SATURN User Group Meeting: Leeds March 23 2023

Presentation by Dirck Van Vliet

BATTING ORDER

- An Anniversary video: 1 November 2021
- Major new 11.6 Improvements
- Miscellaneous 11.6 changes
- New 11.7 Additions
- DVV Ideas & Objectives

Ian Wright: 27/3/71 - 29/9/23

Tim Wright (ex Mott Mac)
Currently QTP Christchurch NZ
Te Araroa Record Holder

1 November 2021 – An Important Anniversary!

Tap to open video

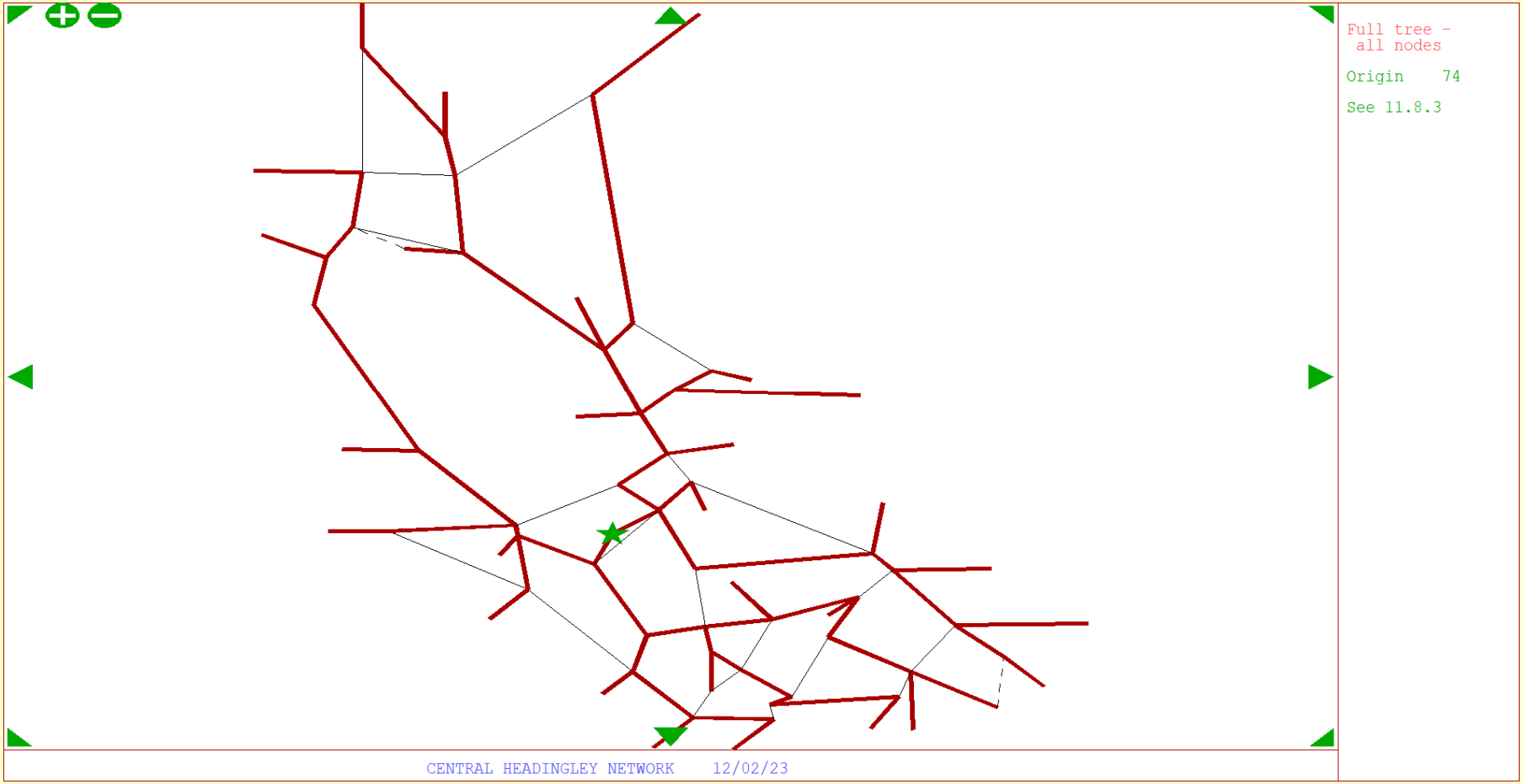
SATURN 11.6: Major Improvements

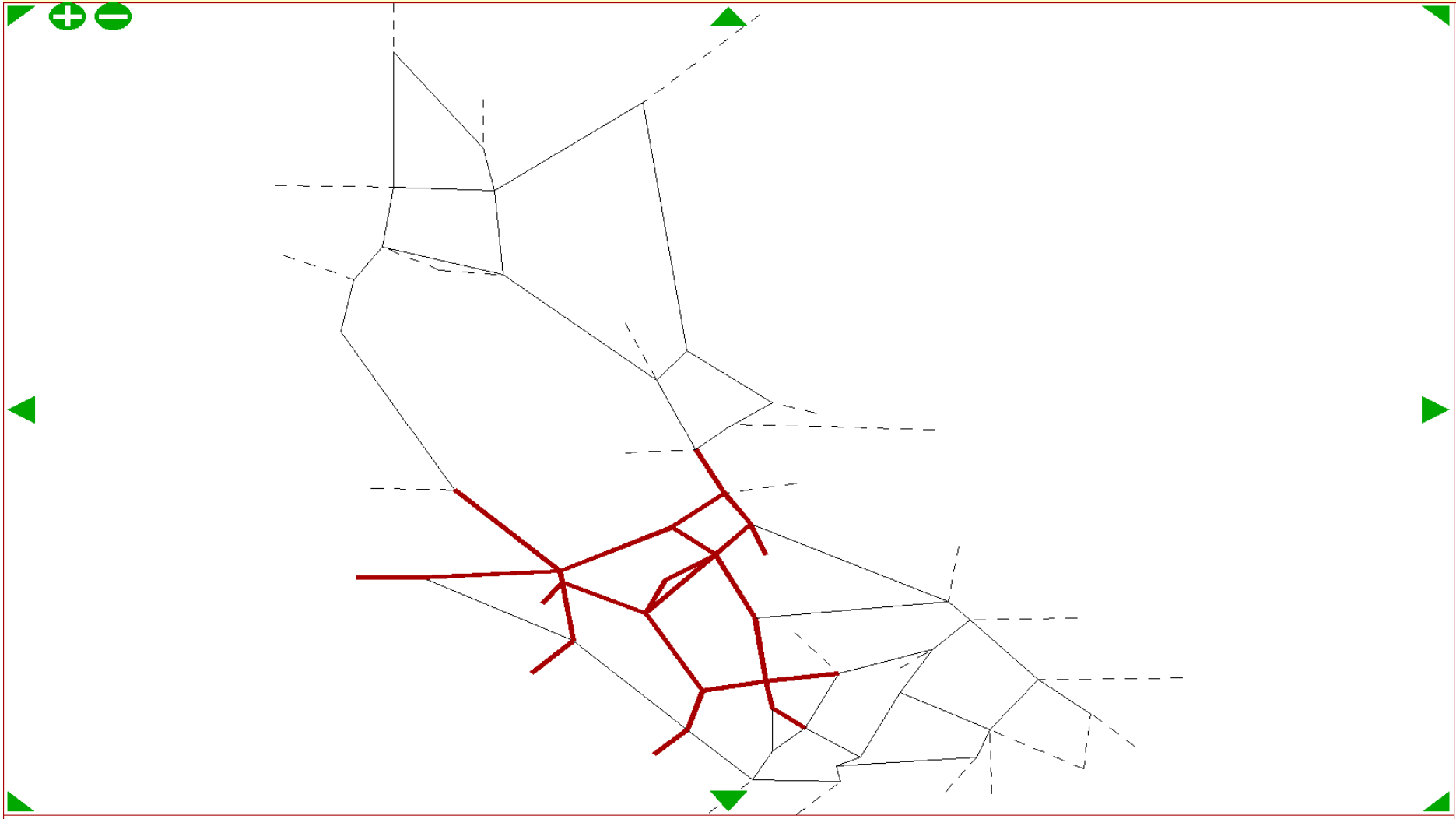
- Tree Building: CELESTE and LUCIEN
- SATUFE (AKA SATUFC++): Compact re-assignment post SATALL
- SATUFF: Incremental trees for analysis

Tree Building Algorithms

- Moore: very small networks
- D'Esopo: medium sized networks
- Dijkstra: large networks (> 1,000 nodes)
- Trade-offs between errors in processing nodes and organising the loose-end table

Full Headingley Tree





SATURN
Atkins Ltd
DVV / ITS

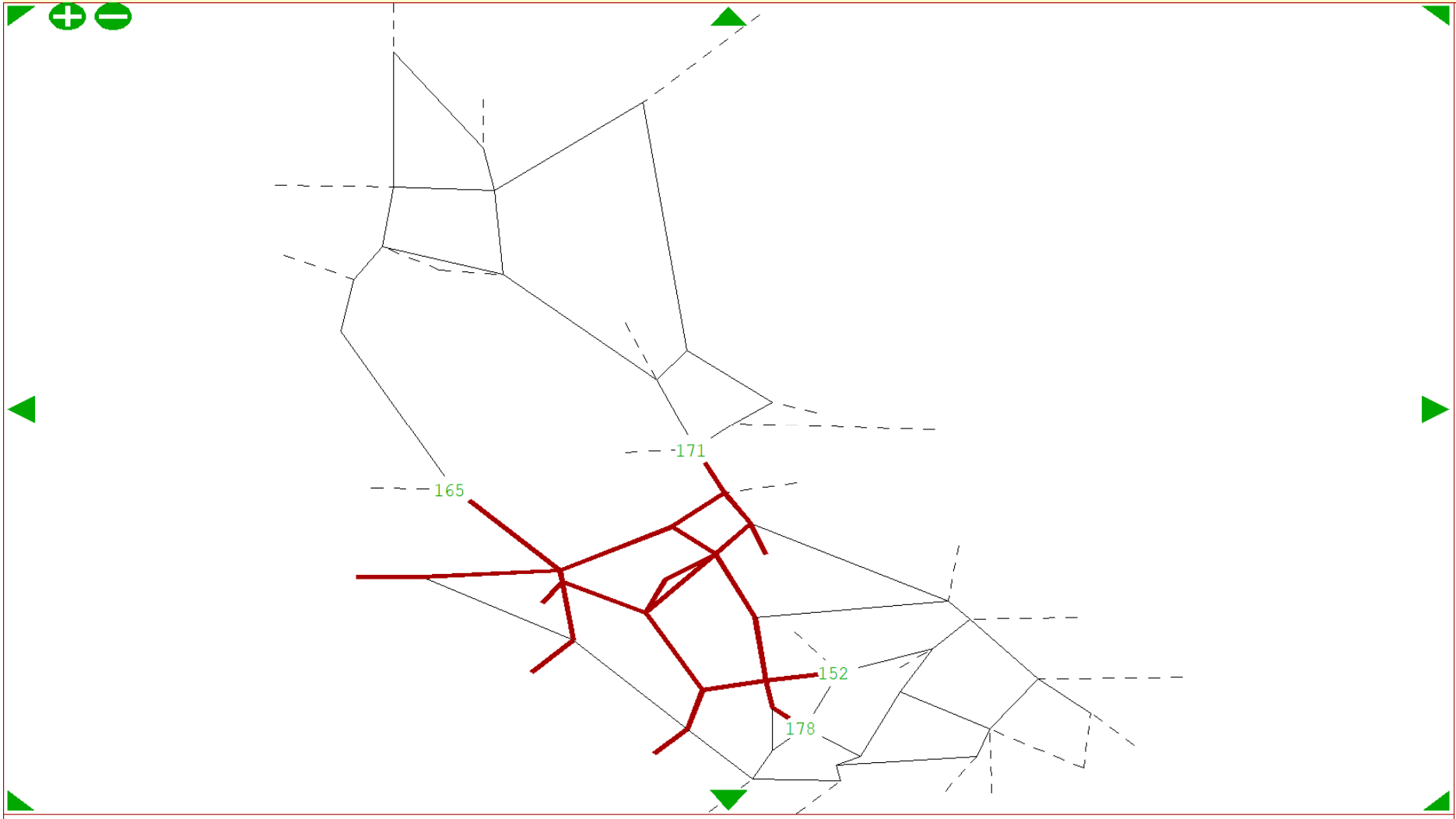
HEADE.UFS

Scale 20875

See 11.6.9

CENTRAL HEADINGLEY NETWORK 20/03/23

20/03/23
FVVB LTD (SA



CENTRAL HEADINGLEY NETWORK 20/03/23

Node Display Menu:

Display Mode >
numerical

Choice of
Node data: >
Currently:
BKT-N
Housekeeping >

Node Shapes ◉
are excluded

Line Width ?
= 0.00 mm.

Colours used ◉
by node type

Magnify by: ?
1.00

Offset Names ◉
- No

SeLect ON ◉
HiGhlightOFF ◉
SElect menu >

Annotation ◉
if space OK

SATDB Opts >

Hilite Error
marKers OFF ◉

fUll DB list >

1- Part 2 x

Q - Return

+ Menu bar!

Celeste vrs Dijkstra Table

Network	Celeste	Dijkstra	CPU Ratio	Nodes	Links	Zones	Links/Nodes	CPU Load	Load Ratio
SLOHAM	29.14	76.96	0.378	8,868	96,859	2520	10.9	6.96	0.24
LOHAM	54.41	139.06	0.391	17,022	246,172	5411	14.46	22.2	0.41
Oxford	0.863	1.216	0.35	2,681	23,232	822	8.66	0.232	0.27
Derby	3.7	9.51	0.39	2,699	25,405	547	9.41	0.39	0.1
York	0.065	0.135	0.48	299	4339	171	14.5		
Sloham++	25.81	91.97	0.28	15,106	58,125	2520	3.85	5.2	0.2
Oxf++	6.56	22.19	0.28	3,984	15,566	822	3.9	1.63	0.25

LUCIEN

- Tree correction rather than building
- Loose-end table not required – order taken from a previous tree build (Dijkstra or Celeste) with d'Esopo-style corrections
- Empirically 70-80% of Celeste CPU times for a wide range of network sizes
- Alternative same-cost versions for (a) adjacent origin, (b) added/deleted node

SATUFC++/SATUFE

- Reconstructing a UFC++ file using "Simplicial Decomposition"
- 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
- Expensive early iteractions are eliminated.

SATUFE Results

- Fewer iterations and/or better convergence.
- E.g., Cambridge network has 56 vrs 203 iterations (speed-up factor of 3.6)

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
- Useful application of LUCIEN
- Creates large but not ginormous .UFF files

Deleting Wrong-Way Links

- Eureka moment not yet reached!
- Removing links in SATUFF works but takes more CPU than time saved as a result

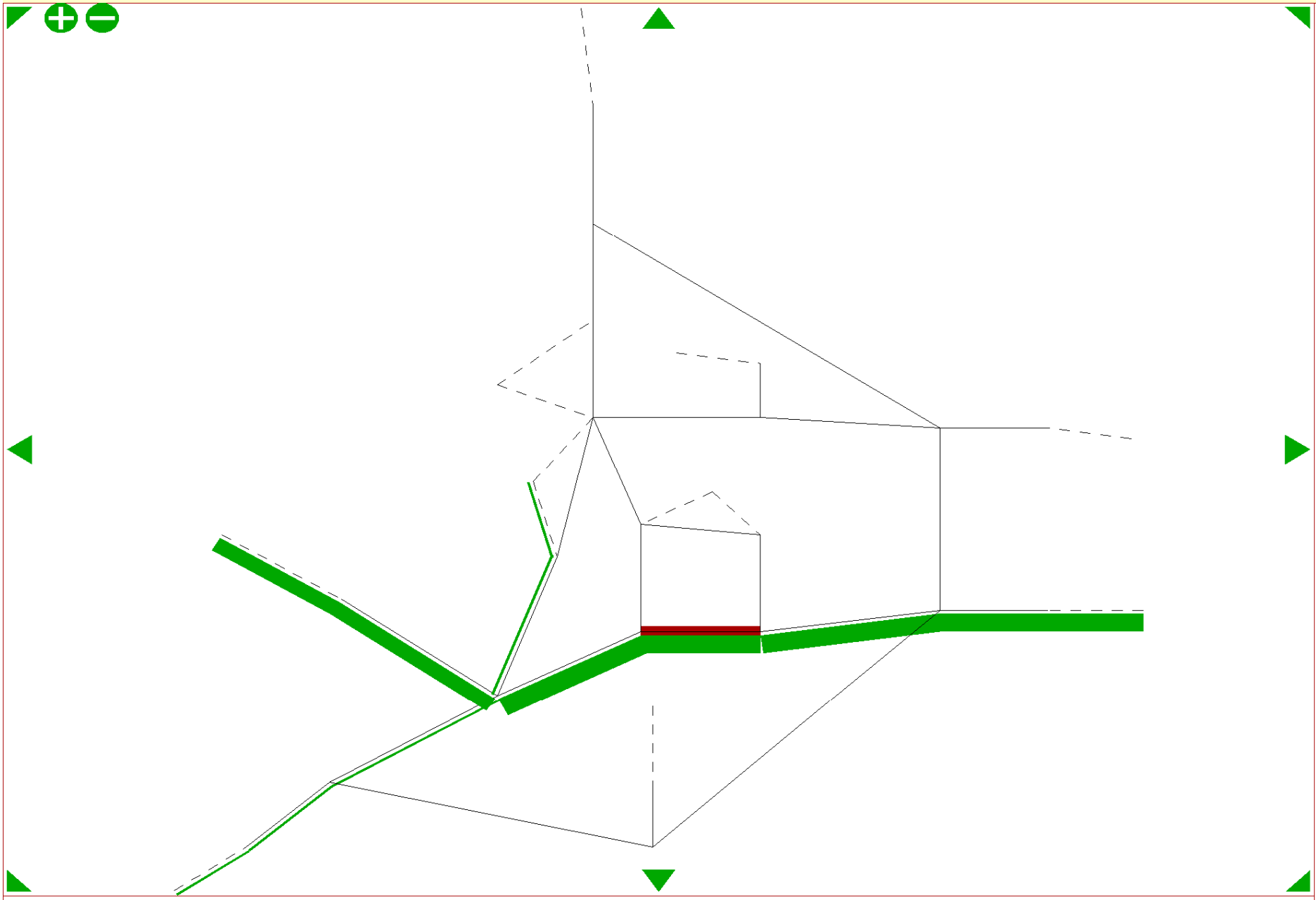
Improved Analysis CPU Times: 11.6

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

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

Added 11.6 Options: Post 05/20

- Zone-to-zone direct connectors
- SATPATH = SATPIG + UFF files
- SLA in P1X effectively rewritten including
- … X-SLA
- DCF flows created “on the fly” in SATRAP



GROTLEY SATURN NETWORK 3UC 14/03/23

Select Link Assignment
Thru links:
12 13

Data plotted
Total Demand (Factored)

Total Flows: (Unfactored)
Demand 469
Actual 440
Queued 28

Mean OD time
212.4 S
Mean OD dist
654.0 M

All User Cls

Full stats x

Reset SLA x
plot flows? (Demand)

Matrix out? x

New link x

diSplay of link annotat >

ploT DB data x

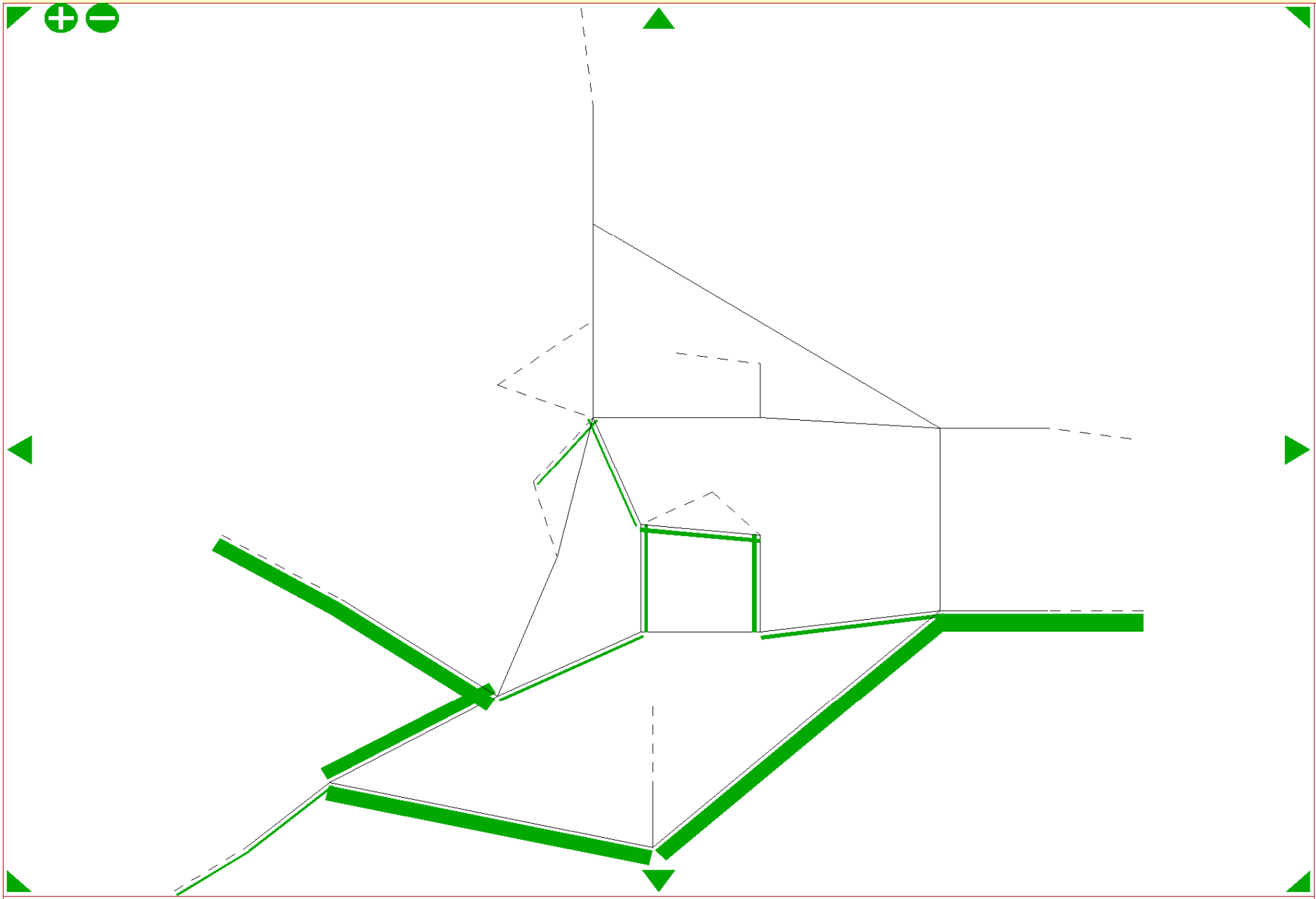
hoUsekeeping (Annotate select flows >

viEw D.B. x

Information x

Q - Return

+ Menu bar!



GROTLEY SATURN NETWORK 3UC 14/03/23

Select Link Assignment
Thru links:
12 13

X-SLA Data:

Total Flows:
Demand 469

Mean OD time
SLA 212.4
XSLA 234.1
Diff 21.8
3 PCU-HR

Mean OD dist
SLA 654.0
XSLA 1092.0
Diff 438.0
205 PCU-KM

Full stats x

Reset SLA x
plot flows?
(Demand)
X-SLA Flows x
X-SLA + SLA x
X-SLA - SLA x
Matrix out? x
New link x
display of >
link annotat
houSekeeping>
(Annotate
select flows
viEw D.B. x
Information x

Q - Return

+ Menu bar!

11.6 TAC Options

- Full set of Analysis (UFC/UFF) options available (e.g., P1X SLA, SATRAP etc.)
- Further checks on TAZ cordon definitions
- Skimmed matrices include blocks to cover different choices of TAC paid
- LUCIEN used in TAC assignments where appropriate

SATNET: 11.6

- DIJKST(ra) replaces NIJKST(ra)
- N.B. Namelist names > 6 characters
- Maximum KNOBS increased to 20
- SAVEIT defaults to F

Simulation: 11.6

- Minor changes to simulation =
- Minor changes to SATALL outputs

P1X: 11.6

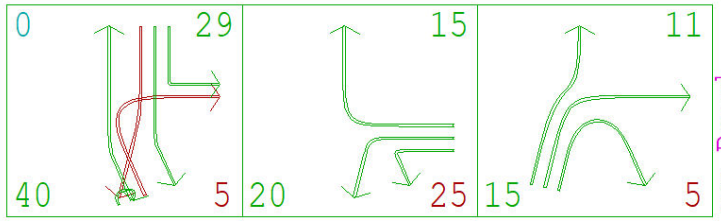
- SLA based on full possible sets of user and/or vehicle classes
- Output tables (e.g. Joyrides) in CSV
- Bus routes listed by link
- Trees to/from nodes (not just zones)
- Improved options to display errors at nodes
- Hallmark display by validated timed routes

General Changes: 11.6

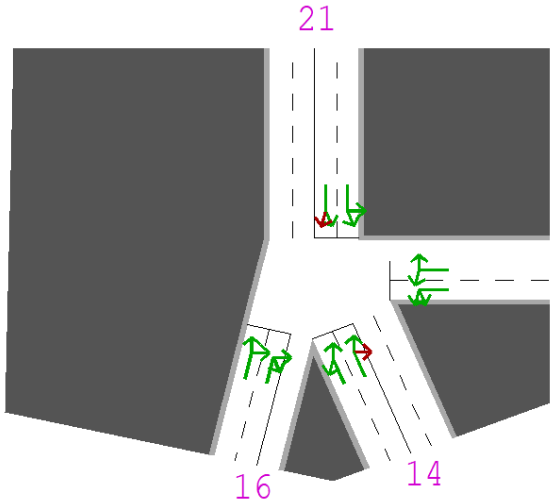
- Increased use of “true” direct access files to:
- (a) reduce input/output CPU by storing,e.g., trip matrices within programs (tij.UDM);
- (b) pass data between programs; e.g., link costs from SATUFE to SATUFF(net.UDC)
- New batch files SATURN2E, SATURN2F, SATSKIM …

New 11.7 Features

- 3 TAC networks: Assign and analysis
- “Blocked” DA arrays to reduce file sizes
- Phase-based display of signal stages
- Pedestrian stages displayed
- Full treatment of Compliant TAC trips



Grimley Road



Upper Grotle

Bridge St

Signals Menu

Green stage lengths x
Intergreen lengths x
miN/maxGreen x
Cycle time x
Offset time x
OptiMize stage times x
Test various offsets x
1 - Add Ped Stages x

Add a stage x
Delete stage x
Revise stage movements x
Swap stages x

Filters >

Print x

Balance G+R = cycle time x

Linsig? No ◉

No errors

Q - Process and return x

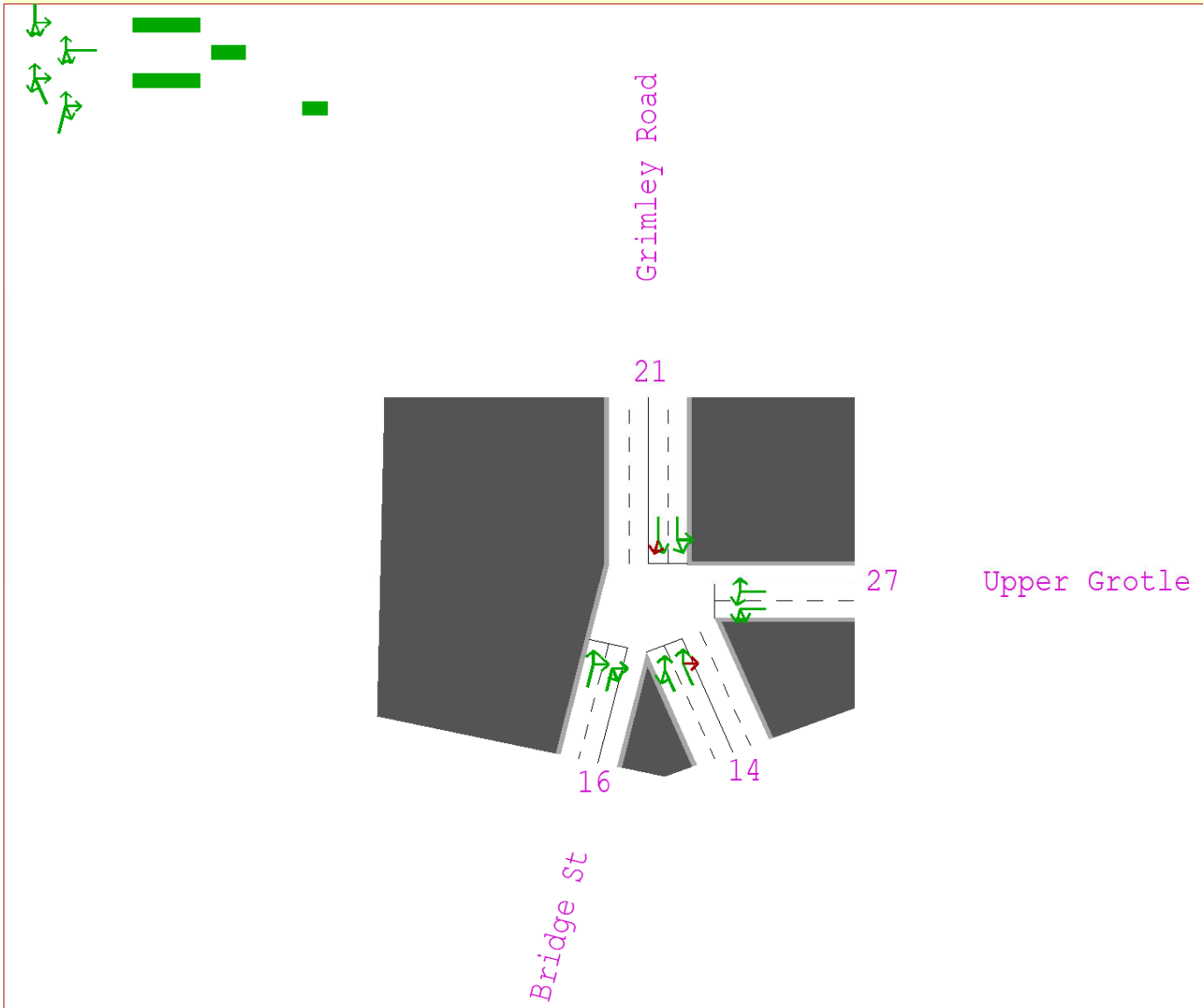
Process and simUlate x

+ Menu bar!

See 11.12.2

Manor Sq

Node 10



Finish with Node 10

What next?

Choose from x network plot

Change node:

Up (11)>

Mouse set >

Number set >

Go back to x Node 10

Click an adjacent node

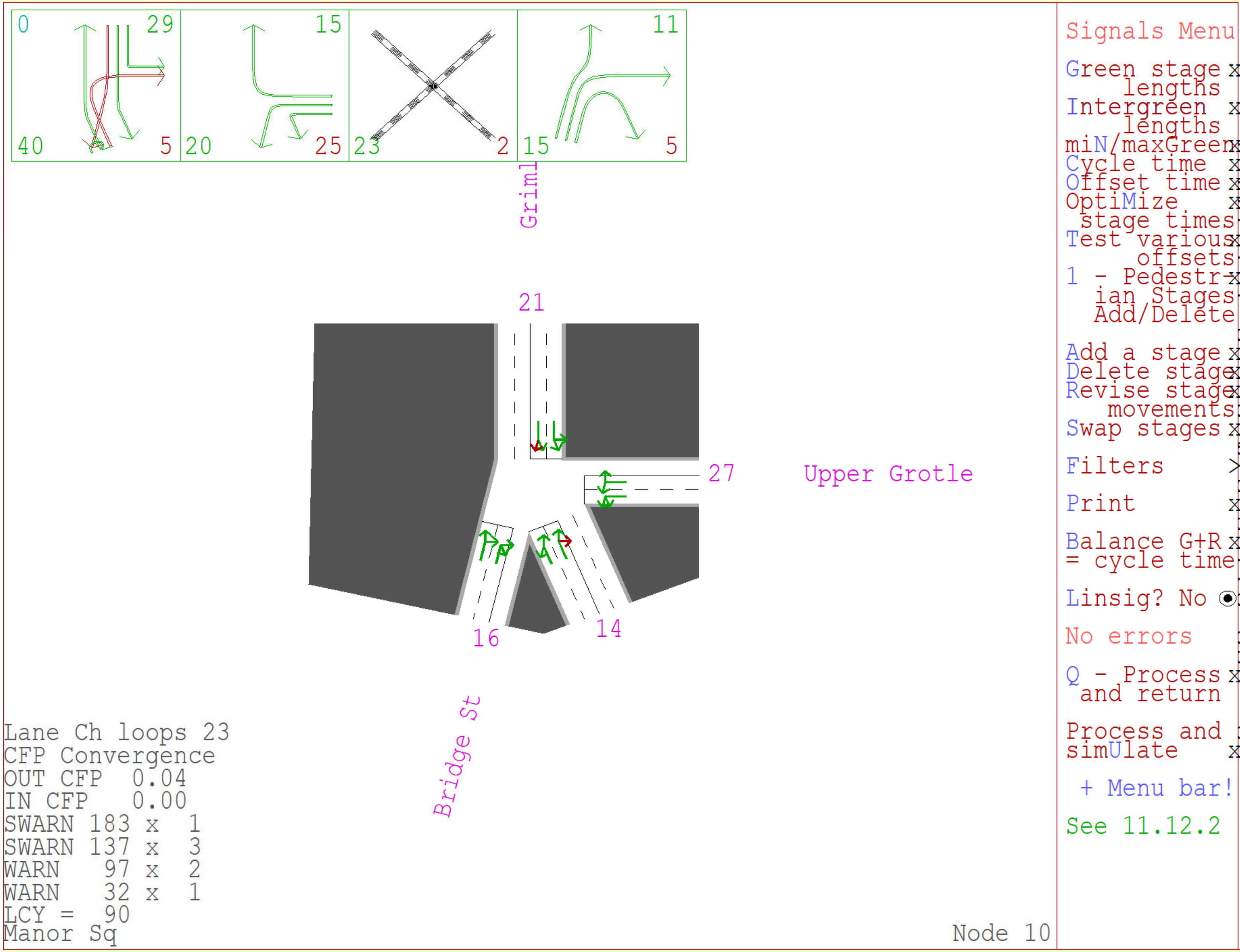
Q- Return x (I.e. finish 11111 edits)

+ Menu bar!

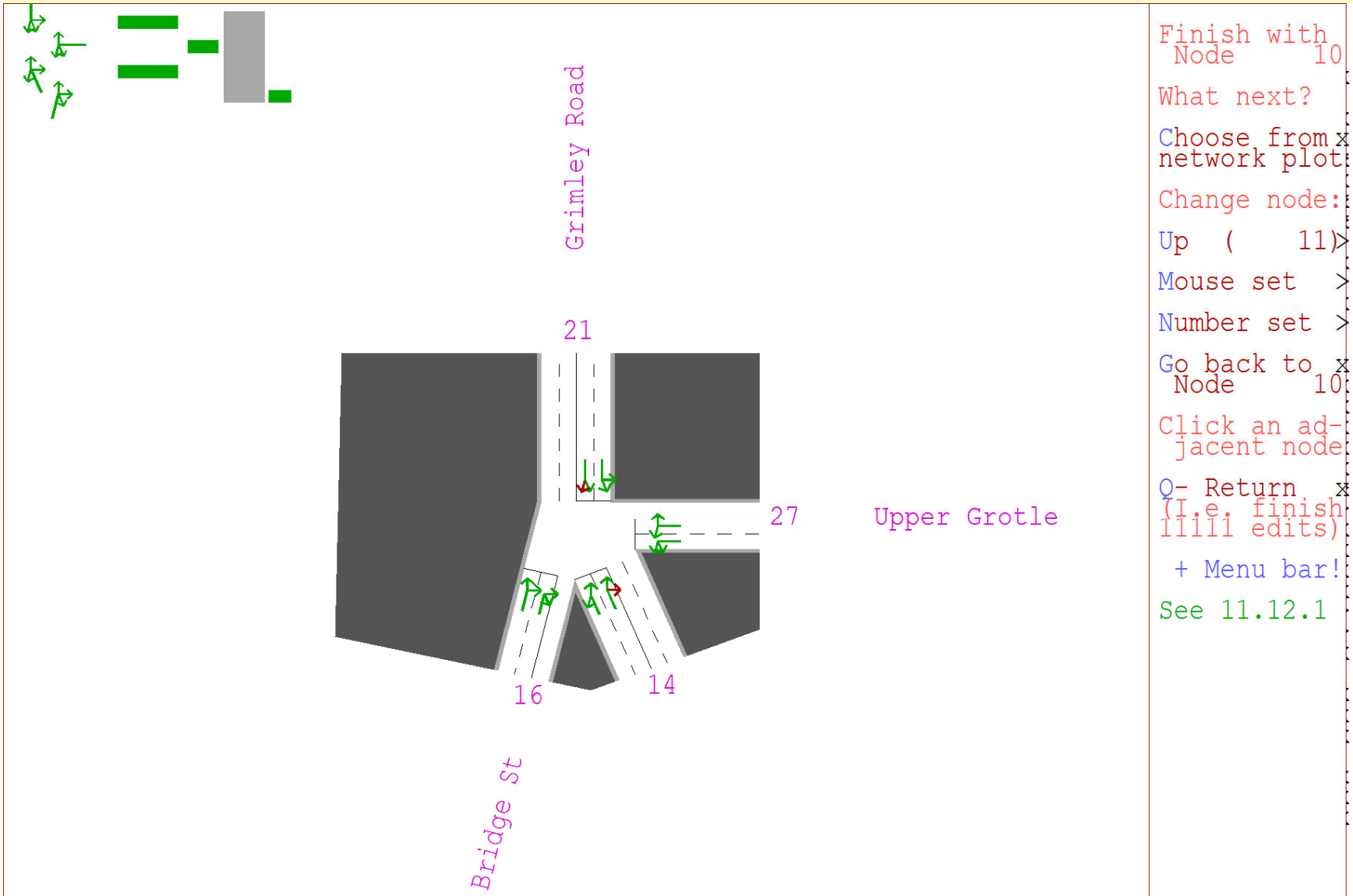
See 11.12.1

Manor Sq

Node 10



0
29
40
5
15
20
25
23
2
15
11
15
5
Griml
21
27
Upper Grotle
16
14
Bridge St
Lane Ch loops 23
CFP Convergence
OUT CFP 0.04
IN CFP 0.00
SWARN 183 x 1
SWARN 137 x 3
WARN 97 x 2
WARN 32 x 1
LCY = 90
Manor Sq
Node 10
Signals Menu
Green stage lengths x
Intergreen lengths x
miN/maxGreen x
Cycle time x
Offset time x
OptiMize stage times x
Test various offsets x
1 - Pedestrian Stages Add/Delete x
Add a stage x
Delete stage x
Revise stage movements x
Swap stages x
Filters >
Print x
Balance G+R = cycle time x
Linsig? No
No errors
Q - Process and return x
Process and simUlate x
+ Menu bar!
See 11.12.2



Finish with Node 10

What next?

Choose from x network plot

Change node:

Up (11)>

Mouse set >

Number set >

Go back to x Node 10

Click an ad-jacent node

Q- Return x (I.e. finish 11111 edits)

+ Menu bar!

See 11.12.1

Manor Sq

Node 10

DVV Ideas & Objectives

- Blocking back at roundabouts
- Distance-based area charges
- Automated CASSINI loops
- 64-bit, MX in particular
- Congested Values of Time
- Assigning TAC trip matrices directly
- P1X backgrounds a la SATVIEW