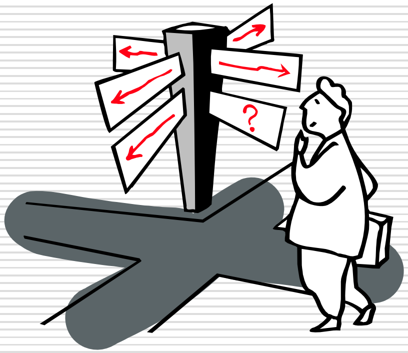
Artery 3.0

New approach to intersection optimization

Joint development of AGA Group, Inc and Solaris Development, Inc.

Purpose

Significantly reduces labor associated with generating Oprimazed Timing Tables for isolated intersections and road networks based on Traffic Data collected by Traffic Detectors such as Iteris



Urgency

Existing optimization methods:

- Manual traffic data entry
- Third-party software is used for computation
- Labor-intense process
- Time consuming process

Optimization with Artery 3.0:

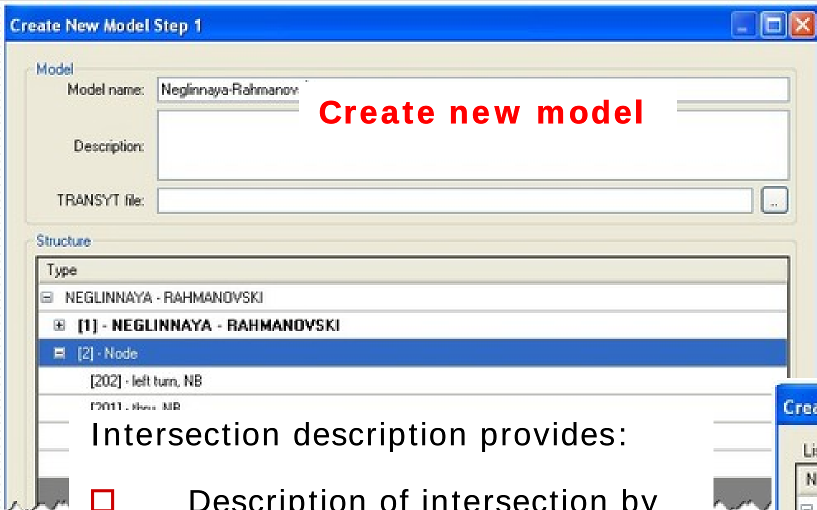
- Step-by-step execution of pre-set algorithms
- Unattended execution
- Minimal labor expenditure
- Economic efficiency calculation

Major functionalities

- Interaction with traffic detectors
- Creation and editing intersection models
- Calculation and correction of timing tables
- Timing tables calculation based on expert plans
- Export file format is compatible with control applications, such as Traffic View 32
- Reports on the resulting economic benefits from optimization of timing tables

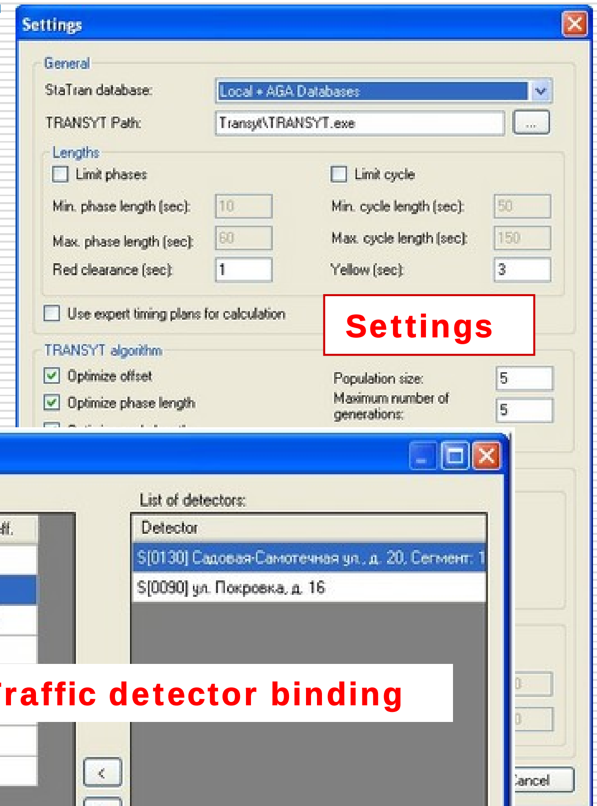
Creation of intersection models

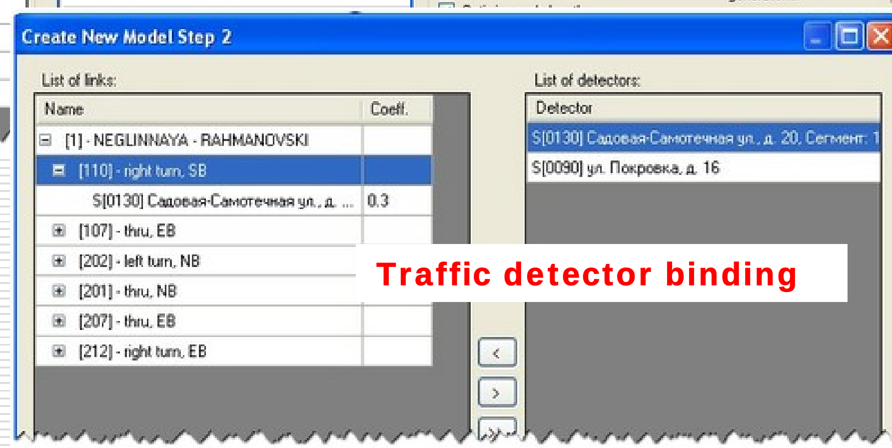
Once described as part of the intersection configuration, traffic detectors provide current data to be used for an ongoing fine tuning and optimization of timing tables.



Intersection description provides:

- Description of intersection by binding to traffic detectors
- Calculation of saturation flows for each direction by AGA or Transyt algorithm
- User-defined parameters for automatic determination of min and max cycle duration
- User-defined parameters for optimization algorithm

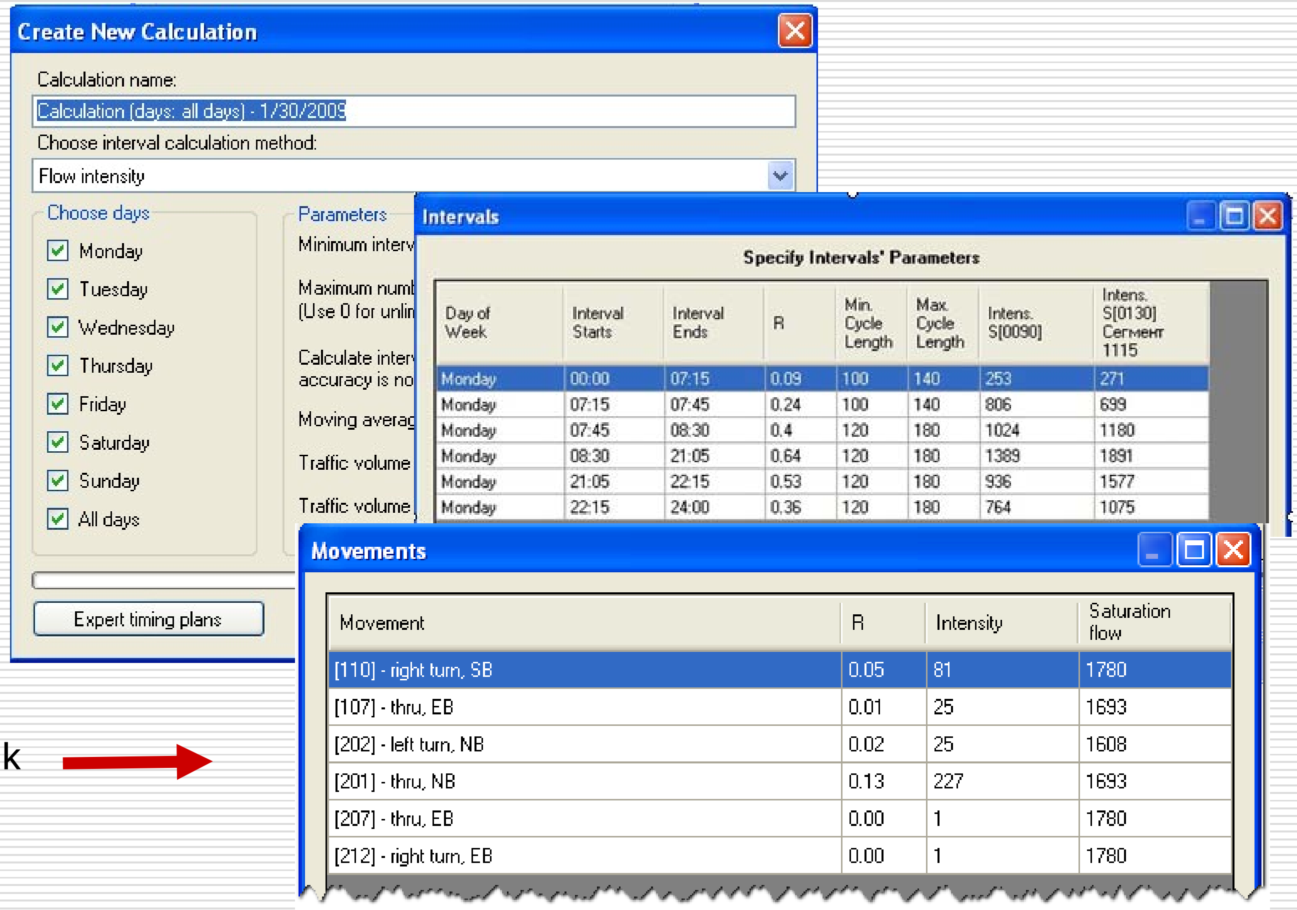




Timing tables set optimization

User can modify automatically optimized time intervals set

Traffic volume on any link can be adjusted



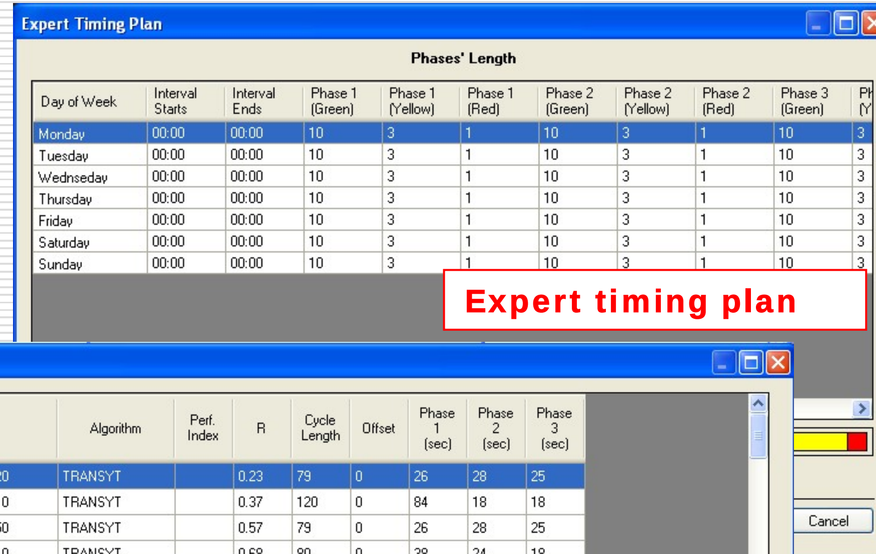
Calculation is based on traffic detector data retrieved and processed by StaTran 4.0

Expert plans

The use of single good working timing table(expert plan) to optimize the rest of the set

Expert plan creation:

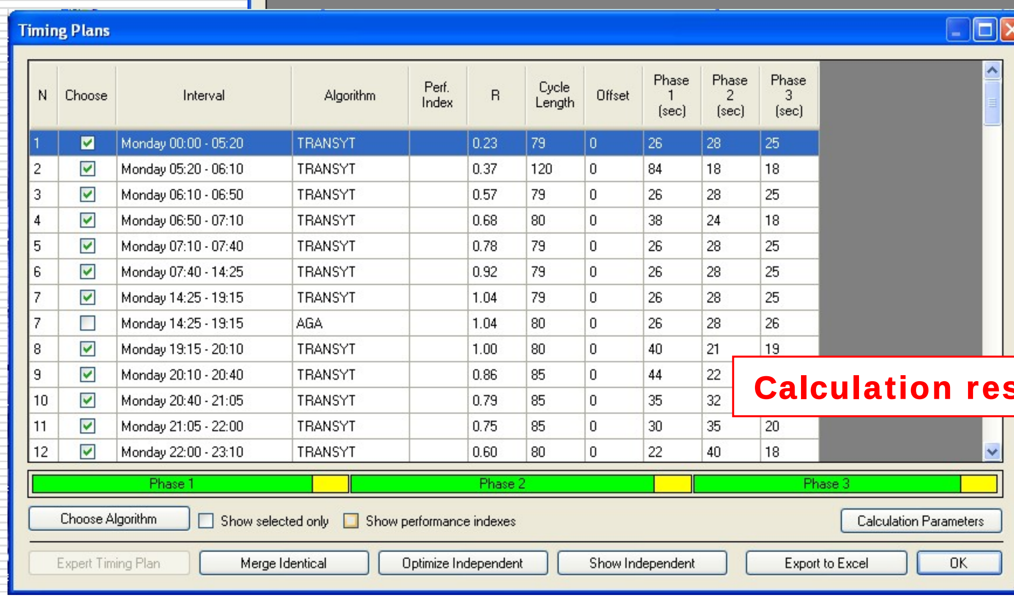
- Prototype intersection is selected
- Days of week to work with Expert Plan are determined
- Changeable time intervals



Day of Week	Interval Starts	Interval Ends	Phase 1 (Green)	Phase 1 (Yellow)	Phase 1 (Red)	Phase 2 (Green)	Phase 2 (Yellow)	Phase 2 (Red)	Phase 3 (Green)	Ph (Y
Monday	00:00	00:00	10	3	1	10	3	1	10	3
Tuesday	00:00	00:00	10	3	1	10	3	1	10	3
Wednseday	00:00	00:00	10	3	1	10	3	1	10	3
Thursday	00:00	00:00	10	3	1	10	3	1	10	3
Friday	00:00	00:00	10	3	1	10	3	1	10	3
Saturday	00:00	00:00	10	3	1	10	3	1	10	3
Sunday	00:00	00:00	10	3	1	10	3	1	10	3

Calculation Results:

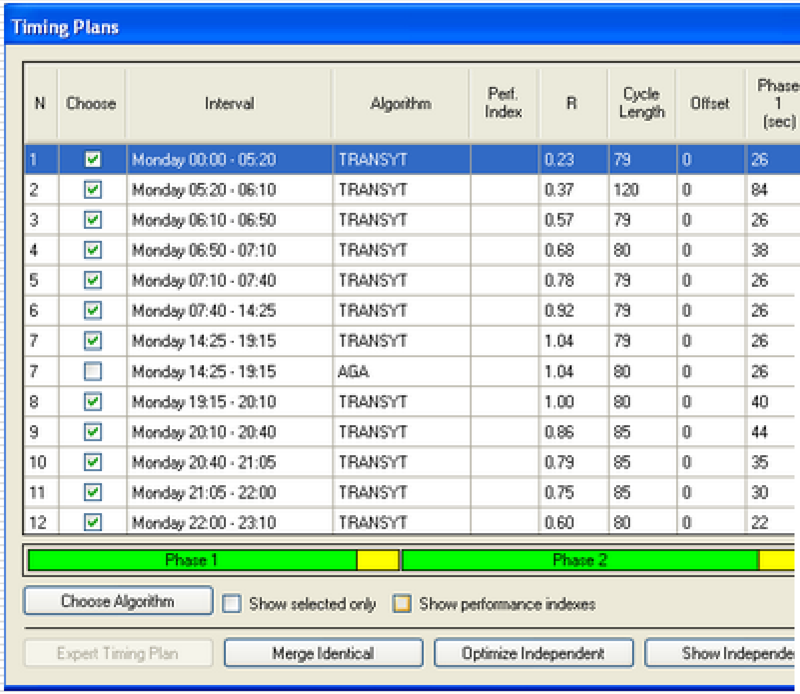
- Calculation algorithm is selected: AGA or Transyt,
- Intervals with the same phase values are merged
- Calculated timing plans are saved in MS Excel format



N	Choose	Interval	Algorithm	Perf. Index	R	Cycle Length	Offset	Phase 1 (sec)	Phase 2 (sec)	Phase 3 (sec)
1	☑	Monday 00:00 - 05:20	TRANSYT		0.23	79	0	26	28	25
2	☑	Monday 05:20 - 06:10	TRANSYT		0.37	120	0	84	18	18
3	☑	Monday 06:10 - 06:50	TRANSYT		0.57	79	0	26	28	25
4	☑	Monday 06:50 - 07:10	TRANSYT		0.68	80	0	38	24	18
5	☑	Monday 07:10 - 07:40	TRANSYT		0.78	79	0	26	28	25
6	☑	Monday 07:40 - 14:25	TRANSYT		0.92	79	0	26	28	25
7	☑	Monday 14:25 - 19:15	TRANSYT		1.04	79	0	26	28	25
7	☐	Monday 14:25 - 19:15	AGA		1.04	80	0	26	28	26
8	☑	Monday 19:15 - 20:10	TRANSYT		1.00	80	0	40	21	19
9	☑	Monday 20:10 - 20:40	TRANSYT		0.86	85	0	44	22	[illegible]
10	☑	Monday 20:40 - 21:05	TRANSYT		0.79	85	0	35	32	[illegible]
11	☑	Monday 21:05 - 22:00	TRANSYT		0.75	85	0	30	35	20
12	☑	Monday 22:00 - 23:10	TRANSYT		0.60	80	0	22	40	18

Resulting economic benefits

Calculation of economic benefits from timing tables optimization for Traffic signal operating mode changed based on Artery 3.0 calculation



Timing Plans

N	Choose	Interval	Algorithm	Perf. Index	R	Cycle Length	Offset	Phase 1 (sec)	Phase 2 (sec)	Phase 3 (sec)
1	✓	Monday 00:00 - 05:20	TRANSYT		0.23	79	0	26	28	25
2	✓	Monday 05:20 - 06:10	TRANSYT		0.37	120	0	84	18	18
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6	✓	Monday 07:40 - 14:25	TRANSYT		0.92	79	0	26		
7	✓	Monday 14:25 - 19:15	TRANSYT		1.04	79	0	26		
7		Monday 14:25 - 19:15	AGA		1.04	80	0	26		
8	✓	Monday 19:15 - 20:10	TRANSYT		1.00	80	0	40		
9	✓	Monday 20:10 - 20:40	TRANSYT		0.86	85	0	44		
10	✓	Monday 20:40 - 21:05	TRANSYT		0.79	85	0	35		
11	✓	Monday 21:05 - 22:00	TRANSYT		0.75	85	0	30		
12	✓	Monday 22:00 - 23:10	TRANSYT		0.60	80	0	22		

Efficiency index	Unit of measure
mileage	Vehicle-km/hour
Mileage time	Vehicle-hour/hour
Standard delay	Vehicle-hour/hour
Random delay	Vehicle-hour/hour
Delay	Vehicle-hour/hour
Average delay	Sec/vehicle
Passenger delay	Passenger-hour/hour
Number of stops	Vehicle/hour, %
Random number of stops	Vehicle/hour, %
Total number of stops	Vehicle/hour, %
Time of traffic jam	%
Fuel volume	Liters/hour
Maintenance	$/hour

Reports are generated in Microsoft Excel format

ARTERY eco system

Integrated with:

- StaTran 4.0
- Transyt-7F
- Traffic View -32

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TRANSYT-7F Release 10.3 -- Genetic Algorithm Optimization

dolzhanskaya - murashkinskaya
File D:\_AGA\Town\Itersection\TRANSYT\new\Test.tin
Simulation Engine: TRANSYT

Genetic Algorithm Input Parameters
----------------------------------
Crossover Probability (%):                   30
Mutation Probability (%):                    1
Convergence Threshold (%):                   0.01
Maximum Number of Allowable Generations:     200
Actual Number of Optimization Generations:   7
Population Size:                             20
Random Number Seed:                          7781
Elitist Method:                              True
Objective Function:                          Disutility Index

Optimization Results  (Cycle Length and Splits)
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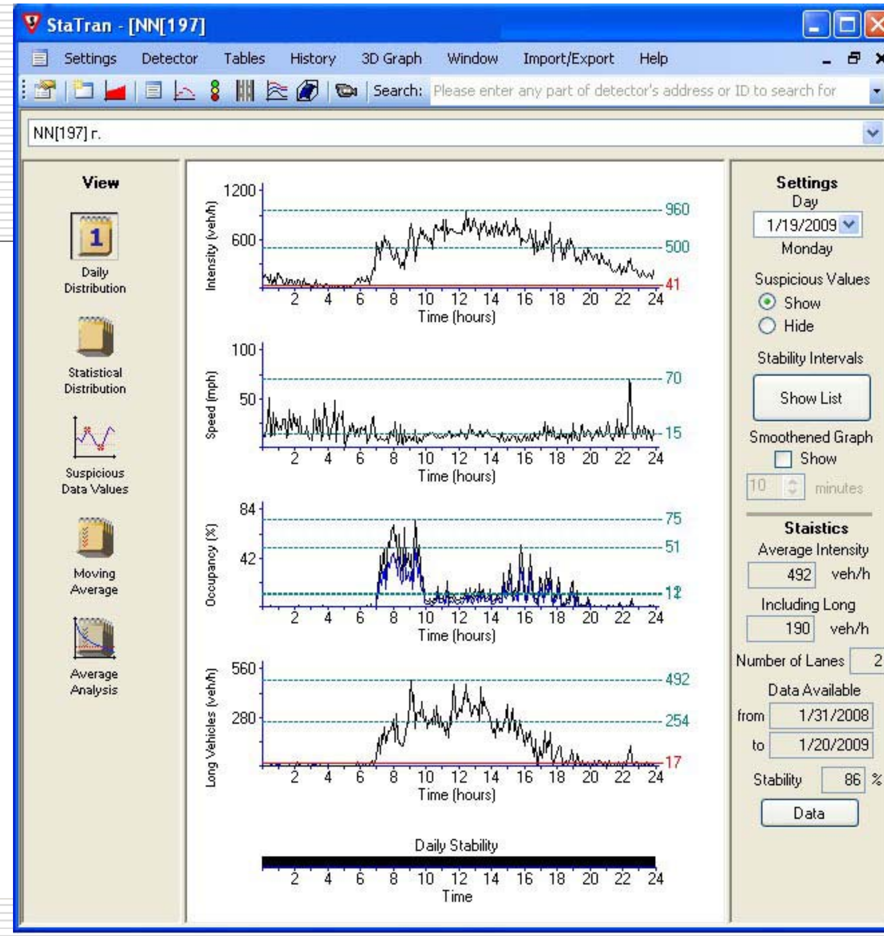
Node  Cycle      Offset    NS Phasing EW Phasing
    Init Final  Init Final  Init Final Init Final
  1  65   70      0     0    ---   ---  ---   ---
  2 ---  ---    ---   ---    ---   ---  ---   ---
  3 ---  ---    ---   ---    ---   ---  ---   ---

Node Split #1   Split #2   Split #3
    Init Final Init Final Init Final
  1  21   29    23   20    21   21
  2  --   --
  3  --   --

              Control    Total     Fuel      Travel   Performance
               Delay     Stops  Consumption   Time       Index
             (sec/veh)    (%)    (lit/hr) (veh-hr/hr)

Initial         5.9       22        55        11       1481.00
Final           5.9       20        54        11       1480.00

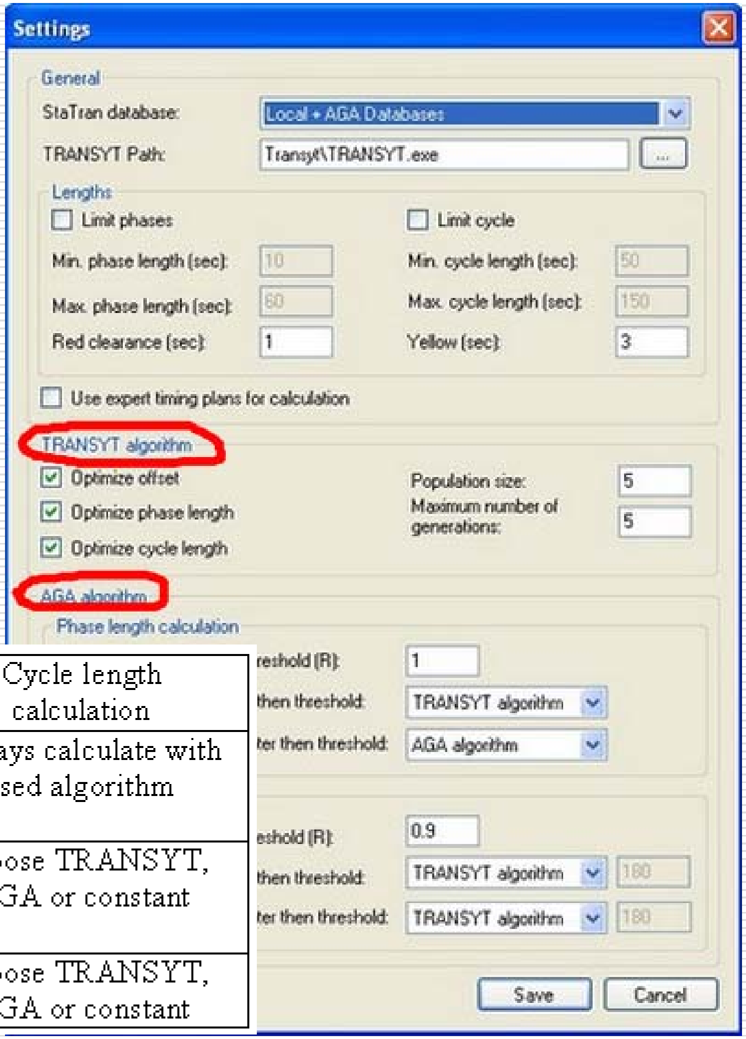
The final solution originated in generation #2
To obtain detailed output, process the punch file:
Test.pun
```



Optimization algorithms

There are two pre-set optimization algorithms: TRANSYT and AGA.

Full user control over optimization parameters and criterions.



R	Saturation level	Phase length calculation	Cycle length calculation
R <= 0.9	Saturated intersection	TRANSYT, AGA or both algorithms are acceptable	Always calculate with used algorithm
0.9 < R < 1.0	Intersection is on the verge of saturated and unsaturated	TRANSYT, AGA or both algorithms are acceptable	Choose TRANSYT, AGA or constant
R >= 1.0	Unsaturated intersection	Always use AGA algorithm	Choose TRANSYT, AGA or constant

Why ARTERY?

1. There are more than 350000 intersections in the USA.
2. According to PATH (UC Berkeley), One experienced traffic engineer can develop 50 sets of timing plans per year.
3. At least once in 2 years any set of timing tables should be recalculated due to traffic flow changes.
4. So, to serve all our intersections we have to assign 3500 experienced traffic engineer for full time employment. That means 70 engineers per state DOT, which is absolutely unrealistic.
5. ARTERY reduces labor for timing plan initial optimizing substantially (at least 12 times) and lower labor for recalculation to ZERO

Therefore, ARTERY is a solution!

Artery 3.0

By reducing the labor involved and therefore reducing operating cost Artery has the potential to shift market focus back from Adaptive to Actuated type of systems

Solaris Development

AGA