



# **A “Traffic Signal Analysis” Tool for ArcGIS Desktop**

**Radha Krishna Swayampakala  
Department of Civil Engineering  
University of North Carolina, Charlotte**

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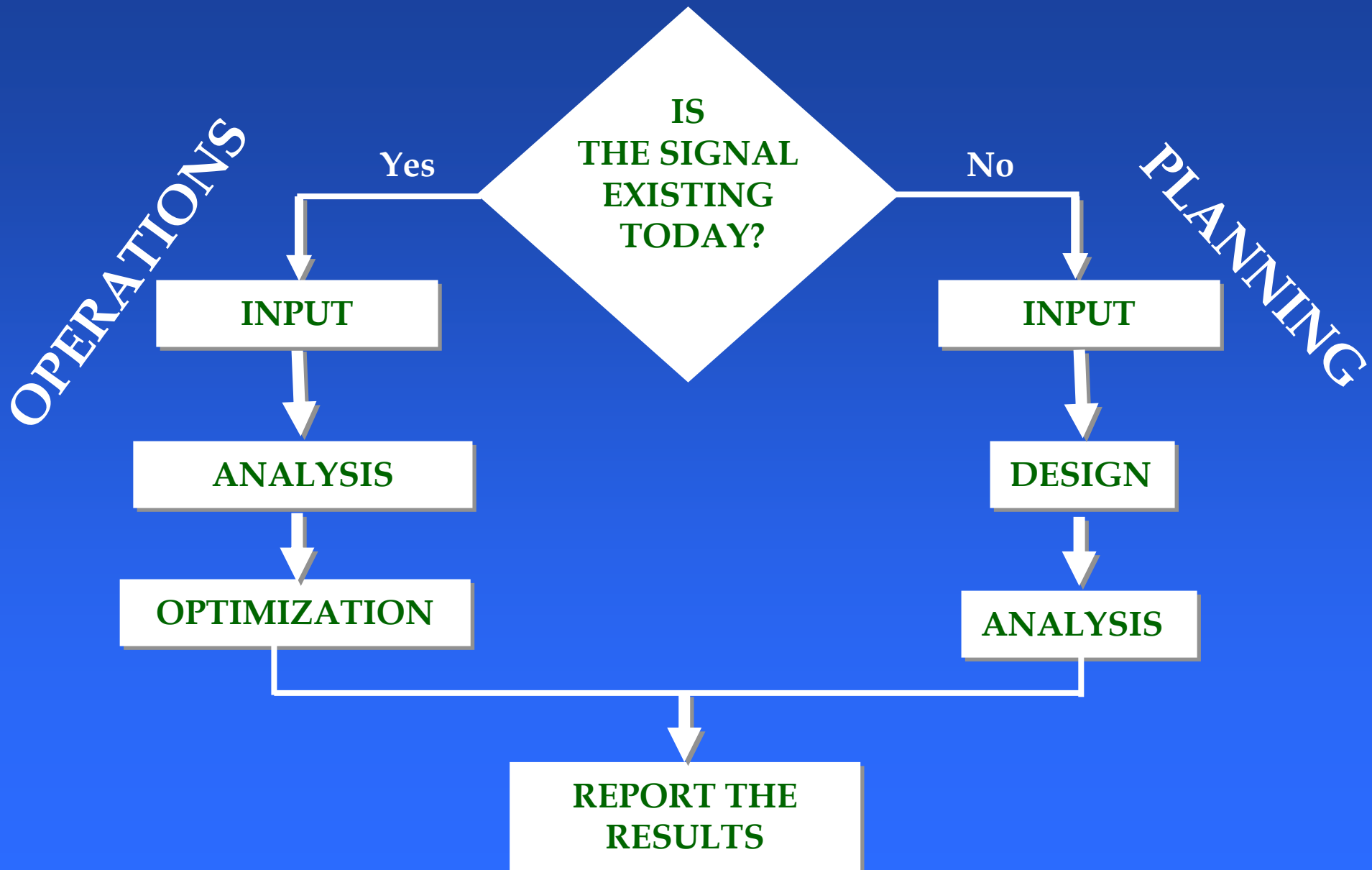
# OUTLINE...

- Background
- Signal Analysis Tools
- What is TSAT?
- Is TSAT a solution?
- Methodology
  - ArcMAP
- Data Analysis
- Questions ?

# BACKGROUND

- **Signalization is a Two Phase process**
  - Designing a New Signal
  - Analyzing & Optimizing existing signals
- **Data Elements**
  - Geometric Conditions
  - Volume Information
  - Timing & Phasing Information
- **Software**
  - HCS
  - SYNCHRO
  - TRANSYT-7F

# BACKGROUND... SIGNALIZATION



# BACKGROUND... DATA ELEMENTS

<b>Geometric Conditions</b>	<b>Volume Information</b>	<b>Timing &amp; Phasing Information</b>
Cross street names	Traffic Volume	Cycle length
Road width	Pedestrian Volume	Signal Splits
Number of lanes and lane sharing	Peak Hour Factor	Length of Green, Yellow and Red signals
Grade	Bus blockage	Turn types
	Parking	Phase numbers
	Heavy Vehicles	

# BACKGROUND...

## PRIMARY DATA ELEMENTS

- Cycle Length
- Green, Yellow & Red times
- Delay (sec/veh)
- LOS Table (A - F)
- v/c Ratio

<i>LEVEL OF SERVICE</i>	<i>SIGNAL DELAY (Sec/Veh)</i>
A	$\leq 10$
B	$>10$ AND $\leq 20$
C	$>20$ AND $\leq 35$
D	$>35$ AND $\leq 55$
E	$>55$ AND $\leq 80$
F	$> 80$

# BACKGROUND...

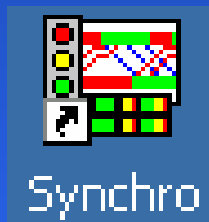
## EXISTING SOFTWARE PROBLEMS

- **Database**
  - 650 Traffic Signals \* 2 SYNCHRO Files = 1300 Files
- **GIS Capability**
- **Exporting Capability**
  - Text Report

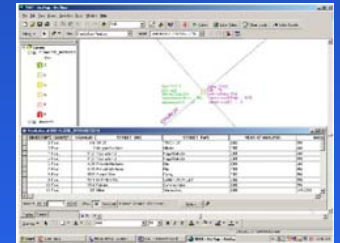


# WHAT IS TSAT?

- A new add on toolbox created for ArcGIS Desktop
- Works as an Interface between Signal Analysis tools and ArcGIS



TSAT



- Helps to analyze the data and produce various maps with a variety of Symbols and Labels

# IS TSAT A SOLUTION ?

## Database

- Provides a huge database with 252 fields
  - Provides quick and easy access to signalized intersection information

## GIS Capability

- Provides all the ArcView GIS functionality
  - Allows for swift identification of troubled intersections

## Exporting

- Geodatabase will be in Access format
- Keep maintenance activities up to date to help spot problems before they occur

# METHODOLOGY

- Signal Analysis in SYNCHRO
- Creating a Text report in SYNCHRO
- Data Transfer
  - How TSAT works?
  - Importing the data to TSAT
  - Data Analysis

# METHODOLOGY...

# SIGNAL ANALYSIS in SYNCHRO

- **FOUR** Stages
  - Map Window
  - Lane Window
  - Volume Window
  - Timing & Phasing Window

The screenshot displays three windows from the Synchro 4 software interface for a signal at 9th & Church.

**Map Window:** Shows a map view of the intersection with lane markings and traffic flow directions. Lane widths are indicated as 18, 1655, and 264 feet.

**Lane Window:** Shows the configuration for the signal. The table below represents the data shown in this window:

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes and Sharing (EBRL)	1			1						1		
Ideal Sat. Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)	0			0			0			0		
Area Type	Other			Other			Other			Other		
Storage Length (ft)	0			0			0			0		
Storage Lanes (#)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	55			55			55			55		
Trailing Detector (ft)	-5			-5			-5			-5		
Turning Speed (mph)	15			15			15			15		
Lane Utilization Factor	1.00			1.00			1.00			1.00		
Right Turn Factor (prot)	0.831			0.831			0.831			0.831		
Left Turn Factor (prot)	1.000			1.000			1.000			1.000		
Subsaturated Flow Rate (prot)	1629			1629			1629			1629		
Right Turn Factor (prot)	0.831			0.831			0.831			0.831		

**Volume Window:** Shows the traffic volume for the signal. The table below represents the data shown in this window:

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	0	94	81	97	49	0	0	0	0	264	1655	18
Conflicting Ped. (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour Factor	1.00	0.97	0.72	0.76	0.56	1.00	1.00	1.00	1.00	0.96	0.93	0.64
Growth Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Adj. Parking Lane?	No	No	No	No	No	No	No	No	No	No	No	No
Parking Manuevers (#/hr)												
Traffic Issue and Block (%)	0			0			0			0		
Link OD Volumes												
Adjusted Flow (vph)	0	108	112	128	88	0	0	0	0	307	1780	28
Lane Group Flow (vph)	0	220	0	0	216	0	0	0	0	0	2115	0

**Timing & Phasing Window:** Shows the timing and phasing for the signal. The table below represents the data shown in this window:

Control Type	Minimum Initial (s)	Minimum Split (s)	Maximum Split (s)	Minimum Gap (s)	Time Before Reduce (s)	Time To Reduce (s)
2-SBTLL	18.0	8.0	23.0	25.0	0.0	0.0
4-EBWB	18.0	8.0	23.0	25.0	0.0	0.0
Minimum Split (s)	23.0	21.0	25.0	25.0	0.0	0.0
Maximum Split (s)	23.0	21.0	25.0	25.0	0.0	0.0
Yellow Time (s)	4.0	4.0	4.0	4.0	0.0	0.0
All-Red Time (s)	1.0	1.0	1.0	1.0	0.0	0.0
Lead/Lag						
Allow Lead/Lag Optimize?						
Vehicle Extension (s)	0.2	1.3	0.2	1.3	0.0	0.0
Minimum Gap (s)	0.2	1.3	0.2	1.3	0.0	0.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Coord	None				
Pedestrian Phase	Yes	Yes				
Walk Time (s)	7.0	6.0				
Flash Don't Walk (s)	8.0	10.0				
Pedestrian Calls (#/hr)	0	0				
90th Side Green Time (s)	60	cd	20			
70th Side Green Time (s)	60	cd	20			
50th Side Green Time (s)	60	cd	20			
30th Side Green Time (s)	60	cd	20			
10th Side Green Time (s)	63	cd	17			

# METHODOLOGY...

## Text File in SYNCHRO

Signal ID &  
Street Names

Date of Analysis

Select Reports

Select Reports

Options

Header

%description%

%date%

%time%

Footer

First Page #: 1

Header...

Graphics...

Save Text

Print

Preview

Print Setup

Cancel

Scope

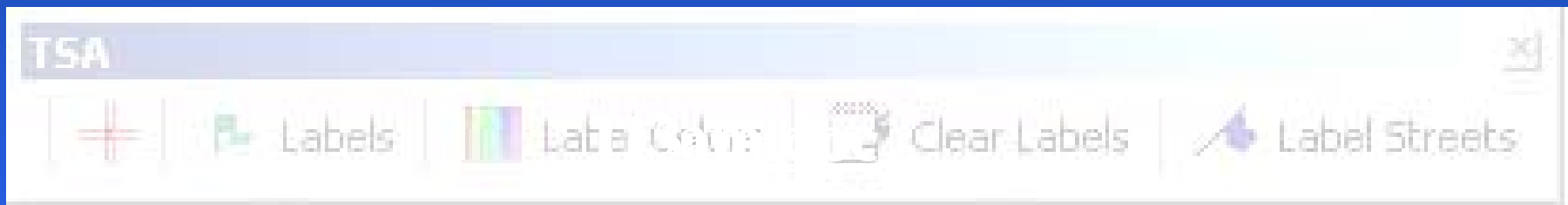
Single Intersection

Zone

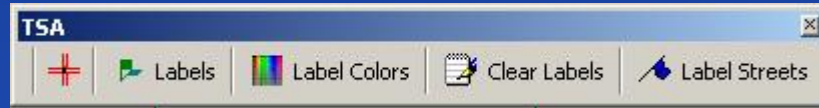
Entire Network

Time of Analysis

# METHODOLOGY... DATA TRANSFER



# METHODOLOGY... HOW TSAT WORKS?



Predefined point symbol (Third Step)

SIGNALIZED\_INTERSECTION feature class (Second Step)

The screenshot shows the ArcMap interface. The map displays a signalized intersection with a yellow signal symbol and a pink street name 'CHURCH'. The layers panel on the left shows the 'SIGNALIZED\_INTERSECTION' feature class with various signal types (A-F). The attribute table at the bottom lists the following data:

OBJECTID*	SHAPE*	SIGNALID	STREET_ONE	STREET_TWO	YEAR OF ANALYSIS	ANALYSIS DATE
2	Point	114	9th ST	TRYON ST	2002	
3	Point	3	Margaret Wallace	Idlewild	2000	
4	Point	1427	Albemarle Rd	Regal Oaks Dr	2001	
5	Point	1427	Albemarle Rd	Regal Oaks Dr	2001	PM
6	Point	1435	Pineville-Matthews	Elm	2001	AM
7	Point	1435	Pineville-Matthews	Elm	2001	PM
8	Point	1502	Sharon View	Colony	2002	PM
9	Point	1544	FAIRVIEW RD	CAMERON VALLEY	2002	PM
10	Point	1544	Fairview	Cameron Valley	2000	PM
11	Point	307	Milton	Sharon Amity	2000	3/5/2000

Zooming to the intersection (First step)

New Geodatabase

# METHODOLOGY...

## IMPORTING DATA to TSAT

DATA from TEXT FILE → Geodatabase

Data Elements	Number of Fields
Object_Id, Shape, Two Street names and Signal_Id	5
Timing of analysis (AM/PM)	1
Year of the analysis	1
Traffic Volume of each approach	40
Pedestrian Volume of each approach	40
Lane configuration of each approach	40
Natural & Optimized cycle lengths	2
LOS, Delay and v/c Ratio of each approach	3
LOS, Delay and v/c Ratio of whole intersection (3 * 40)	120
<b>Total Fields</b>	<b>252</b>



# TSAT in ArcMAP



# METHODOLOGY... DATA ANALYSIS

- User can produce a map showing all the traffic signals in the area
  - Classified based on the signal performance such as LOS or intersection delay or v/c ratio
  - Depicting all the intersections that have single left turn lanes and serving at LOS F (Failure)
  - Having Right Turn Volume more than 99 and conflicting pedestrians greater than 49

# FUTURE WORK



# QUESTIONS ?



**RADHA KRISHNA SWAYAMPAKALA**

**[rkswayam@uncc.edu](mailto:rkswayam@uncc.edu)**

**KEVIN YOUNT**

**[kyount@esri.com](mailto:kyount@esri.com)**

**ARTHUR ROBINSON**

**[arobinson@esri.com](mailto:arobinson@esri.com)**