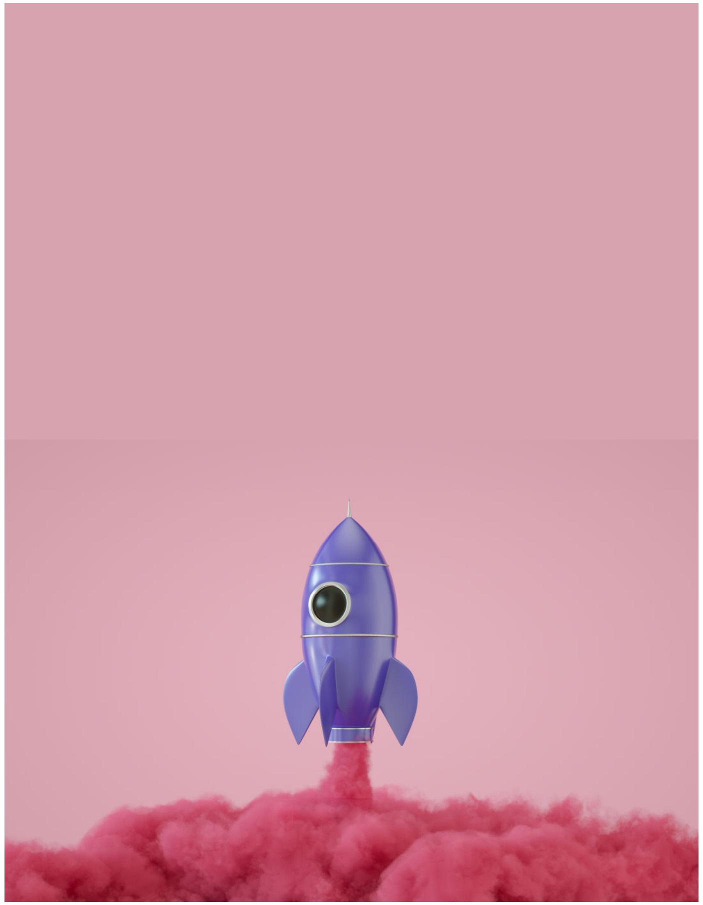
- First full release of SATURN 11.6 in June 2023
- SatWin 11.6 - fully compatible
- SatView v1.34 - fully compatible (released July 2023)

- *Known features (for implementation in 11.7)*
  - *New UFF files do not yet handle networks with Compliance Factors*
- *Known bugs*
  - *SATURN2 / SATALL2 batch files do not respond correctly to SATURNcfcf=X*
  - *SATURN2X / SATALL2X batch files (as recommended) do work correctly*
  - *Some P1X menus for more complicate TfL combinations go off screen*

SATURN 11.6.03A Service Pack 1

- Released to TfL on 08/09/2023
- Corrected for all known bugs at the time

- *NOT generally released as SATURN Software Downloader was down*
  - *New Downloader now available*



SATURN 11.6 (ii)

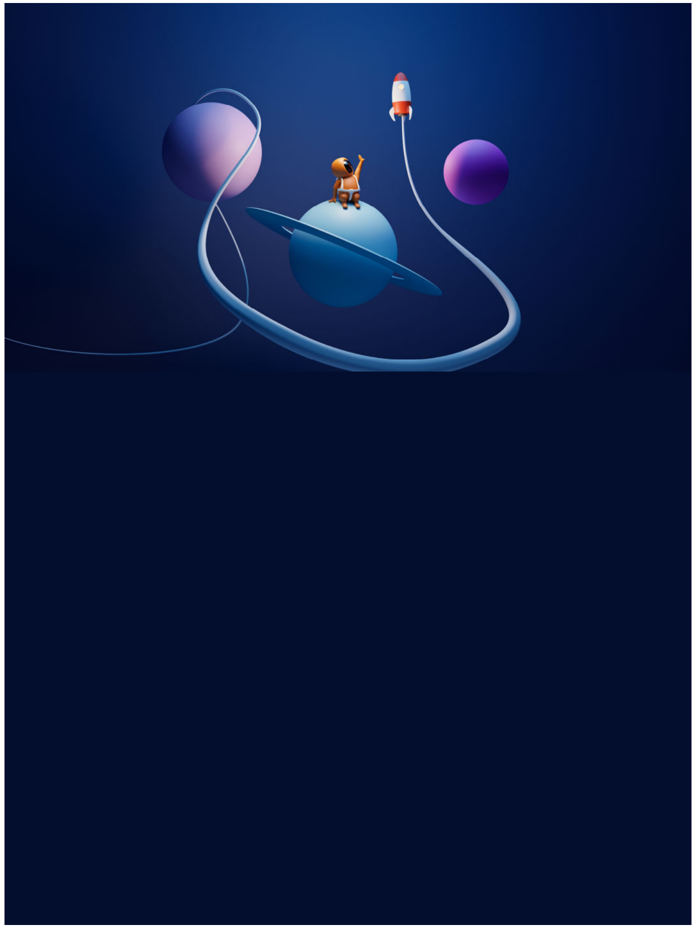
SATURN 11.6.03D/04D in progress

- 11.6 appears to be running fine
- but incorporate fixes for further bugs

SATURN 11.6.03D/04D 64-bit Beta

- Propose to release 64-bit version **for testing**
  - Some users acquiring 48 and 56 "core" machines
  - Wider testing

- *Known bugs*
  - *MoTiON run divide by zero failure*
    - *early supply/demand processes can hit more extreme conditions,*
  - *SIGOPT problem when reading in selected nodes*
  - *Area Charging assignment problem*
    - *LUCIEN assignment did not handle a network with limited connections*
  - *Matrix estimation (SATPIJA/SATME2)*
    - *PASSQ handling improved*
    - *other differences under investigation*



SATURN in the Cloud

Current situation

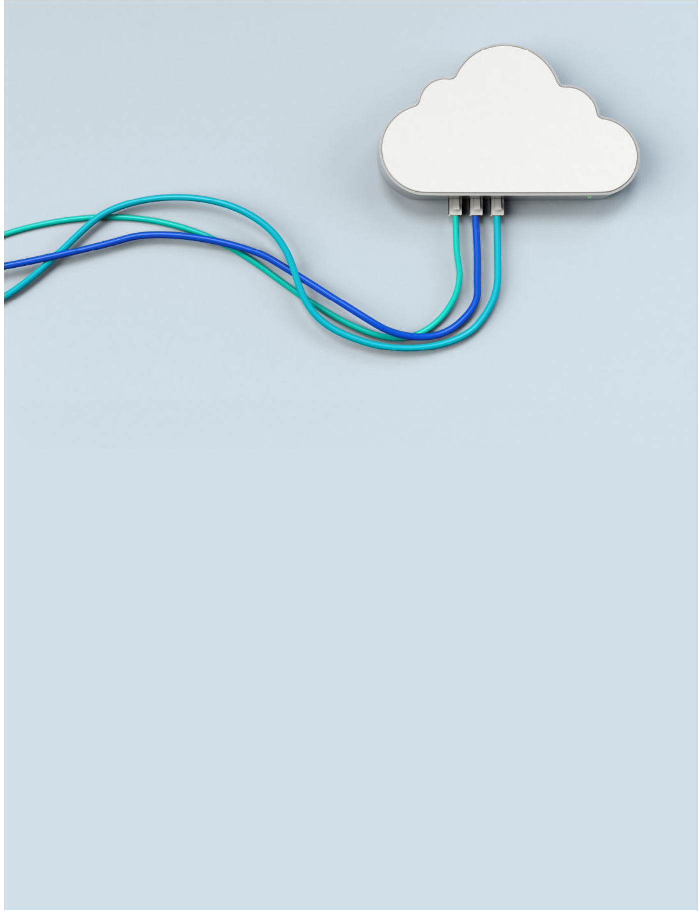
- Standard **User Agreement** does **NOT** permit use of SATURN in the Cloud
- Current **SATURN licensing mechanisms** for
  - **SATURN Core** *<u>can work</u>* in the Cloud
  - **SatView** and **SatCoder** *<u>do not</u>*
    but this is under investigation
- **Cloud service agreements** were historically found acceptable for Microsoft Azure

- *Permissive amendment for an **organisation** to use **Microsoft Azure** in experimental mode, with...*
- *... **individual users** agreeing to SATURNnext Terms and Conditions*
- *Other Cloud service providers such as Google Cloud and AWS are not currently supported*

Future

- We are reviewing our licence agreements and mechanisms
- We are considering additional licence themes:
  - cloud
  - short term
  - individual

- *Please let us know of any computing provisioning you are considering*
- *Good to have dialogue between computing specialists*



Recent Developments (Cont)
Dirck Van Vliet

Batting Order

- 11.7: Miscellaneous Additions
- Simulation Modelling of Roundabouts
- SATDCF – Discretionary Choice Flows with Area Charges
- UFM matrices with zero block rows
- Super-node Interchanges
- On-going Areas of Special Interest

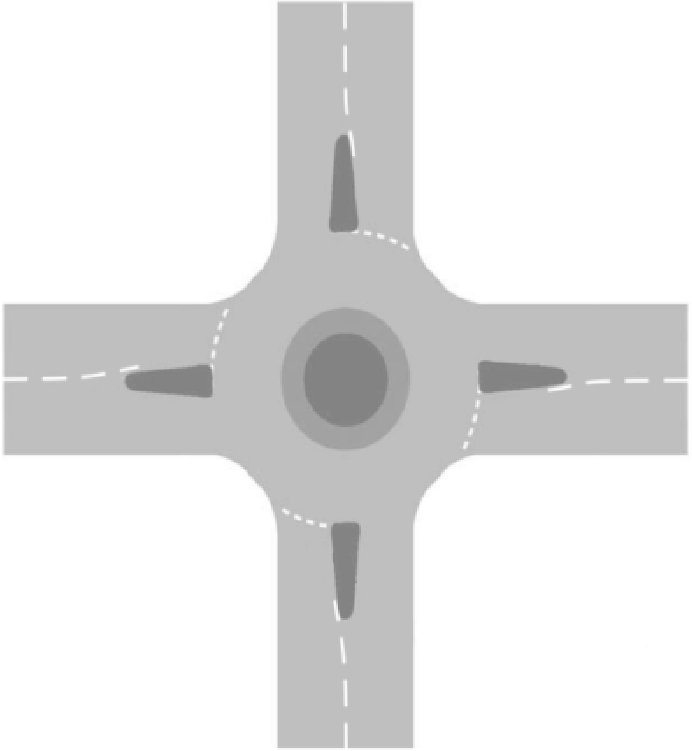
SATURN 11.7 Miscellaneous Additions

- Programming on 11.7.1A commenced in March 2023
- Current version 11.7.1.M undergoing testing
- 3 TACS available throughout
- Range of error messages increased from 500 to 1,000
- Consolidation of SATUFE and SATUFF and their applications
- USEUFF parameter may be set on control lines
- Warm Starts extended to UFF/TAC networks (CASSINI?)
- Increased SLA applications; e.g., restricted OD trips
- Improvements to skimming

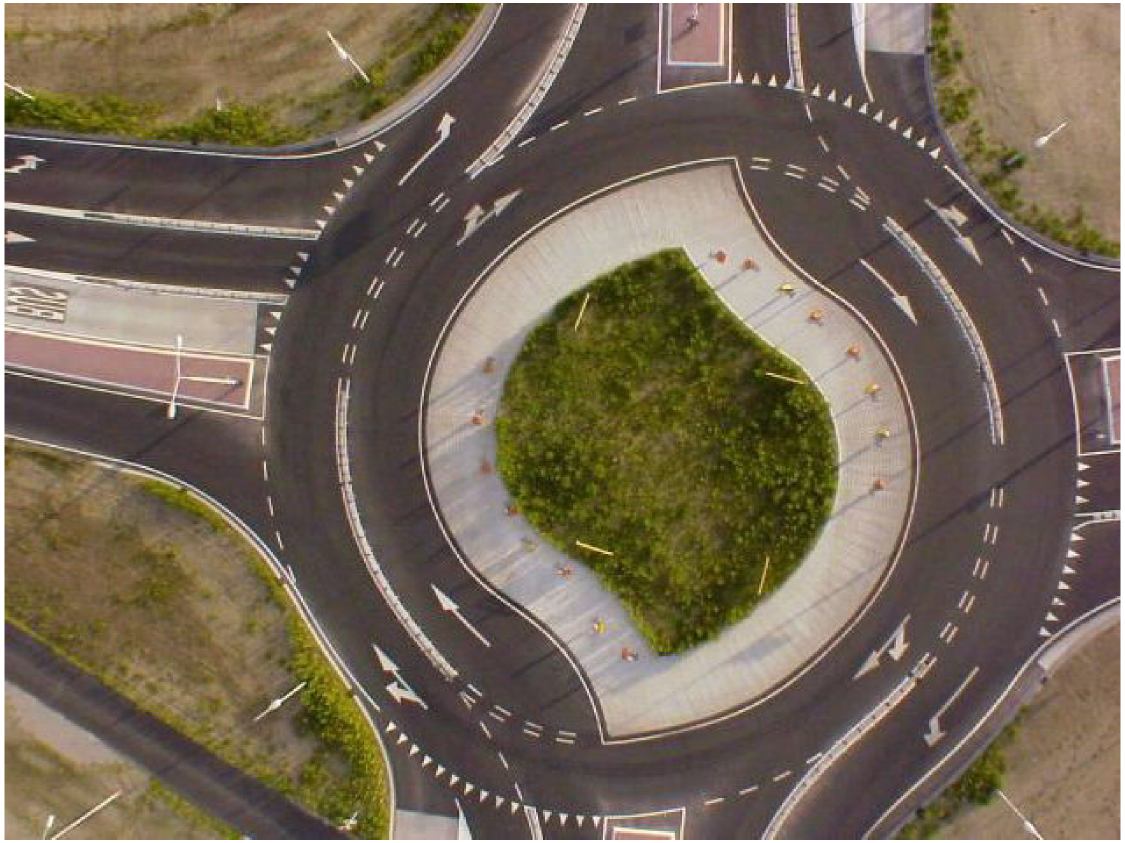
Roundabouts

Roundabouts: Traditional Modelling

- Each arm represents a single combined entry flow…
- … which gives way to the cross traffic on that arm.
- Saturation flow refers to the full arm over all lanes …
- … which are unmarked by lane with no explicit lane choice
- Each arm modelled as a 3-arm priority junction to give a delay and capacity per arm
- Equal delays for all turns from the same arm (fixed circulating delays added)
- Assignment Advantage: changes in flow for one turn impact immediately on other turns from the same arm – faster convergence



Issues 1



Issues 2

- Blocking back through roundabouts

New 11.7 Features of Roundabouts

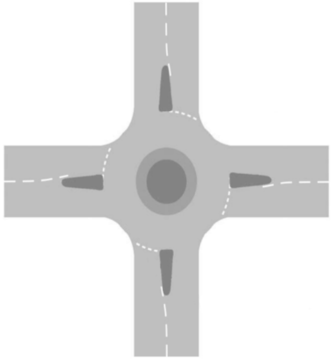
- Explicit Entry Arm Lane Markings
- Explicit saturation flows per lane by turn
- Filters for nearside turns
- Clear exit turns (e.g., exclusive nearside lane, overpass/underpass)
- Flares
- Explicit lanes and saturation flows for circulating traffic
- Blocking Back
- Central radius/diameter (for plotting purposes?)
- Added distances and circulating times set by distances
- But no signals

Three New Forms of Roundabouts

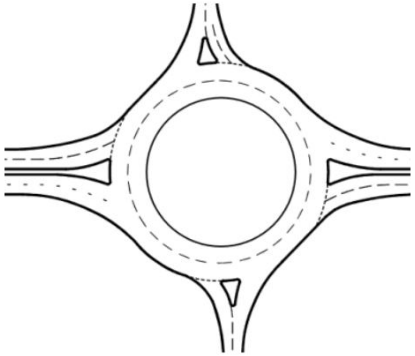
- Mini roundabouts (single lane on all arms, one circulating lane) – Type 2M
- Laned roundabouts – Type 2L or 5L
- Laned roundabouts with “spiral” or “segregated” circulating lanes – Type 2S or 5S

CAN BE RETROFITTED TO EXISTING CODING EASILY

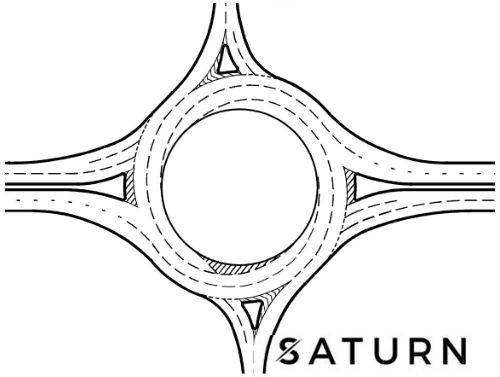
2M



2L / 5L



2S / 5S



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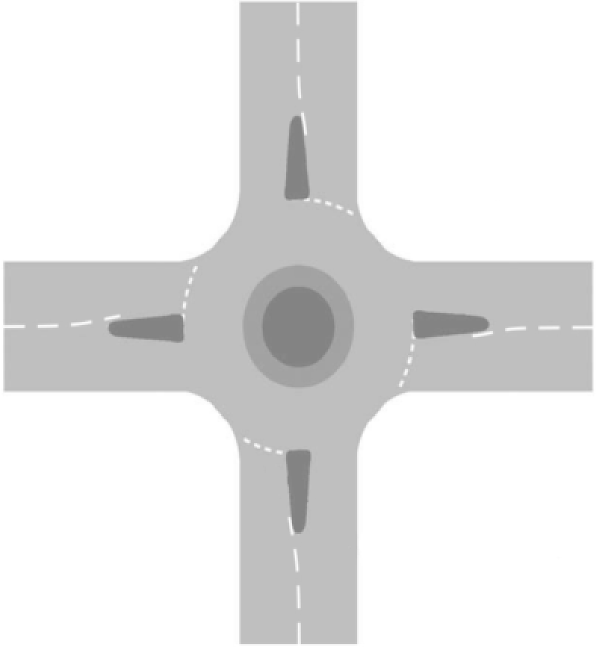
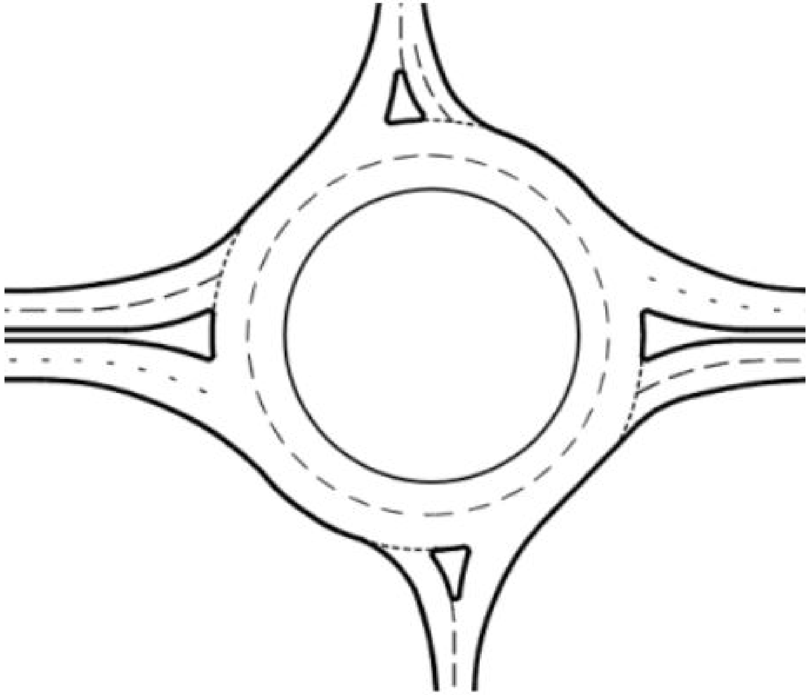
Mini Roundabouts (2M)

- Each arm has a single entry lane
- Circulating traffic has a single lane
- No U-turns
- Blocking back may reduce effective saturation flows
- Each arm is effectively a 3-arm priority junction (as per current roundabouts) …
- … but with blocking back



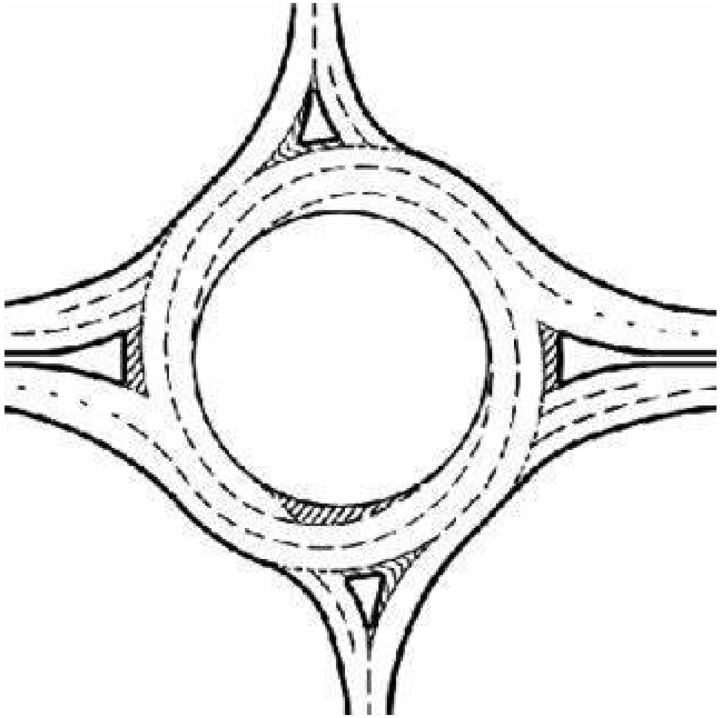
Laned Roundabouts (2L and 5L)

- Entry traffic gives way to ALL circulating traffic …
- … unless marked as F for filter in which case it gives way to traffic taking the next exit



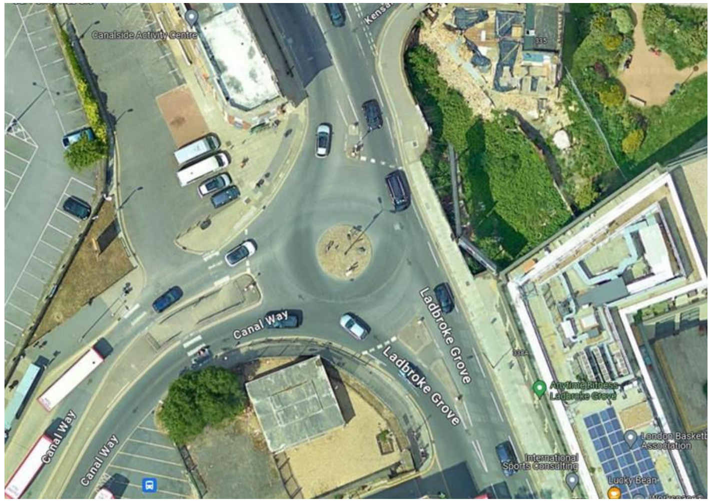
Laned Roundabouts: With spiral/segregated circulatory lanes (2S and 5S)

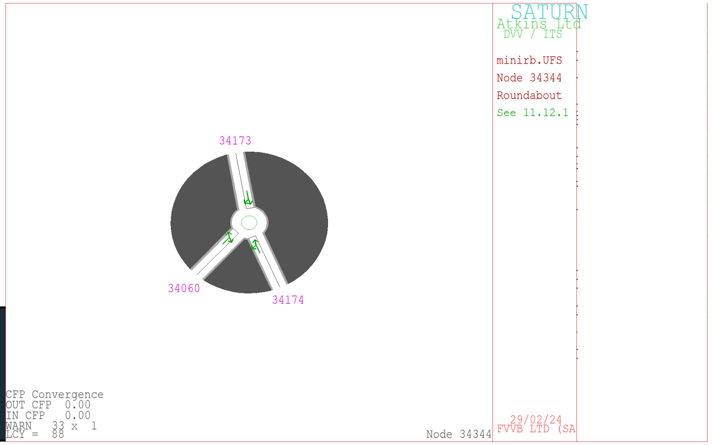
- Segregated Lanes: Entry traffic gives way only to circulating traffic in the single outside lane (exiting at the next exit arm



Blocking Back at Roundabouts: What Actually Happens?

- Imagine that the N(orth) exit arm blocks back.
- Does S-N and W-N traffic queue on their entry arms or on the roundabout? (Yellow box not)
- Is N-W traffic affected?
- If both W-N and S-N queue on entry arms who takes precedence (zipper discipline?)
- Current working premise: Apply the same blocking back factor to the saturation flows of all traffic which exits to N and all queues are on entry arms.
- Q - What do you think happens?


Canalside Activity Centre
Kensi
Canal Way
Ladbroke Grove
Ladbroke Grove
Canal Way
Canal Way
International Sports Consulting
London Basketball Association
Lucky Bean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SATURN
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 DVV / ITS

minirb.UFS
Node 34344
Roundabout
See 11.12.1

29/02/24
FVVB LTD (SA

CFP Convergence
OUT CFP   0.00
IN CFP    0.00
WARN   33 x  1
LCY =  88
                              Node 34344
```

TESTING ONGOING

Discretionary Choice Flows (TAC DCFs)

DCF Discretionary Choice (link) Flows and Trip Matrices

- DCF Flows: O-D trips whose choice of route has been influenced by discretionary charges …
- … either in the “positive” sense that they have chosen to pay a discretionary charge and/or …
- … in the “negative” sense that they have altered their route in order to avoid paying a charge, i.e., diverted.
- DCF matrices: OD trip matrices which satisfy particular DCF criteria.
- Basically an extended SLA without a link.

DCF: Levels of Choice Disaggregation

- TAC status of the origin
- TAC status of the destination
- Discretionary choice of TAC(s) paid
- Discretionary choice of TAC(s) diverted
- User Class
- Compliant/non-compliant
- Direct or “inverse” (see next)

- Full permutations, combinations and aggregations are available; e.g.
- DCF flows for all origins in TAC 1 to all destinations in TAC 2 paying TAC 3 by discretion but summed over all user classes, all choice of diversions and compliant/non-compliant.

DCFs: “Direct” and “Inverse” flows

- Direct DCF flows are those that satisfy all the criteria specified
- If the direct flows are those that pay TAC 1 then the inverse flows would be those that do **not** pay TAC 1, i.e., they divert around TAC1.
- They answer the question: What would happen if …?
- N.B. Not all DCFs have an inverse, only those with some element of choice

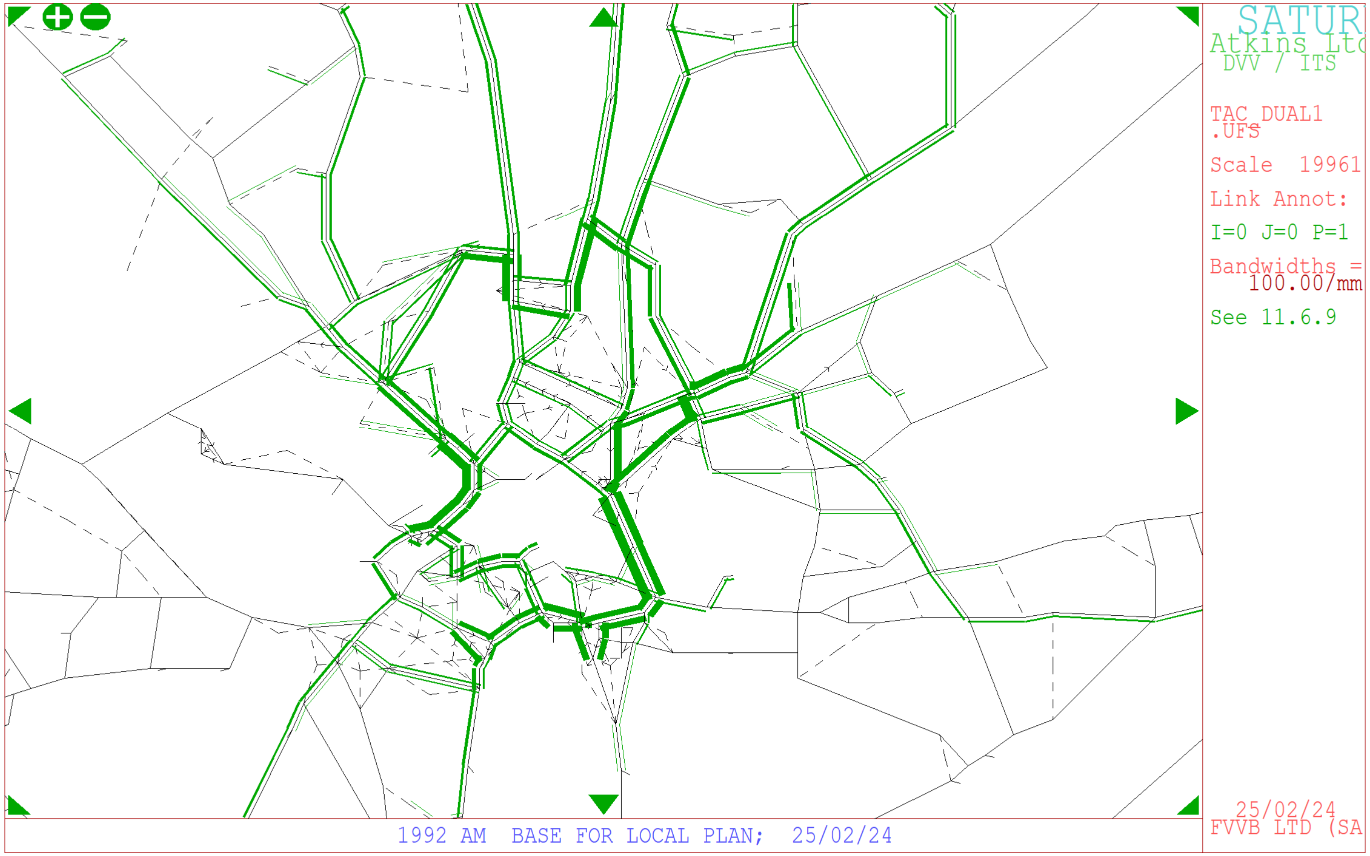
Calculation of DCF Flows and Trip Matrices

- Precise definitions of DCF flows may be set using SATRAP or …
- … the full permutations and combinations set of DCFs are set within SATDCF …
- … and stored on .UFH files and in .UFM matrices
- UFH link flows may be selected and displayed, for example, within **P1X**.

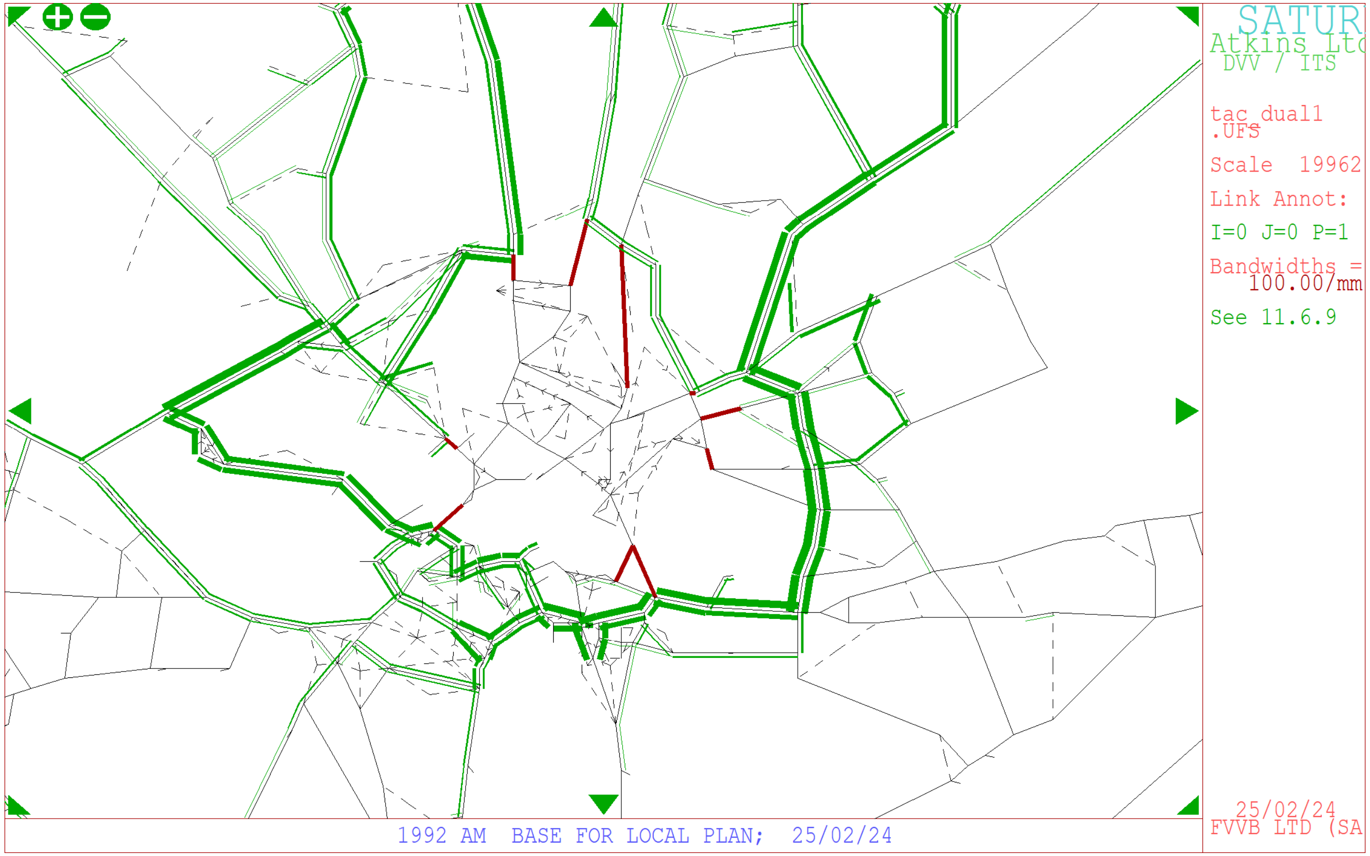
UFH File DCF Contents in P1X

DA	ORIG	DEST	PAY	DIVERT	USER	1=NON-C	SATALL
CODE	TAC	TAC	TAC	TAC	CLASS	2=COMPL	FLOWS
1003	0	0	0	1	1	1	517.46
1013	0	0	0	2	2	1	116.90
1023	0	0	0	2	3	1	350.69
1033	0	0	1	0	1	1	13.34
1043	0	0	2	0	3	2	0.01
1053	0	2	0	1	1	1	45.26
1063	1	0	0	0	1	1	5.66
1073	1	1	0	0	2	1	18.22

DCF: Outer-outer, Pay Charge 1, User Class 1



DCF Outer-outer, Pay charge 1, Inverse, UC 1 :



SATUR

Atkins Ltc

DVV / ITS

tac_dual1
.UFS

Scale 19962

Link Annot:

I=0 J=0 P=1

Bandwidths =
100.00/mm

See 11.6.9

25/02/24
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1992 AM BASE FOR LOCAL PLAN; 25/02/24

UFM (TAC) Matrices with zero block rows

UFM Matrices with zero block rows

- A new form of blocked .UFM matrices in which blocks within a row which are all zero are explicitly excluded.
- Extends current “zip” options within DA files.

Example: A 2 zone, 3 level 4 block matrix

		To											
		1	2	3	4	5	6	7	8	9	10	11	12
From	1	X	X	X	0	0	0	X	X	X	0	0	0
	2	X	X	X	0	0	0	0	0	0	0	0	0
	3	X	X	X	X	X	X	X	X	X	X	X	X
	4	0	0	0	X	X	X	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	X	X	X	X	X	X	X	X	X

Zero Block Rows: Advantages

- Less memory required to store .UFM matrices externally: 1/3 with 2 TACS, 10% with 3 TACS?
- Less RAM required within MX
- Less CPU time to read or write
- Less CPU time to do calculations

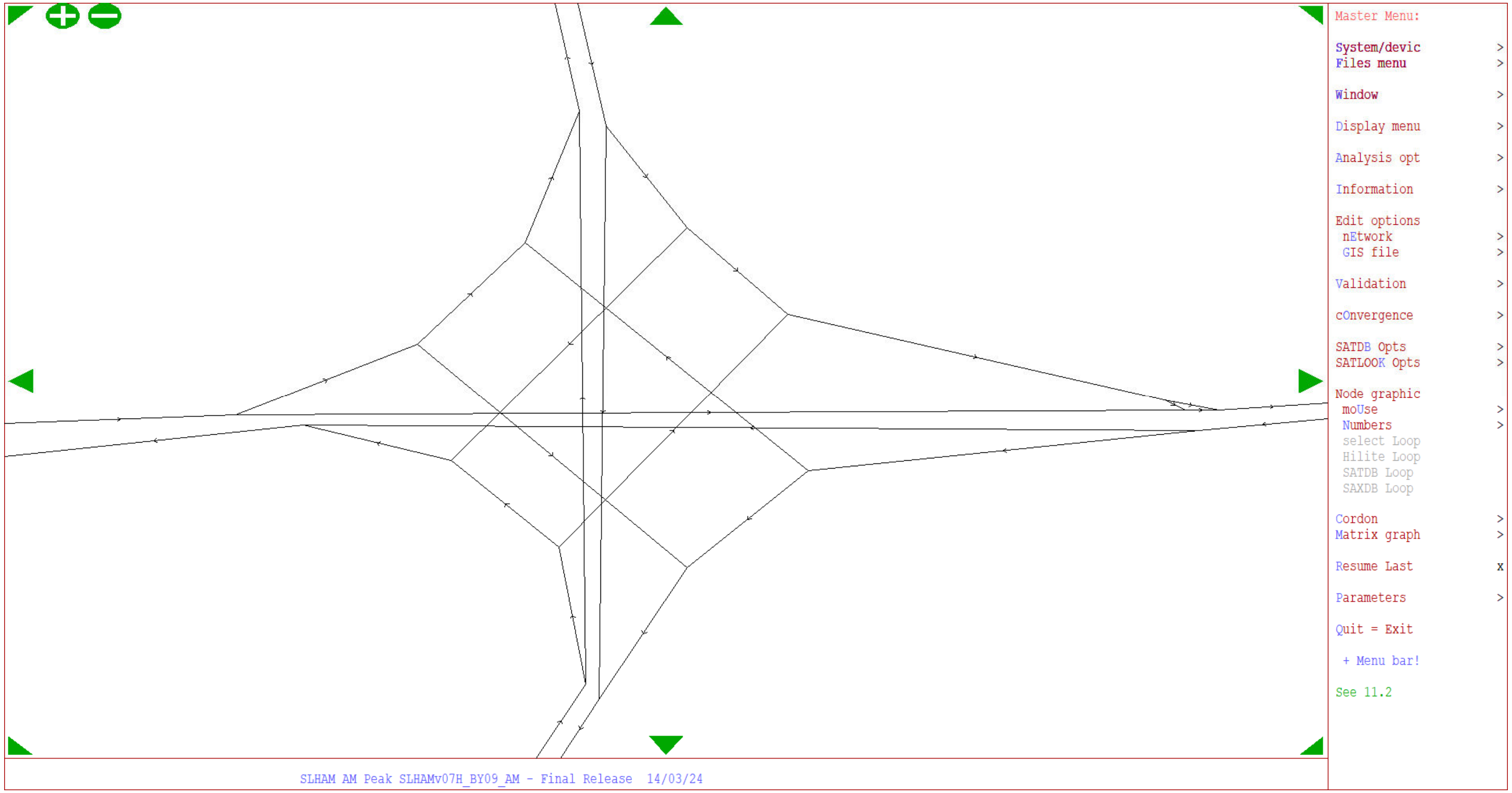
ULTIMATELY – ITS QUICKER FOR THE USER

Zero Block Matrices: TAC Applications

- SATLOOK Skimming: SKZBM = T in the preferences file
- SATDCF output .UFM matrices

Major Intersections

Super-nodes: Large Interchanges



SLHAM AM Peak SLHAMv07H_BY09_AM - Final Release 14/03/24

On-going Areas of Special Interest

On-going Areas of Interest: DVV

- Congested Values of Time
- Travel Time Reliability
- Day-to-day Variability
- Multiple TAC Choices within the assignment
- Improved CASSINI Techniques (Demand-Assignment Convergence)
- UC dependent values of GAP, ALEX, etc. etc.
- Alternative skimming options (e.g., skim routes not currently assigned)

SATUFC++/SATUFE (from 2023 UGMs)

- Reconstructing a UFC++ file using “Simplicial Decomposition” post SATALL
- With thanks to Ben Heydecker and Daniel Luckett for introduction to S.D.
- Re-assignment a la Frank-Wolfe but after each new iteration the existing weights are re-optimised and very often eliminated entirely
- Expensive early interactions are removed.

SATUFE Results

- A UFC assignment with fewer iterations and/or better convergence.
- E.g., Cambridge network has 56 vrs 203 iterations (speed-up factor of 3.6)
- UFC++ files then feed into …

… SATUFF

- Reconstructs all OD trees post SATUFE
- Stores a full tree for iteration 1 but then stores differences in trees per iteration.
- Obviates the need to rebuild trees for analysis (e.g., SLA) but does same job
- Creates large but not ginormous .UFF files

Improved Analysis CPU Times: 11.6

- Reductions due to:
- (a) Compact UFC++ files: 5 to 10 X
- (b) UFF trees: 10 X maybe
- (c) Multi-core: As before

- End result: UFF SLAs etc. run ~100 times faster than UFC

thank you

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