



**London
Streets**



Innovative SCOOT Benefits Analysis

Quantifying Emissions and Travel Time Reductions

ITS World Congress, Stockholm 2009

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Presentation Outline

- Background
- Methodology and simulation development
- Results
- Graphical outputs





BACKGROUND



Background

- London Policy:
 - Mayoral objective to “smooth traffic flow”
 - Legal obligation (Network Management Duty) to “expedite movement of traffic”
 - Deliver more responsive / versatile traffic control system
- Conventional Wisdom – SCOOT benefits
- Planned investment in London SCOOT deployment
- Challenge: confirm SCOOT benefits



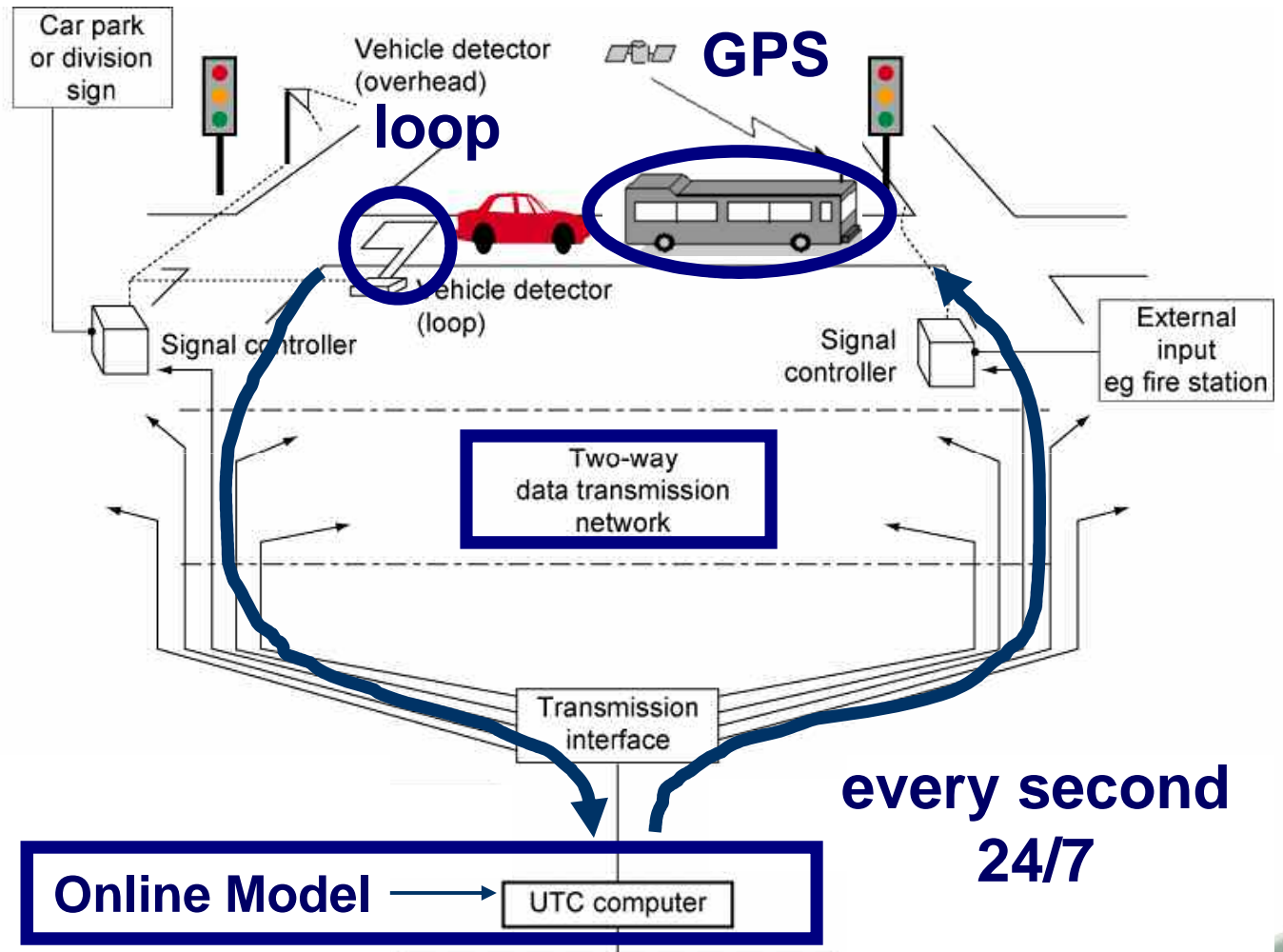
Video Comparison: FT vs SCOOT

Incident Conditions

Video available at www.youtube.com/trlsoftware



How SCOOT Works





SCOOT deployment

- **SCOOT is deployed in:**
 - over 200 Cities worldwide
 - virtually every major town in the UK
- **Local evidence proves benefit of SCOOT**
- **Little new research due to high cost of on street trials**





Location of SCOOT Installation	Previous Control Method	Year	% Benefit over previous control method	
			Delay	Travel Time
São Paulo, Brazil (ver. 2.4)	Fixed-time (TRANSYT)	1997	0 - 40	-
São Paulo, Brazil (ver. 3.1)	Fixed-time (TRANSYT)	1997	0 - 53	-
Nijmegen, The Netherlands (ver. 2.4)	Fixed-time	1997	25	11
Toronto, Canada (ver. 2.4)	Fixed-time	1993	17	8
Beijing, China (ver. 2.3)	Fixed-time (Uncoordinated)	1989	15 - 41	2 - 16
Worcester, UK (ver. N/A)	Fixed-time (TRANSYT)	1986	3 - 11	7 - 18
Worcester, UK (ver. N/A)	Isolated Vehicle Actuation	1986	7 - 18	15 - 32
London, UK (ver. N/A)	Fixed-time	1985	19	6 - 8
Southampton, UK (ver. N/A)	Fixed-time	1985	39 - 48	18 - 26
Coventry, UK - Foleshill Road (ver. N/A)	Fixed-time (TRANSYT)	1981	22 - 33	4 - 8
Coventry, UK - Spon End (ver. N/A)	Fixed-time (TRANSYT)	1981	0 - 8	0 - 3

Delay
▼ 19%

Travel Time
▼ 6 - 8%

London, 1985





Recent Studies

- **Utah**
- **Salt Lake City**

- **And of course this new London one...**



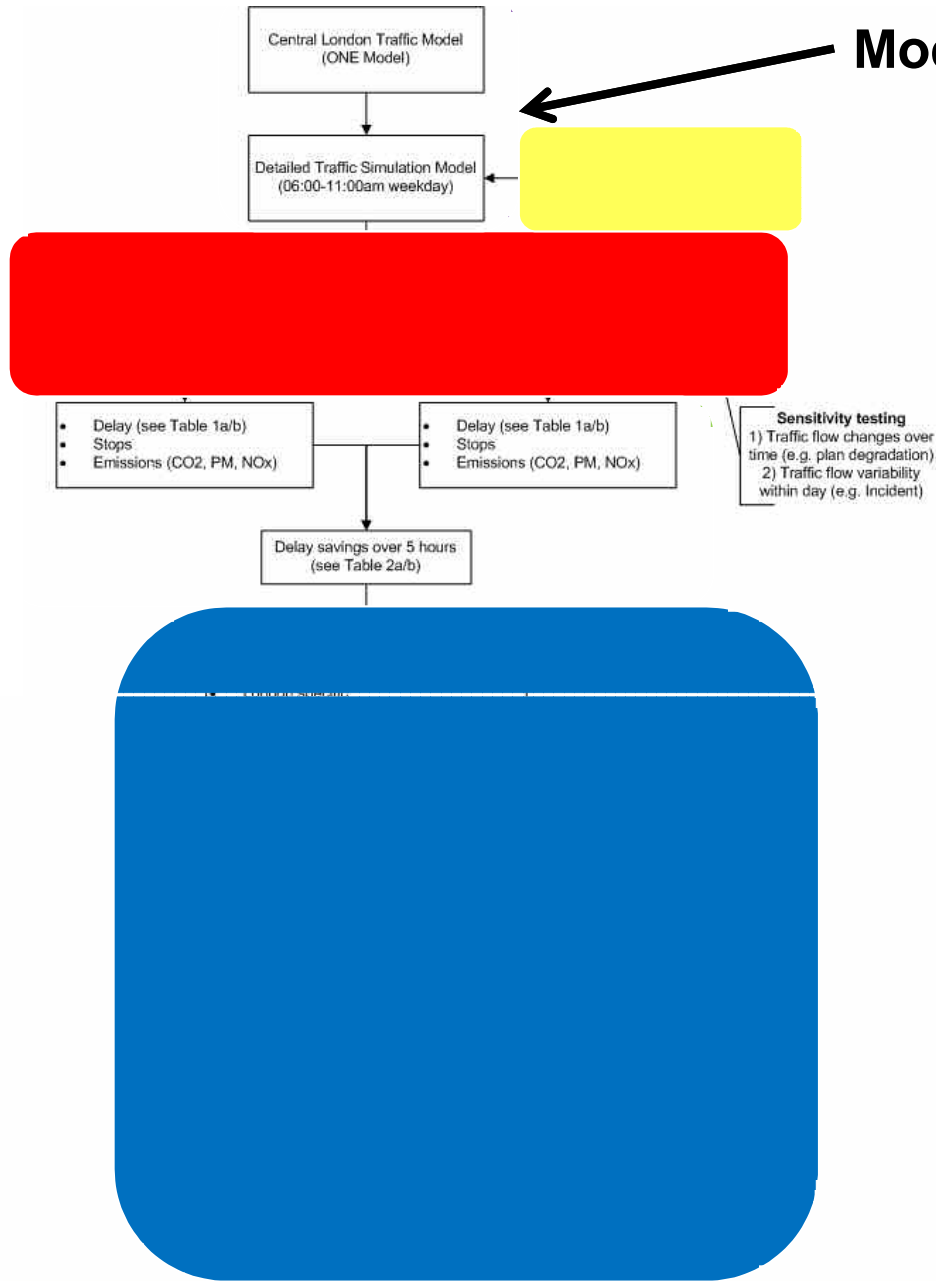


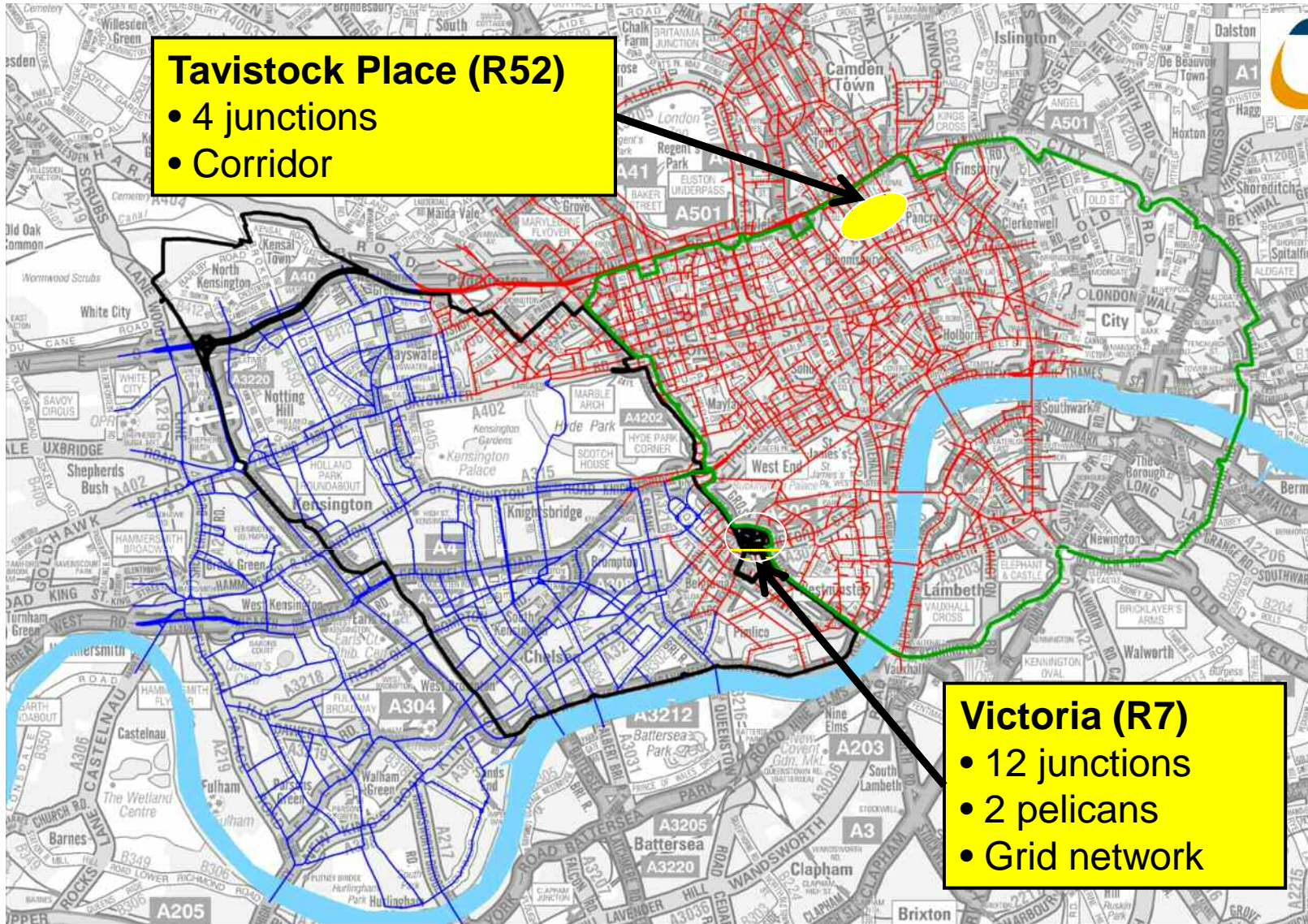
METHODOLOGY





Model development





Operational Network Evaluator (ONE) Model



Model development



Replica UTC/SCOOT traffic control system (UTC-VISSIM Interface)

UTC-VISSIM Interface



- Delay (see Table 1a/b)
- Stops
- Emissions (CO2, PM, NOx)

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Sensitivity testing
 1) Traffic flow changes over time (e.g. plan degradation)
 2) Traffic flow variability within day (e.g. Incident)

Delay savings over 5 hours (see Table 2a/b)

Value of Time (VOT)
 (see Table 3a/b/c)

- London specific
- 2009 base year
- Mode specific
- Vehicle occupancy by time of day, and week/weekend
- Work/non-work time split

User benefit, per hour, for 5 hours (see Table 4a/b and Table 5a/b)

24hr traffic flow profiles from SCOOT loops (see Figure 1/2)

User benefit (£) for 24hr weekday and 24hr weekend (see Table 6 and 7)

365 days/year
 253 weekdays, 112 weekends and Bank Holidays

User benefit, in first year, for full modelled network (see Table 8 and 9)

Divide by number of junctions (Vic. = 12, Tav. Pl. = 4)

User benefit in first year, per junction (see Table 8 and 9)

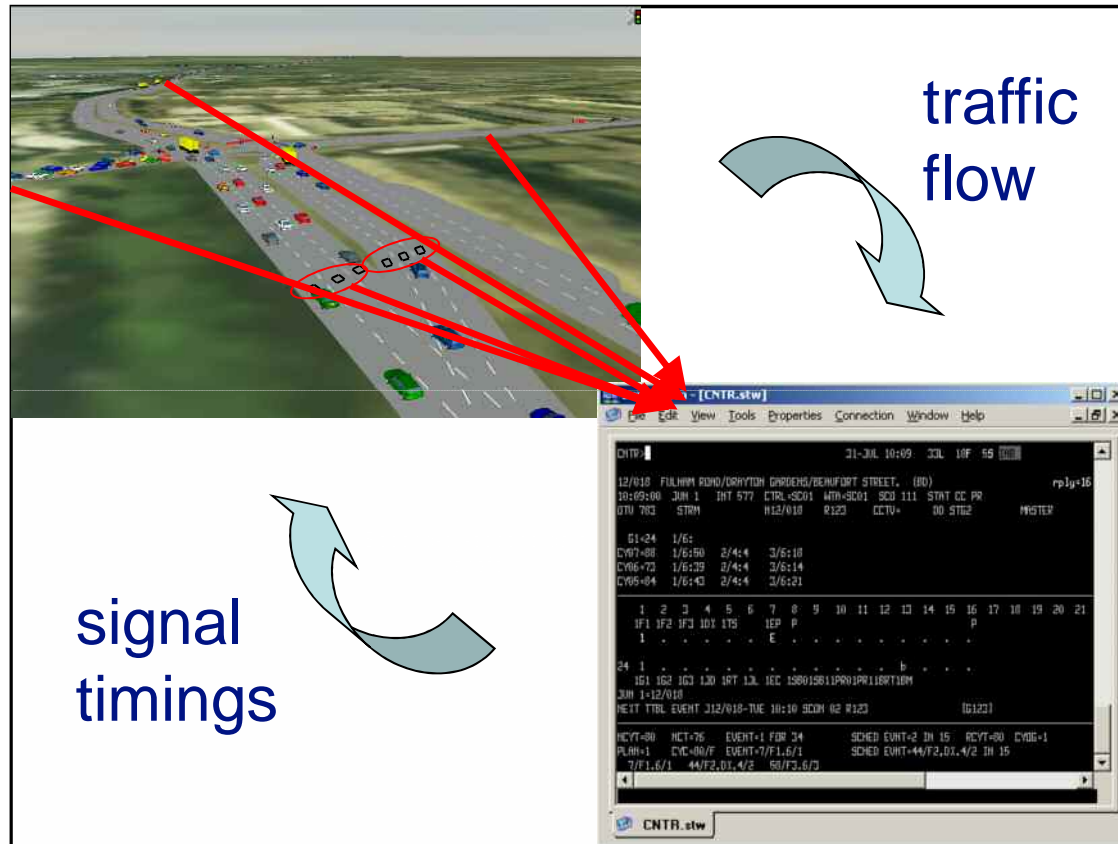
ITS (UK) Award Winner - Product of the Year 2009

Developed by TRL

Faster than real-time operation

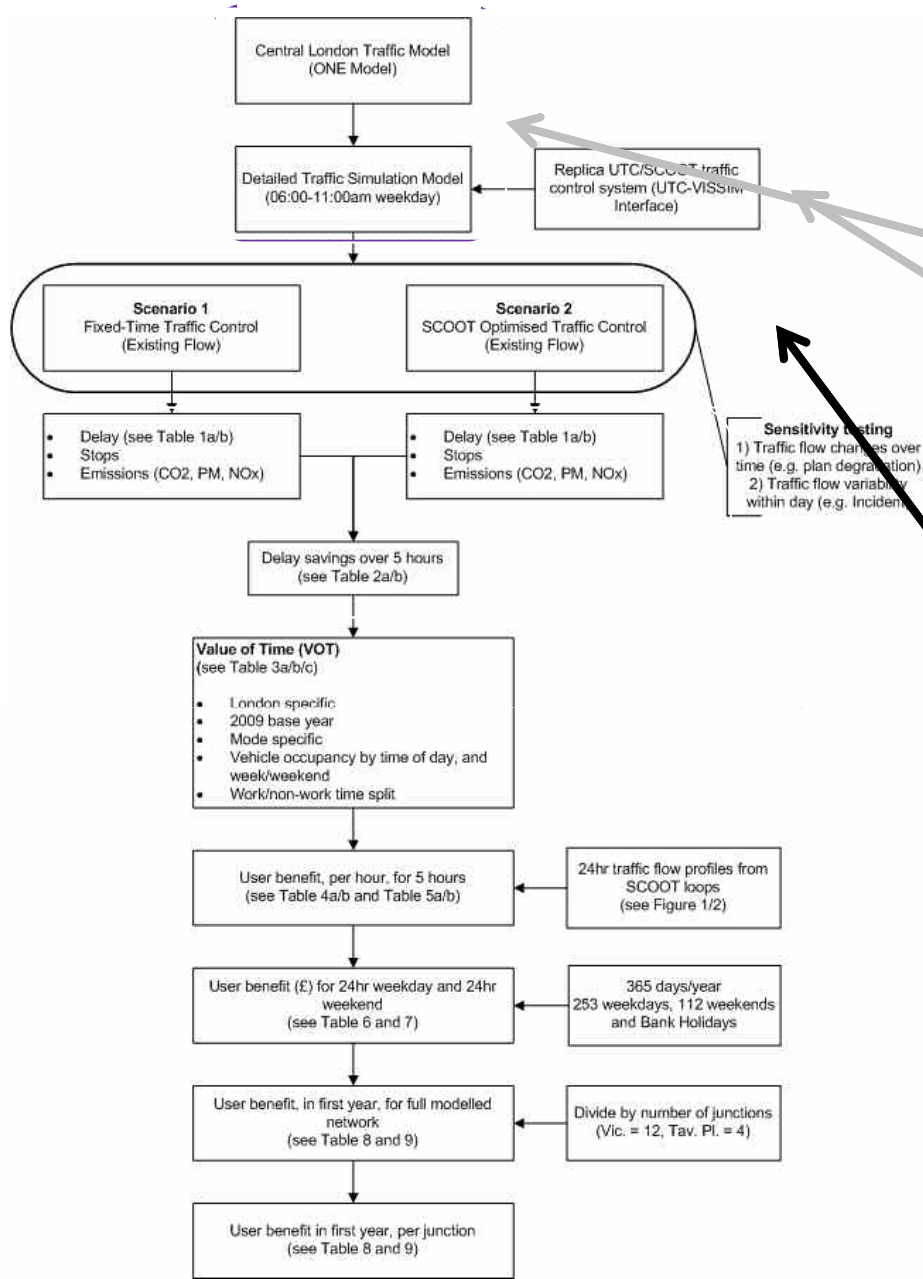


How UTC-VISSIM works



- VISSIM replicates the street (signals / traffic)
- VISSIM sends flow data to SCOOT
- SCOOT optimises timings as normal
- Signal timings updated in VISSIM
- Fully offline environment





Model development

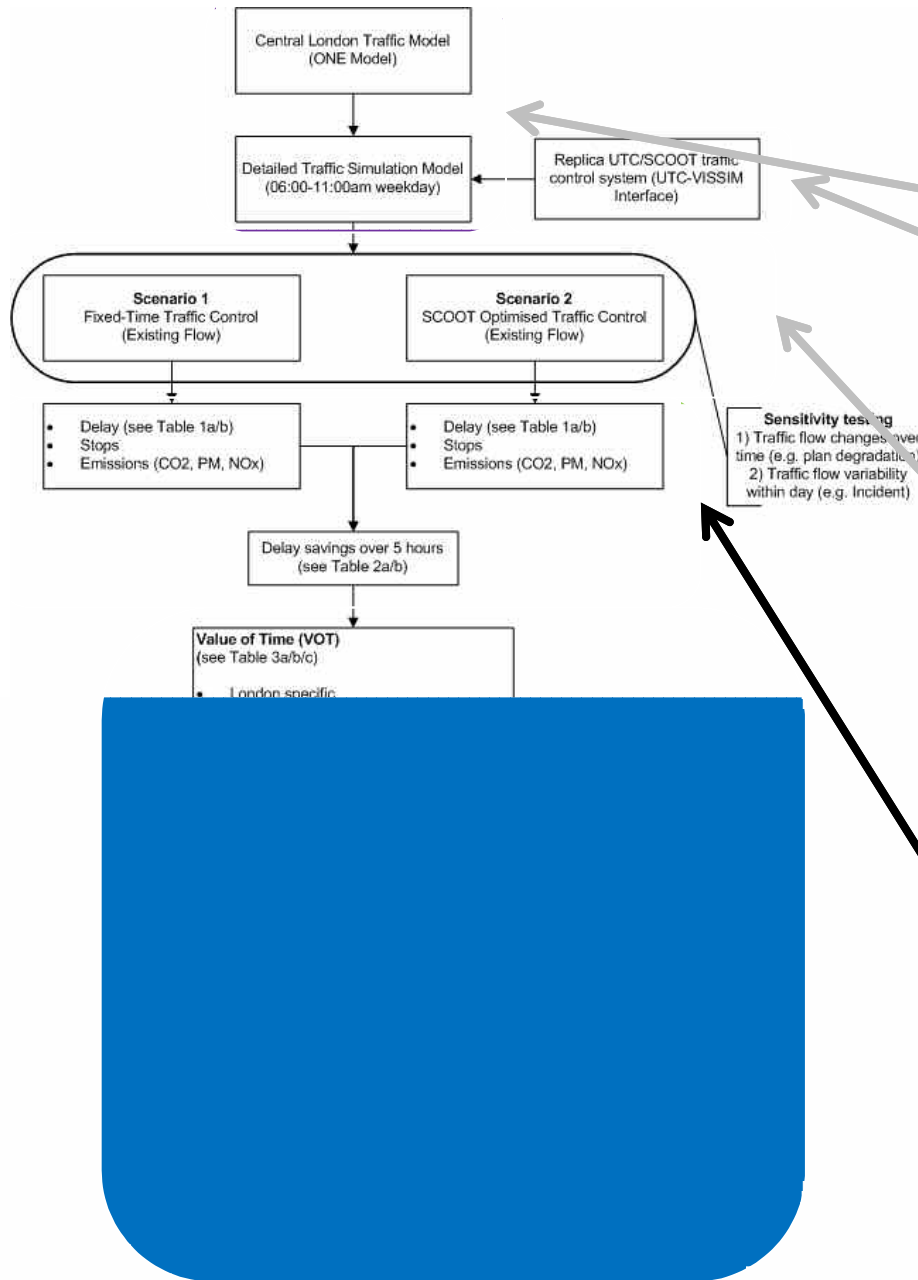
UTC-VISSIM Interface

Traffic control scenarios:

- Fixed time
- SCOOT
- SCOOT raised CT

Traffic flow scenarios:

- Existing flow
- Increased flow 10%
- Increased flow 20%
- Incident flow



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Model output:

- Vehicle delay
- Vehicle stops
- Emissions (PHEM)



Central London Traffic Model (ONE Model)

Detailed Traffic Simulation Model (06:00-11:00am weekday)



- Delay (see Table 1a/b)
- Stops
- Emissions (CO2, PM, NOx)

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User benefit calculation based on VOT



TRL Involvement

- **Review and Audit:**
 - the study methodology
 - the simulation setup and validation
 - the simulation results
- **Input into the methodology**
- **Provide Emission Modelling via the following process...**



Use of Instantaneous Emissions Module (IEM)

- **Developed in a project for UK Highways Agency**
- **A tool to estimate emissions associated with unusual traffic and topographic conditions**
- **A sample of typical speed traces for cars, vans, HGVs and buses analysed with PHEM**
- **Output traces analysed according to instantaneous speed and speed*acceleration**
- **For each vehicle sub-category, look-up tables generated**

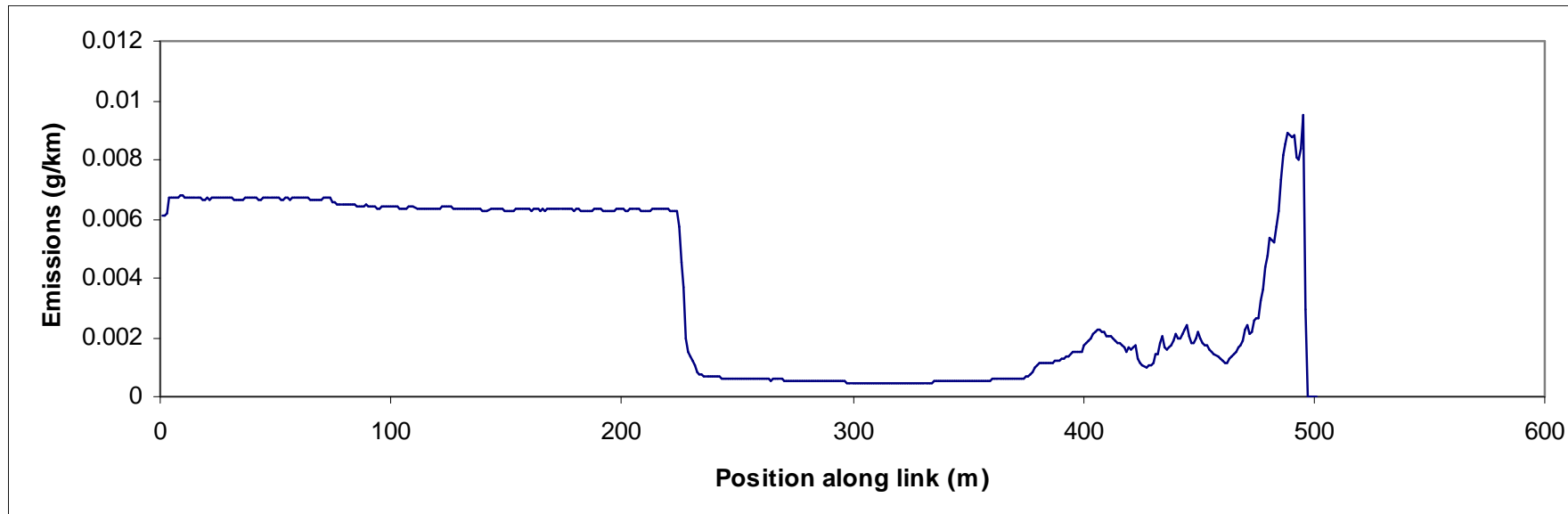


IEM Post-processor

- **Processor to take output data from a micro-simulation traffic model and estimate emissions along each link**
- **Initially developed using sample data generated from VISSIM**
- **Imports trace data files, calculates emissions for each vehicle and allocates the emissions to a section of the link**
- **Ability to inspect speed and accelerations**

IEM

Post-processor – NO_x emissions along a link





RESULTS AND CONCLUSIONS



Emissions Benefits

- Over the morning peak period (5 hours) the model predicted that SCOOT would cut emissions

Table 3 – Base Flow Emissions Reductions

	NOx	PM	Carbon
Victoria	-8%	-5%	-6%
Tavistock Place	-3%	-1%	-3%

Table 4 – Incident Flow Emissions Reductions

	NOx	PM	Carbon
Victoria	-9%	-6%	-7%
Tavistock Place	-7%	-3%	-8%

- **Savings (5 hrs):**
 - 100L petrol (\approx 2 fuel tanks)
 - 236kg CO₂ (64kg carbon + 172kg oxygen)
 - 120m³ of oxygen removed
 - 130m³ of CO₂ produced

Operational Benefits

- **Vehicle stops and delays were all reduced with SCOOT active**

Table 1 – Base Flow SCOOT Benefits

	Delay	Stops
Victoria	12%	10%
Tavistock Place	14%	8%

Table 2 – Summary SCOOT Benefits

	Delay	Stops
Victoria, all scenarios	11 - 16%	10 - 17%
Tavistock Place, all scenarios	8 - 29%	6 - 25%

Economic Benefits

- **Models predicted annual user benefit, per junction, between £89,200 and £107,100**
- **Overall user benefit in the first year, per node, is: £90,000 (2009 VOT)**
- **Excludes:**
 - **Vehicle operating cost (wear and tear, fuel, etc.)**
 - **Social cost of carbon reductions (£70 / tonne)**



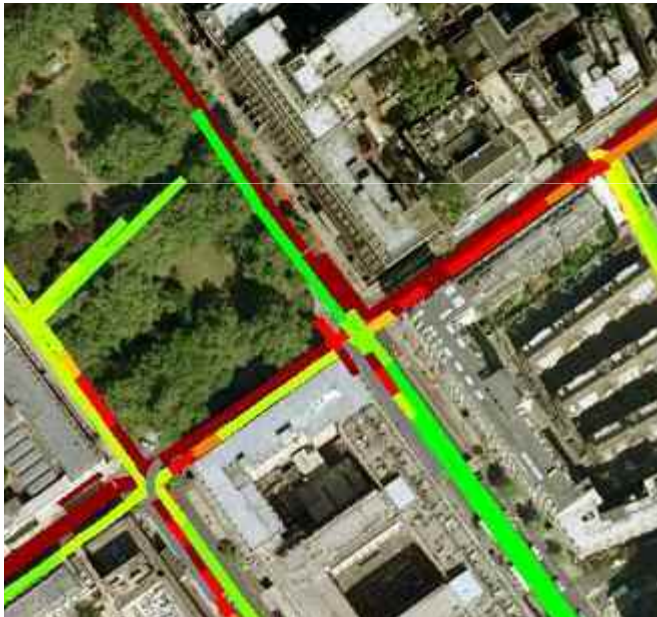
GRAPHICAL OUTPUTS



SCOOT Incident Recovery Benefits



Time: end of incident.



Fixed Time



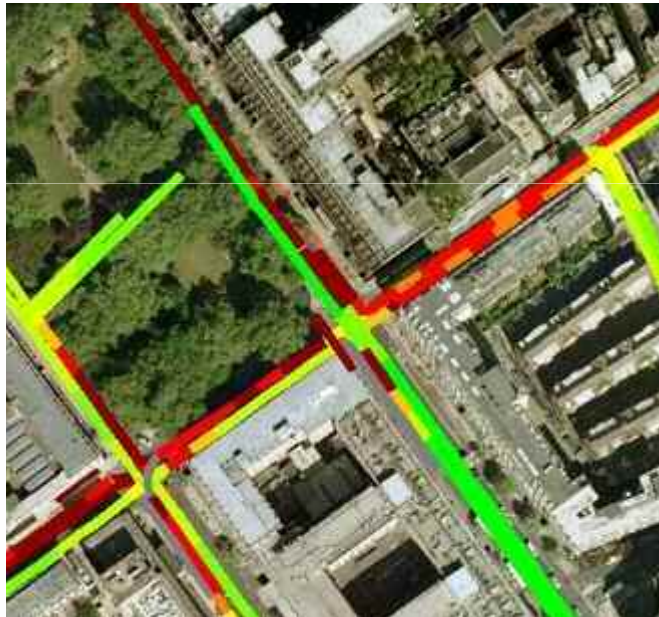
SCOOT



SCOOT Incident Recovery Benefits



Time: 15 minutes after incident.



Fixed Time



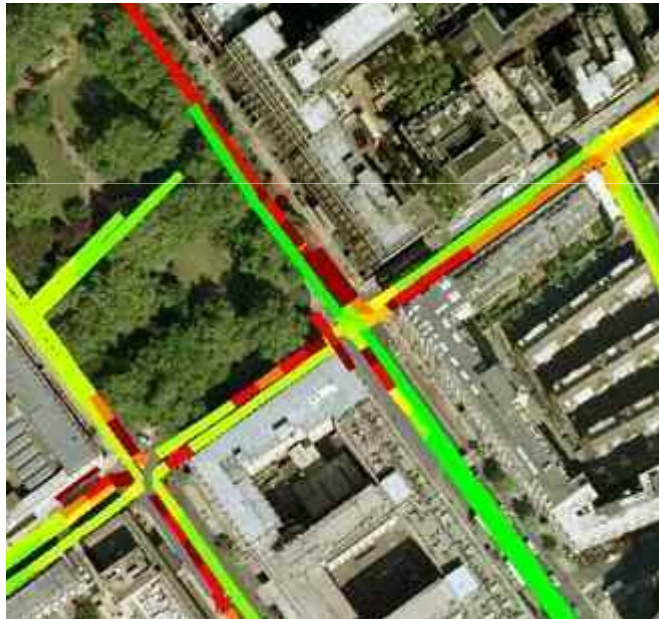
SCOOT



SCOOT Incident Recovery Benefits



Time: 30 minutes after incident.



Fixed Time



SCOOT



Conclusions

- **SCOOT Benefits confirmed**
 - Travel time and emissions
- **Versatile Control System**
 - Optimisation for emissions, delay, pedestrians etc
- **ITS Innovation enables detailed analysis**
- **Emissions benefits from business as usual work**



tfl.gov.uk
trl.co.uk
scoot-utc.com

