

Synchro plus **SimTraffic** **6**

*An In-Depth Look at Trafficware's Latest Version of the Popular
Signal Timing, Capacity Analysis, and Simulation Software.*

We all have heard that congestion on urban freeways and arterials leads to long delays, increased air pollution, and the increased potential for accidents. We all know that the increasing demand for travel within the United States and throughout the world has caused transportation systems to reach the limits of their existing capacity. It is also known that as a transportation system becomes more sophisticated and complex professionals must adopt new ways to manage existing systems more efficiently. But what is not known to transportation professionals including engineers and planners are the direct benefits that traffic analysis software has prior to development and deployment.

Signal Timing Coordination

Two thirds of all miles driven each year are on roadways controlled by traffic signals. In some urban areas, signals at busy intersections may control the movement of more than 100,000 vehicles per day.¹ Traffic engineers face the problem of determining the capacity of these intersections to reduce the delays for the motoring public. By optimizing the capacity of an intersection, traffic professionals can reduce congestion, save time, reduce the number of serious accidents and even reduce aggressive driving behaviors such as red light running.

The Federal Highway Administration (FHWA) recommends that signal retiming should be done every two to three years. There are even special circumstances that could make immediate signal retiming desirable: when a new signal is added or signal is updated; when traffic, pedestrian volumes, or turning movements change significantly; when access to a roadway changes and when there is a change in the geometry of a roadway.¹

Knowing this, agencies still do not retime signals on a regular basis either due to monetary budget constraints or the lack of evidence to prove a need to perform a retiming. However, traffic patterns continually change and increase and without modifying the signal timing, delays can become significant. According to FHWA, as many as 75 percent of all traffic signals could easily be improved by updating equipment, simply adjusting their timing plans or by coordinating adjacent signals.¹

Simulation

Traffic simulation models play a vital role in allowing the transportation engineer to evaluate complex traffic situations that cannot be analyzed directly with other means. The models afford the opportunity to evaluate traffic control and design strategies without committing expensive time consuming resources necessary to implement the alternative strategies in the field. For this reason, the simulation models allow the engineer to analyze many alternatives quickly and avoid the risk, expense, and disruption associated with extensive field experimentation.²

Simulation models improve the decision making process of transportation planners and professionals. Simulation provides the following:

- Project potential future traffic.
- Evaluate planning operational alternatives and prioritize.
- Improve design and evaluation time and costs - cheaper compared to pilot studies, field experiments, of full implementation.
- Use multiple deployment combinations or other complex scenarios in a relatively short time. Reduce disruptions to traffic- cheaply estimate the effects prior to full

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- Present/market strategies to the public/stakeholders - graphic animation displays that can be used as a tool to show possible scenarios to the public or stakeholders.
- Operate and manage existing roadway capacity - recommends the best design or control schemes to maximize performance of transportation facility.

Timing Optimization and Simulation Implications for Traffic Professionals

Traffic professionals face numerous challenges when retiming signals and when using simulation models. Issues range from poor air quality and increased fuel consumption to increased numbers of serious accidents. Consider the following challenges:

Environmental - Air Quality and Fuel Consumption

Motoring Public - Congestion, Time, Accidents, and Aggressive Driving Behavior

Labor - Manpower

Financial - Cost Effectiveness

The process of building and analyzing TRANSYT networks were laborious and time consuming.

A Brief History on Signal Timing Optimization and Simulation

Decades ago, traffic professionals had a very basic means to optimize signal capacity and almost no means to produce a simulated traffic environment. As a way to combat the problems of signal timing optimization and simulation TRANSYT-7F and HCS were developed. TRANSYT-7F was based on punched paper cards until it switched to formatted text files. This meant that the process of building and analyzing TRANSYT-7F networks were laborious and time consuming.

CORSIM is a simulation software developed under contract by the FHWA that combines two components, TRAF-NETSIM and TRAF-FRESIM which model intersection networks and freeways. These models have been under development and in use since the 1970s and also use formatted text files for data input.

The HCM is a reference document published by the Transportation Research Board. It contains the results of research and offers engineers a standard method for analyzing intersections and other transportation facilities. The HCS software implements the HCM methods in software. It is one of the most popular traffic analysis software packages but is limited to analyzing intersections in isolation and has limited optimization options.

What to Look for When Choosing Your Traffic Analysis Software Solution

When deciding on traffic analysis software solution, a number of requirements must be adequately addressed. A good criteria to base your purchasing on would be the *Decision Support Methodology for Selecting Traffic Analysis Tools* as written by the FHWA.

The criterion includes the following:

Geographic Scope - Ability to analyze the appropriate geographic scope or study area for the analysis, including isolated intersection, single roadway, corridor, or a network.

Facility Type - Capability of modeling various facility types, such as freeways, high-occupancy vehicle (HOV) lanes, ramps, arterials, toll plaza, etc.

Travel Mode - Ability to analyze various travel modes, such as single-occupancy vehicles (SOV), HOV, bus, train, truck, bicycle and pedestrian traffic.

Management Strategy - Ability to analyze various traffic management strategies and applications, such as ramp metering, signal coordination, incident management, etc.

Traveler Response - Capability of estimating traveler responses to traffic management strategies including route diversion, departure time choice, mode shift, destination choice, and induced/foregone demand.

Performance Measures - Ability to directly produce and output performance measures such as safety measures (crashes, fatalities), efficiency (throughput, volumes, vehicle-miles of travel (VMT)), mobility (travel time, speed, vehicle-hours of travel (VHT)), productivity (cost savings), and environmental measures (emissions, fuel consumption, noise).

Tool/Cost Effectiveness - For the task at hand, mainly from a management or operational Perspective. Parameters influencing cost-effectiveness include tool capital cost, level of effort required, ease of use, hardware requirements, data requirements, animation, etc.

Synchro plus SimTraffic 6 was developed along two key themes, the first being function-specific enhancements most requested by customers and the second being improved modeling of real world traffic conditions

Trafficware's Synchro plus SimTraffic 6

Trafficware over the last 10 years has developed the industry's most used signal timing and simulation software, Synchro plus SimTraffic. Trafficware continues that tradition with the release of Synchro plus SimTraffic 6, a software suite providing a complete solution for optimizing and modeling urban traffic networks.

Developed along two key themes, the first being function-specific enhancements most requested by customers and the second being improved modeling of real world traffic conditions, Synchro plus SimTraffic 6 easily meets the requirements set forth by the *Decision Support Methodology for Selecting Traffic Analysis Tools*.

Synchro plus SimTraffic 6 Analysis Context: Planning, Design or Operations/Construction						
1	2	3	4	5	6	7
Geographic Scope	Facility Type	Travel Mode	Management Strategy	Traveler Response	Performance Measures	Tool/Cost Effectiveness
What is your study area?	Which facility types do you want to include?	Which travel modes do you want to include?	Which Mmt strategies should be analyzed?	Which traveler responses should be analyzed?	What performance measures are needed?	What operational characteristics are necessary?
Isolated Location	Isolated Intersection	SOV	Freeway Mmt	Route Diversion	LOS	Tool Capital Cost
Segment	Roundabout	Bus	Arterial		Speed	Effort(Cost/Training)
Corridor/Small Network	Arterial	Truck	Intersections	Pre-Trip	Travel Time	Ease of Use
Region	Highway	Motorcycle	Arterial Mmt	En-Route	Volume	Popular/Well Trusted
	Freeway	Pedestrian			Travel Distance	Documentation

Synchro® is a macroscopic capacity analysis and optimization model which allows users to enter data into a single file. Other models generally require one file for each signalized intersection which makes data management cumbersome. With all intersections in one file, a straight-forward analytical capacity analysis can be performed allowing the user to get a

A signal retiming program should take around 20-25 staff hours per intersection. And a general rule of thumb is that it takes one traffic engineer to properly operate and maintain every 75-100 signals and one signal technician to operate and maintain every 40-50 signals.

measure of delays, queues, etc. based on equations. Synchro will also optimize signals in a network. Synchro will attempt to minimize delays and stops. It considers all of the intersection within the file (or zone). This makes it a necessary tool for optimizing traffic signal systems.

SimTraffic® is a more realistic microscopic simulation model. It fully simulates signals, unsignalized intersections (including roundabouts) and the interaction that occurs. Some limitations of the analytical models (such as in Synchro) can be modeled. It is important to note that simulation models do not optimize and are more time consuming. However, SimTraffic uses the inputs for Synchro models, making it quicker to simulate than with other simulation programs.

Synchro plus SimTraffic offers the following benefits:

- Ease of Use
- Increased Management and User Productivity
- Increased Savings
- Improved Air Quality and Fuel Consumption
- Reduced Congestion and Saves Time
- Reduced Accidents, Aggressive Driving
- Industry Acceptance Domestically and Internationally

Management and User Productivity

Management and user productivity indicates how effectively traffic engineering managers and their staff use their time. Making traffic engineering staff members more productive results in direct savings to the organization. Besides reducing the cost of day-to-day operations, gains in management productivity improve the return on hardware and software resources and, more importantly, allow new initiatives to be implemented more rapidly.

The following information was taken from the *ITE Traffic Control Systems Operations: Installation, Management and Maintenance* brochure on estimated labor requirements. A signal retiming program should take around 20-25 staff hours per intersection. And a general rule of thumb is that it takes one traffic engineer to properly operate and maintain every 75-100 signals.

A report on the average salary by Salary.com in 2003 shows that a Traffic Engineer Level I earned approximately \$30/hr which is indicative of a base salary, bonuses and benefits.

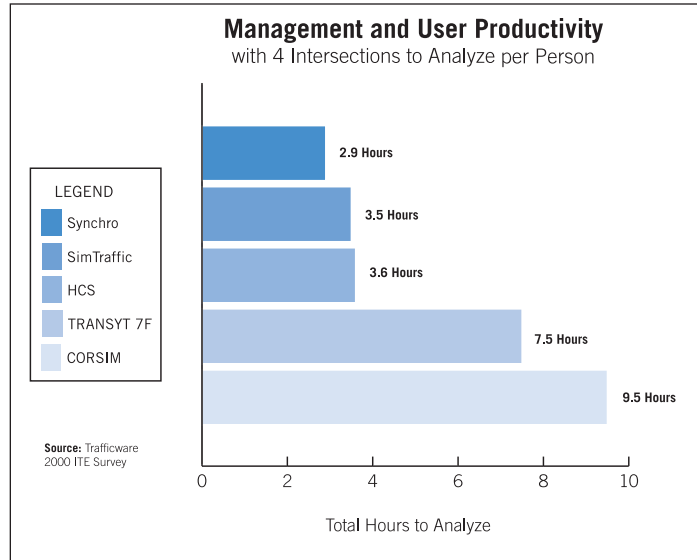
A survey was conducted in June 2000 to find out what software packages are being used for traffic analysis. The anonymous survey was mailed to 400 randomly selected ITE members. The survey asked the respondents to discard the survey if they did not work with traffic analysis software. An unsolicited mail survey was conducted to prevent bias towards the user base of any individual product.

In the survey, traffic professionals were asked how many hours estimated would it take to analyze four intersections for one time period using each of the following software packages: Synchro, SimTraffic, HCS, TRANSYT-7F and CORSIM. The estimated time also accounted for quality review and error correction.

By taking into account the standards set forth by the *ITE Traffic Control Systems Operations: Installation, Management and Maintenance* brochure on estimated labor requirements and the average salary for a Traffic Engineer Level 1 by Salary.com, govern-

ment agencies and consultants could look to save up to \$10,650.00 per engineer for every hundred signals timed using Synchro plus SimTraffic as their traffic software of choice.

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Synchro plus SimTraffic 6 offers the following important advantages:

Ease of Use

Synchro has straight forward data entry windows. The other software used to be DOS based, but they are getting better. However, the others have been slow to respond. The leading competitor, the HCS, requires each intersection to be coded in a separate file. The effects of coordination (delay added or subtracted due to signals in a system) in the HCS, needs to be estimated by the user. Synchro can model all of your intersections in one file. The effects of coordination are directly calculated by Synchro and not a guess by the user. The big ease of use is for groups of intersections. Also, the way you enter data is very intuitive. Easy to follow windows step you through the data items. Next, data for timing is entered in the same format that your controller works on the street. In the HCS, the data needs to be taken from the controller and converted into a format acceptable by the HCS. In technical terms, the controller and Synchro operate with dual-ring control. The HCS uses only single-ring control.

Positive Return on Investment

To get an accurate measure of the investment in using Synchro plus SimTraffic, Trafficware has taken into account for the setup, upgrade, and replacement costs for the traffic signal timing software, in addition to the purchase price. Training and maintenance costs were also included in the total investment figure.

Companies with a 100 user's upgrading to version 6 of Synchro plus SimTraffic invest an average of \$162,244 over three years, which includes \$40,000 in training costs, \$8000 in setup and installation costs, and free technical support and maintenance.

Investment Costs for Upgrading to Synchro plus SimTraffic 6 Over 3 Years		
Item	Cost - 5 User License	Cost - 100 User License
Synchro plus SimTraffic 5	\$ 11,596	\$ 16,234
Upgrade to Synchro plus SimTraffic 6	\$ 4,337	\$ 98,010
Training	\$ 2,000	\$ 40,000
Setup and Installation <small>(includes labor, travel and misc. expenses if needed)</small>	\$ 400	\$ 8,000
Support and Maintenance	\$ Free	\$ Free
Total	\$ 18,333	\$ 162,244

Trafficware bases its ROI calculation on a number of assumptions:

- Time values are multiplied by base salary plus bonuses and benefits provided by Salary.com to quantify efficiency and manager productivity savings
- Downtime values are a product of the number of hours of downtime multiplied by the number of users affected
- The impact of unplanned downtime is quantified in terms of impaired end-user productivity and lost revenue
- Lost productivity is a product of downtime by burdened salary
- Lost revenue is a product of downtime multiplied by the average generated per hour.

Based on an average investment of \$162,244 over three years, the payback period for using Synchro plus SimTraffic averaged 53.8 days, which equates to an ROI of 1628%.

Trafficware used the payback and NPV methodology to determine the total ROI of using Synchro plus SimTraffic. The NPV method calculates the value in today's dollars for the three-year returns on an investment, including the annual average cost savings in IT management and user productivity as well as IT management efficiency.

ROI Analysis for Upgrading to Synchro plus SimTraffic 6		
Item	5 User License Average	100 User License Average
Three Year Cost of Investment	\$ 18,333	\$ 162,244
Annual Savings from Increased Management and User Productivity	\$ 53,250*	\$ 1.1 Million*
Net Present Value of 3 Year Savings	\$ 109,564	\$ 2.5 Million
Payback Period	125 Days	53.8 Days
ROI	698%	1628%
Source: Trafficware 2004 *Results may vary.		

For customers using Synchro plus SimTraffic, these savings average about \$1.1 million annually. Trafficware then accounts for the opportunity costs realized by not having invested the initial amount in some other instrument yielding a 12% return. This results in a NPV of approximately \$2.5 Million.

Payback is the time required for the saving generated to equal the initial investment. Based on an average investment of \$162,244 over three years, the payback period for using Synchro plus SimTraffic averaged 53.8 days, which equates to an ROI of 1628%.

UTDF contains the ability to store multiple volume counts and timing plans for multiple intersections.

The ICU is more precise and less subject to manipulation, and is intended to be used in planning applications such as future roadway design and site impact studies. The ICU objective function is volume to capacity ratios, rather than delay; it is designed to measure the "true" capacity of an intersection.

Improved Features and Enhancements

Curved Links - Synchro and SimTraffic will now support curved links. Curved links add increased flexibility to accurately model complex networks.

Queue Interactions Analysis and Optimization - Synchro 6 now includes a term for Queue Interaction Delay. The queue interaction analysis determines additional delays caused by starvation, spillback, and storage length blocking. Queue Delay is an integral part of the optimization objective in Synchro so this will be directly considered during optimizations.

Improved Intersection Capacity Utilization (ICU) Modeling - Includes improved modeling of shared left-through lanes and an ICU method for determining the true capacity of diamond interchanges.

Right Turn Islands - Synchro and SimTraffic now support right turn islands. The user will be able to enter whether the right turn is channelized and if it is, the curb radius and number of add lanes.

Simulated Roundabouts - SimTraffic now includes detailed modeling for roundabouts. SimTraffic is the only American model to perform micro-simulation of roundabouts. SimTraffic can simulate single and multi-lane roundabouts with multi-lane entries and exits. Entry control types include Stop, Yield, or Merge. Right turn slip lanes, and pedestrians across the links are also modeled.

Multiple Run Recording - SimTraffic now includes an option to record multiple runs with different random number seeds. Reports will allow the user to summarize the average of the selected number of runs.

Powerful Presentations

The effectiveness and success of your presentation depends on your ability to organize your gathered information and present them effectively. Synchro plus SimTraffic 6 gives you the tools to make a great presentation possible. Synchro plus SimTraffic 6 has the capabilities to help improve your presentation including: animations with aerial photo backgrounds, detailed colored time-space diagrams and complete easy to understand reports.

Universal Traffic Data Format

The Universal Traffic Data Format (UTDF) is a standard data format specification for traffic signal and traffic related data for intersections. UTDF can be used for transferring data between traffic software packages. UTDF can also be used to share data between software and traffic signal controller hardware. UTDF contains the ability to store multiple volume counts and timing plans for multiple intersections. This allows for a structured method of storing large amounts of traffic data.

ICU Methodology

Synchro plus SimTraffic uses the Intersection Capacity Utilization (ICU) methodology for analyzing intersection capacity. The ICU is more precise and less subject to manipulation, and is intended to be used in planning applications such as future roadway design and site impact studies. The ICU objective function is volume to capacity ratios, rather than delay; it is designed to measure the "true" capacity of an intersection. The ICU is designed to be used in conjunction with delay based methods such as Synchro and the HCM to give an overall picture of intersection performance.

Support

Trafficware's support applies to registered Synchro plus SimTraffic 6 users worldwide. As a registered owner of the current version of Synchro plus SimTraffic, you are eligible to receive free person-to-person support on issues related to installation and product defects, including crashes and errors caused by the Trafficware software and technical issues pertaining to signal timing optimization and simulation. All you need is your name, company or agency that you work for, and in some cases your product key. There is no charge for this service; you only pay for the cost of the call.

Why Trafficware and Synchro plus SimTraffic 6?

Trafficware Corporation is a privately held California software company headquartered in Albany. Founded in 1993, Trafficware has created a unique signal timing and optimization software that has made them the leaders in traffic analysis software. Synchro plus SimTraffic 6 offers a single, powerful and intelligent solution for optimizing and modeling urban traffic networks.

Trafficware has extensive expertise in the transportation analysis software market. Over 4,000 Government Agencies, Private Consultants, and Universities worldwide rely on Synchro plus SimTraffic for their signal timing and simulation needs. Trafficware is also highly renowned for their customer service and unmatched support.

To find out more about Trafficware and Synchro plus SimTraffic 6, please visit www.trafficware.com.

Sources

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