PTV GROUP

PTV Vistro

Advanced Traffic Signal Training

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Contents

Tables

Examples

1 Starting out

1.1 Global Settings

When starting a new project it is best to revisit Global Settings at **Edit->Global Settings** to ensure that the signal parameters are set to your agency preferences. Each signal created (or converted signal not containing the specified data) will have these global defaults.

Note: Global Settings can be changed at any time during the project to adapt to multiple locations or corridors, districts, or jurisdictions with a project.

Additionally, **Default Signalization** utilizes the Global Setting parameters when automatically setting up the traffic signal controller. See **Page 20** for Default Signalization information.

For the full list of Global Setting Parameters for setting up a traffic signal using HCM Methods, see **Table 1-2 on Page 5**. A few additional parameters are available if the Canadian Capacity Guide methodology is selected as an analysis method.

Tip: Global Settings should be reviewed and adjusted as needed before Importing a in a Synchro model, as Vistro most often includes more information than Synchro. See **Section 0** for more information on Synchro .csv Imports or model Merging and Updates.

Back to top

1.1.1 *Default Signal Group scheme*

Excerpted from **Table 1-2,** intersections created with default signalization will use the following NEMA signal group orientation defaults for the major and minor flow directions, or any other agency signal group scheme. By default, Vistro follows the NEMA scheme, as shown in **Figure 1-1** from *NCHRP Report 812, Signal Timing Manual, Second Edition's Exhibits 5-1* and *5-3*.

Table 1-1: NCHRP Report 812's NEMA Phasing Scheme

Signal Group Scheme Parameter	Description
Major Flow Direction	Determines if the north-south direction or the east-west directions should be the set to the major flow.

| Northbound Signal Group (major)	If the north-south directions are the intersection's major flow, this determines the default northbound signal group.
North-westbound Signal Group (major)	Determines the default major flow signal group for skewed intersections in the north-westbound direction.
North-eastbound Signal Group (major)	Determines the default major flow signal group for skewed intersections in the north-eastbound direction.
Eastbound Signal Group (major)	If the east-west directions are the intersection's major flow, this determines the default eastbound signal group.

Figure 1-1: NEMA Traffic Signal Phasing
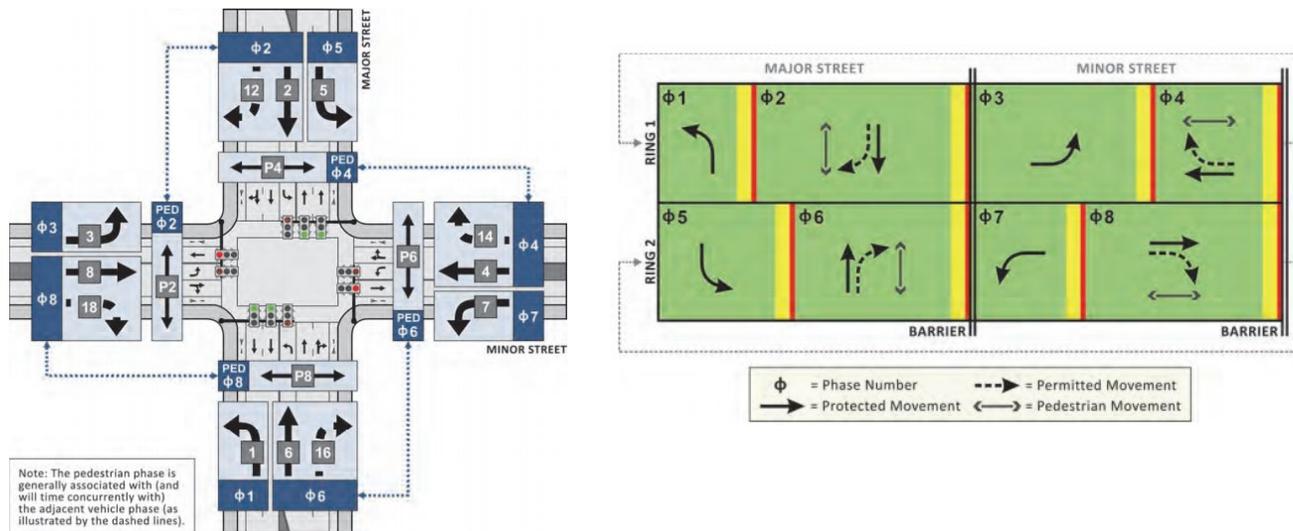
Table 1-2: Global Setting Parameters for setting up a traffic signal using HCM Methods

Global Setting Parameter	Default Setting	Optional Setting	Traffic Control Workflow
Analysis Period	15 min	1 hr	Intersection Settings
Located in CBD	Yes	No	Intersection Settings

Major Flow Direction	North-South	East-West	Intersection Settings
Northbound Signal Group (major)	6	2, 4, 8	Phasing & Timing
Northwestbound Signal Group (major)	6	2, 4, 8	Phasing & Timing
Northeastbound Signal Group (major)	2	4, 6, 8	Phasing & Timing
Eastbound Signal Group (major)	2	4, 6, 8	Phasing & Timing
Lead/Lag Setting	Lead	Lag	Phasing & Timing
Cycle Length (s)	90	0-255	Intersection Settings
Coordination Type	Time of Day Pattern Coordinated	Time of Day Pattern Isolated, Free Running	Intersection Settings
Actuation Type	Fixed Time	Fully Actuated, Semi-Actuated	Intersection Settings
Offset Reference	LeadGreen – Beginning of First Green	- Beginning of Both Green; - Beginning of First Yellow; - Beginning of First Red; - Beginning of First Flashing Don't Walk; - LagFO; - LagEnd; - CoordEnd;	Intersection Settings
Permissive Mode	Single Band	Multi-Band, Reservice	Intersection Settings
Intersection Lost Time (s)	0	0-(cycle length-0.1) s	Intersection Settings
Minimum Green, Through (s)	10	0-255 s	Phasing & Timing
Minimum Green, Left (s)	5	0-255 s	Phasing & Timing
Amber (s)	3.0	0-255 s	Phasing & Timing
Allred (s)	1.0	0-255 s	Phasing & Timing
Vehicle Extension (s)	3.0	0-25.5 s	Phasing & Timing
Walk (s)	5.0	0-255 s	Phasing & Timing
Pedestrian Walking Speed (ft/s)	3.50 f/s (1.07 m/s)		Intersection Settings

Back to top

2 User Interface for Traffic Signal Controllers

2.1.1   *Placing a signal refresher*

Junction Type: To place a signalized using the junction type, select the signalized intersection junction type from the expansion list. Then, with the intersection placement icon displayed, left-click on the base map to place the junction at the desired location.

 ->
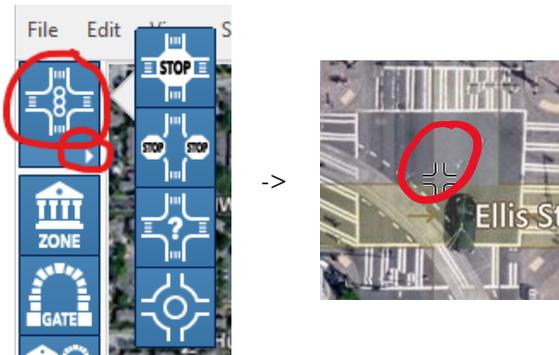
Right-Click: A signalized intersection can be placed at the mouse position by using the *Right-Click* button on a roadway segment's Leg or on at a location on the base map. The right-click will open the context menu. Then select **Insert Intersection -> Signalized**.
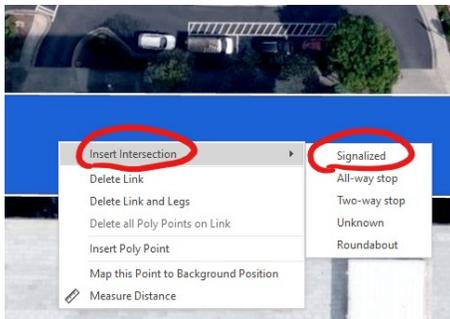
Copy and Paste: A signalized intersection can be placed by copying and pasting an existing signalized intersection. This will make an exact copy of the signal; however, the location will be assigned a new Intersection Number and Controller ID. This can be achieved by selecting an intersection, right-clicking to open the context menu, and selecting **Copy Intersection**. To paste an intersection, find a desired location on the base map, right-click to open the context menu, then select **Paste Intersection**. CTRL+C and CTRL+V are intersection copy and paste shortcuts, respectively.

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2.1.2 *Network Graphic Parameters for Traffic Signal Parameters and Analysis*

PTV Vistro includes many graphic parameters that are useful for traffic signal controller setup and evaluation, as shown in **Table 1-3**. For example, showing signal groups in the network editor enables you to see exactly what movement is allocated which signal group number at the intersection creating strong correlations to the Phasing & Timing Tables, Phase Diagram, and Sequence.

Table 1-1: Network Graphic Parameters useful for Traffic Signal Controller Setup and Analysis

Graphic Parameter	Toolbar Icon	Description
Show Signal Groups		Shows the signal groups per approach movement as indicated in the Traffic Control Workflow, sequence, and phase diagram.
Show Detailed Traffic Conditions		Show movement and lane group results on each approach per the Traffic Control Workflow calculations
Show Intersection Info		Shows intersection information. Regarding traffic signals, the controller type, controller, number, coordination group, cycle length, and intersection ICA check displays useful information.
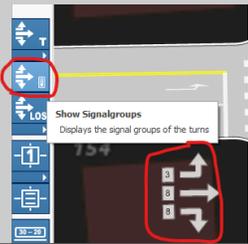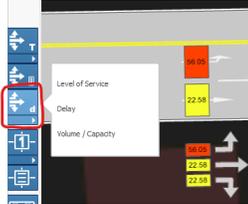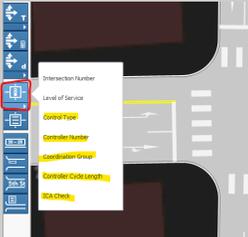
2.1.3 *Signal Control Menu*

Next, the **Signal Control** menu, summarized in **Table 1-4**, contains the tools and lists for traffic signal setup, optimization, and editing.
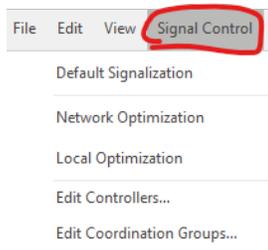
Table 1-2: Signal Control Menu

Menu Items	Control Window	Description
Default Signalization		Creates default signalization for **ALL** intersections at 1 time.
Network Optimization		Contains settings for network optimization along 1 or multiple coordination groups.
Local Optimization		Contains settings for local optimization and the option to optimize all intersections at one time locally.
Edit Controllers		Enables renumbering of Controller ID numbers and add controller descriptions or inventory information. This lists the associated Intersection(s) number to each Controller ID. Lists can be filtered.
Edit Coordination Groups		Create, delete, and name coordination groups. Also, a Master Controller ID can be selected from a list of intersections that are members of each coordination group.
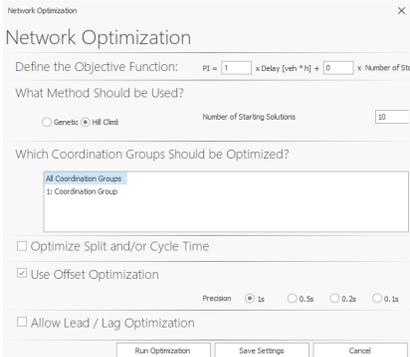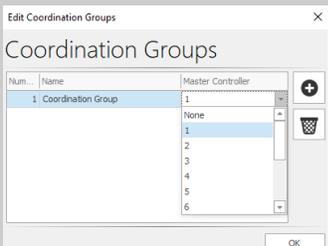
Back to top

2.1.4   *Traffic Signal Workflow Table*

Traffic signal information is entered on the Traffic Control Workflow table. The Control Type needs to be set to Signalized to create and edit a traffic signal controller.

Figure 1-1: Traffic Signal Workflow Table
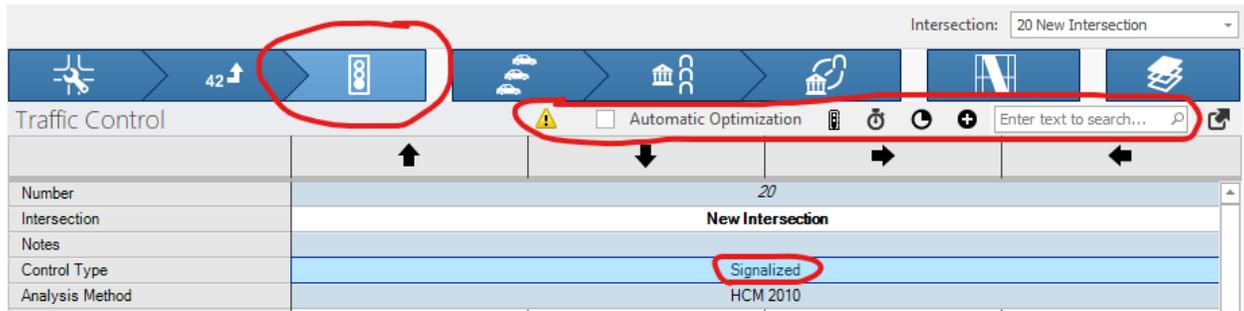
On this workflow table, there is a special toolbar that is useful for traffic signal optimization, calculation checking, and data entry.

Figure 1-2: Traffic Signal Workflow Toolbar

Menu Items	Description
ICA Check	This tool checks for basic parameters used for an Intersection Capacity Analysis. This tool along with the graphic parameter (Show Intersection Info -> ICA check) provides a basic quality control check of the model. Clicking on this button displays warnings or critical error messages useful to fix the intersection's setup.
Automatic Optimization	When checked, Automatic Optimization can be used to quickly optimize intersection, locally. This is useful when new volume parameters, intersection configurations, trip distributions, assignment information, and other relevant parameters are entered. Default Optimization parameters will be taken from Global Setting and the Local Optimization settings under the menu **Signal Control->Local Optimization**.
Default Signalization	After setting the primary controls and methods, this button activates default signalization at the active intersection. This generates signal groups based on the control types and the Sequence and Phase Diagram for common 3 and 4-leg intersections. Default Signalization will use the timing parameters defined in Global Settings and the Major and Minor street Priority Scheme to allocate the NEMA phasing convention. **Min. green times and clearance intervals will be overwritten**.
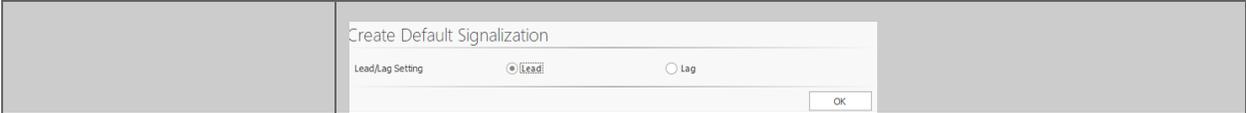
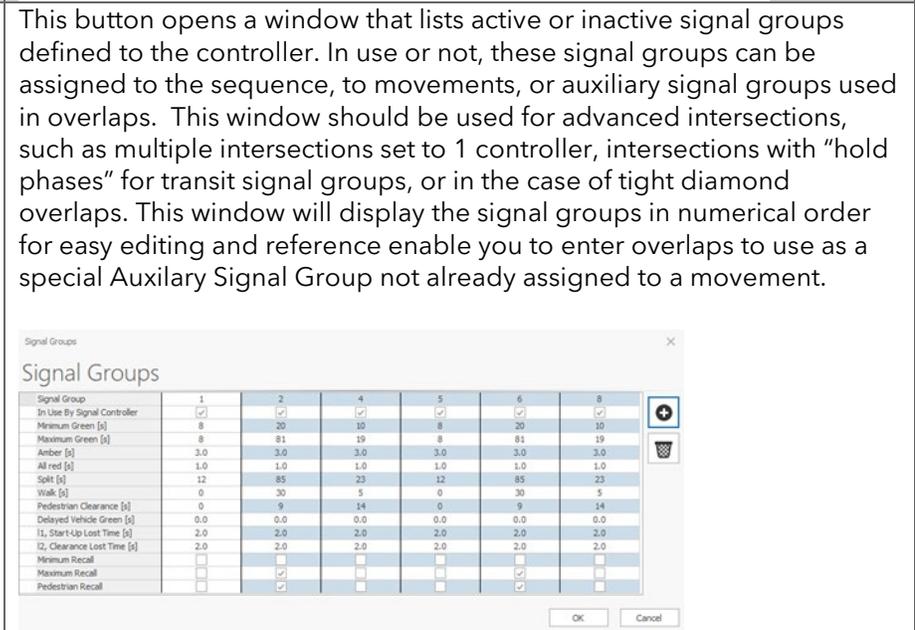|	
	Create Default Signalization Lead/Lag Setting ⦿ Lead ◯ Lag OK
Optimize Split and Cycle Time	This button activates the Local Split and Cycle Time optimization menu, but only for the active intersection. **Intersection min. green times and clearance intervals are respected**. Here local settings and optimization strategies can be selected, such as upper and lower limits to the cycle length, step sizes, objective functions. Optimize Split and Cycle Time Objective Function ⦿ V / C Balancing ◯ Minimize Critical Movement Delay Cycle Optimization Settings ⦿ Between Boundaries ◯ Try Set Lower Bound 60 Step Size 10 Upper Bound 150 OK
Optimize Split	This button activates the Local Split (only) menu, but only for the active intersection. **Intersection minimums and clearance intervals are respected**. Here local settings and optimization strategies can be selected, such as upper and lower limits to the cycle length, step sizes, objective functions. Optimize Split Objective Function ⦿ V / C Balancing ◯ Minimize Critical Movement Delay OK
Signal Groups Menu	This button opens a window that lists active or inactive signal groups defined to the controller. In use or not, these signal groups can be assigned to the sequence, to movements, or auxiliary signal groups used in overlaps. This window should be used for advanced intersections, such as multiple intersections set to 1 controller, intersections with "hold phases" for transit signal groups, or in the case of tight diamond overlaps. This window will display the signal groups in numerical order for easy editing and reference enable you to enter overlaps to use as a special Auxilary Signal Group not already assigned to a movement. Signal Groups **Signal Groups** 	Signal Group	1	2	4	5	6	8	 |---|---|---|---|---|---|---| 	In Use By Signal Controller	✓	✓	✓	✓	✓	✓	 	Minimum Green [s]	8	20	10	8	20	10	 	Maximum Green [s]	8	81	19	8	81	19	 	Amber [s]	3.0	3.0	3.0	3.0	3.0	3.0	 	All red [s]	1.0	1.0	1.0	1.0	1.0	1.0	 	Split [s]	12	85	23	12	85	23	 	Walk [s]	0	30	5	0	30	5	 	Pedestrian Clearance [s]	0	9	14	0	9	14	 	Delayed Vehicle Green [s]	0.0	0.0	0.0	0.0	0.0	0.0	 	I1, Start-Up Lost Time [s]	2.0	2.0	2.0	2.0	2.0	2.0	 	I2, Clearance Lost Time [s]	2.0	2.0	2.0	2.0	2.0	2.0	 	Minimum Recall	☐	☐	☐	☐	☐	☐	 	Maximum Recall	☐	✓	☐	☐	✓	☐	 	Pedestrian Recall	☐	✓	☐	☐	✓	☐	 OK Cancel
Search Bar	Within each workflow, a search term can be entered to filter the current Workflow Table. This can be useful to quickly find key parameters, calculation values, or results by name, partial text string, or keyword(s).

| Traffic Control	✓	☐ Automatic Optimization							grid			⊙	⤢
	↗			↖			↘			↘			
Minimum Green [s]	5	5	5	5	5	5	5	5	5	5	5	5
Maximum Green [s]	200	200	200	200	200	200	200	200	200	200	200	200
Green Time Start [s]	0	8	8	0	10	10	171	171	171	158		158
Green Time End [s]	6	154	154	4	154	154	186	186	186	167		167
G, Actual Green Time [s]	6	146	146	4	144	144	15	15	15	9		9
g_i, Effective Green Time [s]	6	146	146	4	144	144	15	15	15	9		9
g / C, Green / Cycle	0.03	0.77	0.77	0.02	0.76	0.76	0.08	0.08	0.08	0.05		0.05
g / C, Green / Cycle	0.03	0.77	0.77	0.02	0.76	0.76	0.08	0.08	0.08	0.05		0.05
P, proportion arriving on green	0.03	0.77	0.77	0.02	0.76	0.76	0.08	0.08	0.08	0.05		0.05
PF, progression factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00

Workflow Pop-out	Some locations require more monitor space to view numerous movements and information. This button enables multi-monitor layouts with a full-screen experience by popping out the workflow tables. Use the windows maximize button to dock the workflow display.

2.1.5 Multi-Change Tool

After intersections are created in Vistro, it may be necessary to update a single, a few, or all intersection parameters all at 1 time, such as clearance intervals, minimum green times, analysis methods, or right-turn on red methods.   The multi-change tool can be used to update key attributes all at once or by customizable selection sets using the list sorting and filtering functionality. Additionally, intersections can be viewed by coordination groups to select intersection sets by a corridor or district. The following is an overview of the multi-change tool.

1. Under the Edit Menu, select **Multi Change**.
2. Select the Attribute to change.
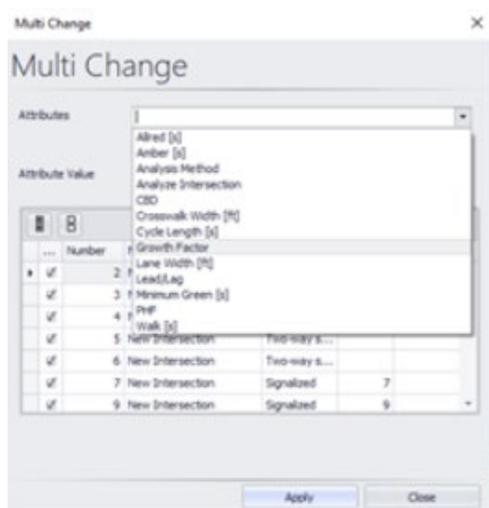
3. Enter attribute value to apply to the intersection selection set
4. Selection Filters:

- All intersections or No intersections using the quick icons.
- Sort ascending or descending by left-clicking on the column headers
- Filter list by hovering over a column header and left-click the funnel ▼.

3 Traffic signal controller setup

The following is a list of PTV Vistro's traffic signal controller inputs, along with a description, guidance on using the parameter, and the *Synchro Equivalent* parameter, if applicable. For more detailed descriptions and units of each parameter, visit the Vistro help under Chapter 8.

Table 2-1: Typical traffic signal controller setup terminology

Parameter	Short Description	Synchro Equivalent
Intersection Settings		
Priority Scheme	Sets which approaches are the major or minor streets. This is set with Global Defaults; however, can be modified at any time.	-
Analyze Intersection?	This indicates this intersection will be included in the reports.	-
Analysis Period	The time period for the analysis	Analysis Time Period
Located in CBD	A check box indicates the intersection is in a central business district. HCM for a description of the CBD area.	Area Type CBD
Controller ID	Each signal controller has a unique ID number. This value defaults to the intersection number, or intersections can share a controller. To edit default Controllers IDs to another number or specialized agency number systems open the **Edit Controller** window under **Signal Controller ->Edit Controllers**.	Node#
Signal Coordination Group	Signalized intersections of the same subgroup are coordinated collectively. Multiple subgroups (coordinated routes) are permitted.	Zone
Cycle Length	Controller cycle length. This is the maximum time it will take for each signal group to cycle once. The cycle length is only used for coordination.	Cycle Length
Coordination Type	Defines coordination as Free, Time of Day Pattern Coordinated, or Time of Day Pattern Isolated. The following describes coordination methods: • **Free-running** means that the traffic signal controller does not have a set cycle length and is running with fully actuated detection. • **Time-of-day Coordinated** sets a cycle length and places the controller in coordination with other signals in the same coordination group. • **Time-of-day isolated** sets a cycle length but does not place the controller in coordination with other signals.	Control Type
Actuation Type	Defines whether the controller operates as: ➡ **Fixed-time** (pre-time) control consists of predetermined signal timing values not based on the detection.	Control Type

	➡ **Fully actuated**: If the **Coordination Type** is not **Free Running**, the fixed time signal plan is used to calculate the Force-Off Points of the non-coordinated phases. The user has to provide a valid and useful fixed time signal plan. By modifying the signal plan, the user can influence the calculated Force-Off Points with maximum and minimum green inputs, recalls, and vehicle extensions. This control type sets detection on all lanes that influence signal operations.	
	➡ **Semi-actuated**: contains some lanes with detection that influences signal operations. Often, the major-street thru lanes do not operate with detection to generate phase calls.	
Offset	When coordinated, the local cycle timer will be offset from the master cycle timer by the defined offset time relative to the reference point.	Offset
Offset Reference	This is the point in the cycle where the master cycle timer will be equal to the defined Offset time when the controller is coordinated and not in transition (offset seeking). Further explanations can be found in **NCHRP Report 812 – Signal Timing Manual**. The selections are: • **Lead Green** – **Beginning of First Green**: The reference point will be at the start of the leading coordinated signal group green (the computed start of green, note that the signal group may return to green early if there is a lack of demand on opposing movements). • **Beginning of Both Green –** at start of 2nd coordinated green (both are green) • **Beginning of First Yellow –** start at first coordinated yellow • **Beginning of First Red –** start at first coordinated red • Beginning of First Flashing Don't Walk • **LagFO** (Lagging Force-Off) – The reference point will be at the force-off point for the lagging coordinated signal group. • **LagEnd** (End of Lagging Red) – The reference point will be at the end of Red Clear for the lagging coordinated signal group. • **CoordEnd** (End of Coordinated Group Red) – The reference point will be at the end of red for the last signal group in the concurrent barrier group with the coordinated signal groups.	Reference to

Leading/Lagging Left Turns

Dual Lagging Left Turns
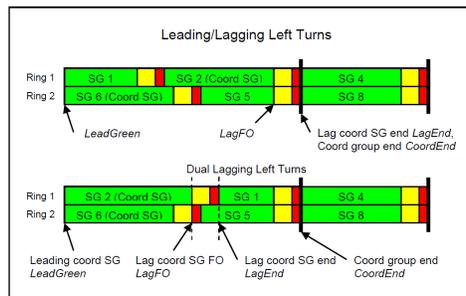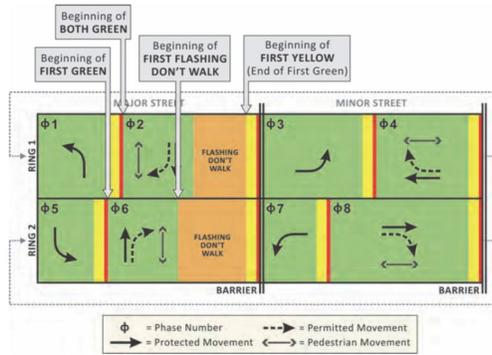
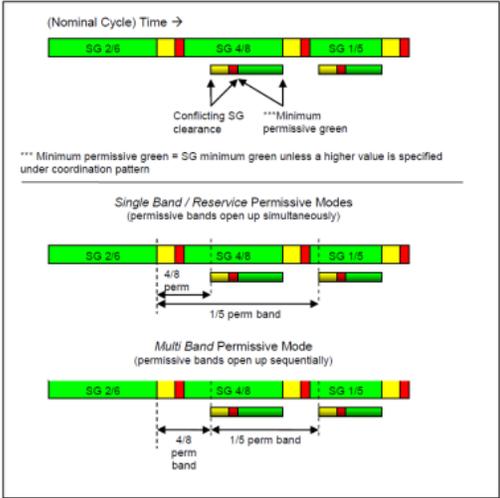| Permissive Mode	This setting defines the permissive mode for the coordination pattern per **NCHRP Report 812 – Signal Timing Manual**.	Yield Point
	The permissive mode controls the method in which permissive periods are opened and closed for all non-coordinated signal groups. The controller will only yield to signal groups that are permissive following the end of green on each coordinated signal group. The permissive modes are as follows:	
	• **Single- and multi-band modes:** The single-band permissive mode starts all permissive signal groups at the same time (one band). The multi-band permissive mode starts one at a time, where the next permissive band opens after the last one closes (multiple bands).	
	The advantage of single-band permissive mode is that, under light traffic volumes, there is the ability to skip minor street (or non-coordinated phases 4 & 8 in the image) and call perhaps the main street turning phases early (phases 1 and 5 in the example image) if the Phase 1 call comes before Phase 4. This is better if the main street is Agency the priority and the minor street is not a high priority. For "fairer" operations on the minor street, multi-band allows for an opportunity for a side street to be reevaluated and is not a first-	

	come-first-serve detection after the yield point between 1/5 and 4/8. If detection of 4/8 comes along after a call on 1/5, 4/8 goes first still (if there is still time for the call to be considered and not skipped).	
	• **Reservice:** The permissive mode will operate the same as Single Band Permissive until the coordinated signal groups yield to a non-coordinated movement. ALL signal groups will be allowed to reserve. After the coordinated signal groups yield once.	
Lost Time	Total intersection time per cycle that is not effectively being used due to driver reaction time, acceleration, and deceleration at the start and end of active signal groups. This is typically three to four seconds per signal group, times the number of signal groups.	-
Phasing & Timing		
Control Type	Defines control of movements as permissive; protected; protected / permissive; split; overlap; unsignalized (outer turns only using HCM 6th Edition) Control Type for each movement should be reviewed under the Phasing & Timing section and set to the following: • **Permissive** (Permitted) control requires motorists to choose acceptable gaps and/or yield to conflicting vehicles or pedestrian traffic streams. • **Protected** control assigns the right-of-way to turning drivers. • **Protected/permissive** control has a protected signal group assigning right-of-way to turning drivers that then transitions to the permissive parent signal group, requiring turning vehicles to yield. Permissive/protected control is modeled by selecting protected/permissive and changing the Lead/Lag setting to Lag.	Turn Type

	Note: In the HCM there are special requirements to ensure safe operations for Shared Thru/Left protected/permissive operations. Shared thru/left are set to recall per the HCM. Max green for the left turn is equal to the min green of the thru since the left and thru are shared. Vistro will fix these settings if implemented differently to meet these requirements. • **Split** phasing control provides separation between signal groups within the same barrier and prohibits the signal groups from running concurrently. • **Overlap** control is a controller output that combines two or more non-conflicting signal groups. This is mostly used to combine signal groups that sit in separate barriers. A common example is when a right-turn movement has an overlap phase running concurrently with the "shadowing" left-turn movement on the cross-street. Note: Overlaps can be set for all movements to create advanced signal group combinations like those seen in tight diamond interchanges.	
Allow Lead/Lag Optimization	Checkbox to allow for lead/lag optimization.	Allow Lead/Lag Optimize
Signal Group	The signal group is the signal phase number.	
Auxiliary Signal Groups	All signal groups serving the movement. When the Control Type is "Overlap" and the Signal Group for the Overlap phase is entered, the Auxiliary Signal Groups cell is active and allows selections of any phases with which this movement overlaps.	X_Y phase setup convention in Synchro
Lead/Lag	Selection for Lead or Lag left turn for protected phasing.	Lagging Phase?
Minimum Green	The minimum green time that the signal group will serve before changing to yellow. Note: Min Green value needs to be updated manually when the optimized split is determined. Different default Minimum Greens can be set for left and through movements in the Global Settings.	Minimum Initial
Maximum Green	The maximum time that the signal group will be allowed to extend before it will max-out. A max-out will make a signal group eligible to terminate, even though it may not have gapped-out. This parameter when exported to RBC is reflected as Max1.	-
Amber	Time a signal group will time an amber interval before advancing to red.	Yellow Time
All red	Time a signal group will time red before a conflicting signal group will be allowed to begin timing.	All-Red Time
Split	Amount of time allocated in the cycle for each signal group to time. The split includes the time it will take the green, yellow, and red intervals to time for each signal group.	Total Split
Vehicle Extension	Allowed time between successful vehicle extensions before a signal group will gap out. This parameter may be referred to as passage in some controllers.	Vehicle Extension
Walk	The minimum time a signal group will display a walk indication before advancing to the pedestrian clearance	Walk Time

	interval (flashing don't walk). A signal group may not advance to yellow while the pedestrian movement is in the walk interval.	
Pedestrian Clearance	Time a signal group will display a flashing don't walk indication before advancing to solid don't walk. A signal group may not advance to Yellow while the pedestrian movement is in the pedestrian clearance interval. Pedestrian clearance is **estimated** based on lane widths and median widths when Default Signalization is clicked. Note: This is an estimated crossing time and engineering judgment should be used to calculate field-based pedestrian clearance intervals.	Flashing Don't Walk
Delayed Vehicle Green	Used to establish Lead Pedestrian Intervals. This value is the amount of time that the vehicle green interval is delayed before the start of vehicle Green allowing the pedestrian walk interval to start first.	-
l_1, Start-Up Lost Time	Additional time needed to react to the initiation of the green signal and then accelerate.	-
l_2, Clearance Lost Time	The time between signal indication changes during which the intersection is not used by vehicles.	-
Coordinated	Identifies the coordinate signal groups for the signal controller.	Recall Mode
Minimum Recall	Signal groups flagged for this option will receive an automatic vehicle call regardless of actuation and time for at least its minimum green time. The green time may extend beyond the minimum if demand is present.	Recall Mode
Maximum Recall	Signal groups flagged for this option will receive an automatic vehicle call and extension. The maximum green timer will unconditionally begin timing at the beginning of green. Normally, the maximum green timer will only time if there are opposing calls to the signal group.	Recall Mode
Pedestrian Recall (Pedestrian push-button)	Signal groups flagged for this option will receive an automatic pedestrian call and time for the full walk plus pedestrian clearance time. **NOTE:** This box does not need to be checked with fixed time signals to recall pedestrians, as this is automatically assumed. For non-fixed time signals, if this box is not checked and crosswalks are present, Vistro will automatically assume that this intersection has a pedestrian push button or pedestrian detector to activate a pedestrian call.	Recall Mode
Dual Entry	When a signal group has a call in the next barrier group, concurrent phases in that barrier group may not have a call. In such cases, both the signal group with the call and the signal group with no call will begin timing when the barrier is crossed if both signal groups are flagged with Dual Entry. This feature is often used for through movement signal groups such that if one signal group is called, the signal group in the opposite direction will automatically serve, even if it does not have a call.	Dual Entry
Detector	Checkbox to choose detector for the Signal Group	Detector Phase
Detector Location	Distance upstream of stop bar of the leading edge of the detector.	Detector 1 Position
Detector Length	Length of the detector.	Detector 1 Size

I, Upstream Filtering Factor	Adjustment factor to account for the effect of an upstream signal on vehicle arrivals to the subject movement group. This is currently user-defined.	HCM Upstream Filtering Factor
Exclusive Pedestrian Phase		
Pedestrian Signal Group	The signal phase number for the exclusive pedestrian phase. All other pedestrian signal groups on each approach will be locked. This pedestrian signal group must be added to the sequence.	Ped Hold
Pedestrian Walk	The minimum time the exclusive pedestrian signal group will display a walk indication before advancing to the pedestrian clearance interval (flashing don't walk). A signal group may not advance to yellow while the pedestrian movement is in the walk interval.	Walk Time
Pedestrian Clearance	Time the exclusive pedestrian signal group will display a flashing don't walk indication before advancing to solid don't walk. A signal group may not advance to Yellow while the pedestrian movement is in the pedestrian clearance interval.	Flashing Don't Walk
Arrival Type	The arrival type selects the Platoon Ratio which describes the level of platooning quality arriving at the selected approach. The platoon ratio will be automatically updated based on the selection of Arrival Type per approach. Default = 3; Range = 1 – 6 (very poor – exceptional coordination) 1 Very Poor Progression 2 Unfavorable Progression 3 Random Arrivals or Uncoordinated (default) 4 Favorable Progression 5 Highly Favorable Progression 6 Exceptionally Favorable Progression The Arrival Type should be updated to match the field or desired conditions. See the HCM for further guidance on the selection of the Arrival Type and Platoon Ratio.	-

The following are PTV Vistro's traffic signal controller results table and a short description of the parameter, as well as the *Synchro Equivalent* parameter, if applicable. For more detailed descriptions and units of each parameter, visit the Vistro help under Chapter 8.

Table 2-2: Typical traffic signal controller results terminology

Parameter	Short Description	Synchro Equivalent
Lane Group Results		
X, Volume/Capacity for Lane Group	The ratio of the total analysis volume (flow rate) to the capacity	Volume to Capacity Ratio
d, Delay for Lane Group	Control delay for lane group	Control Delay
Lane Group LOS	Level-of-service for lane group	Level of Service
Critical Lane Group	Lane groups with the highest flow rate are indicated as critical.	-
50th-Percentile Queue Length	50th percentile queue length measured in the number of vehicles per lane	-
50th-Percentile Queue Length	50th percentile queue length measured in feet per lane	Queue Length 50th

95th-Percentile Queue Length	95th percentile queue length measured in the number of vehicles per lane	-
95th-Percentile Queue Length	95th percentile queue length measured in feet per lane	Queue Length 95th
Movement, Approach, and Intersection Results		
d_M, Delay for Movement	Control delay per movement	-
Movement LOS	Level-of-service for movement	-
Critical Movement	The Critical movement on the approach	-
d_A, Approach Delay	Average control delay by the approach	Approach Delay
Approach LOS	Level-of-service for approach	Approach LOS
d_I, Intersection Delay	Average control delay for the intersection	Intersection Delay
Intersection LOS	Level-of-service for intersection	Intersection LOS
Intersection V/C	Volume-to-capacity ratio for the intersection	Max v/c Ratio

4 Steps in creating signal controllers and performing local optimization

4.1 Default Signalization

After inputting the intersection geometry, crosswalk information (if applicable), and setting the primary controls and methods, PTV Vistro automatically sets up the traffic signal controller. Default signalization generates signal groups based on the control types. As a result, this will generate your **Sequence and Phase Diagram for common 3 and 4-leg intersections** and is the preferred signal creation method for most intersections.

Figure 3-1: Typical Intersection settings needed before clicking Default Signalization
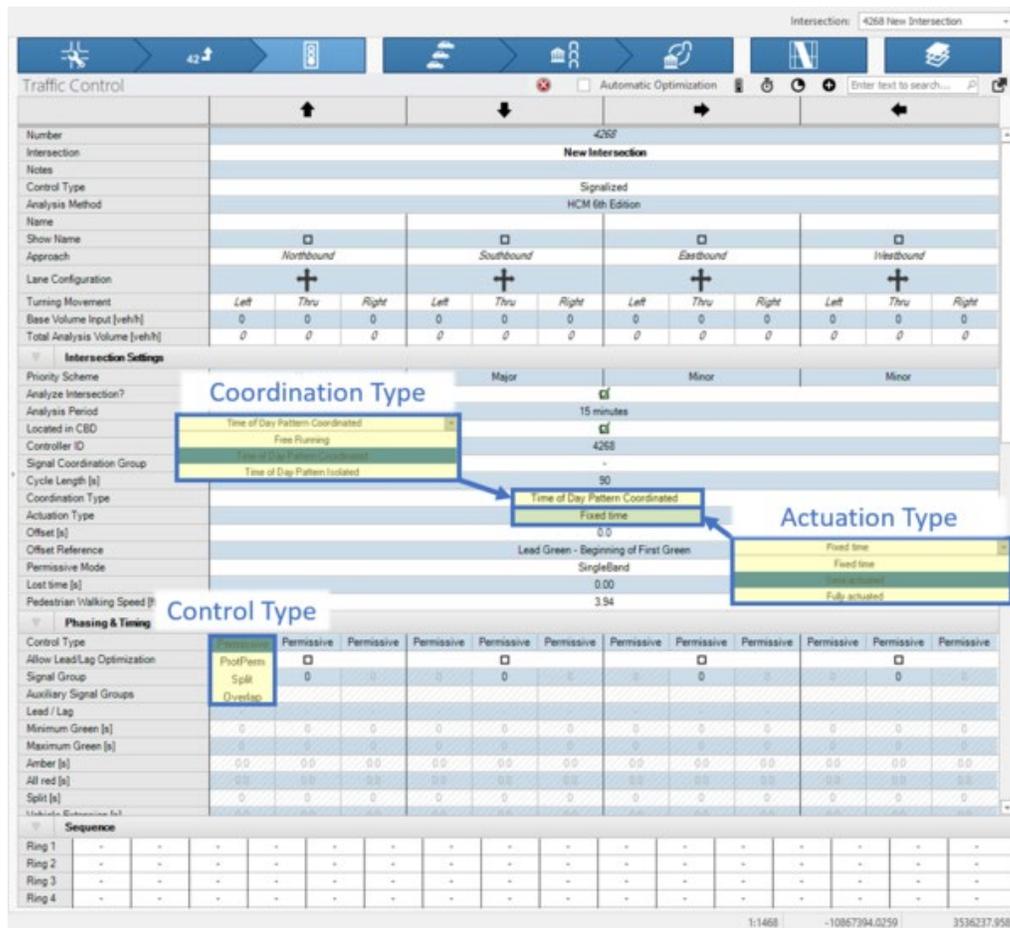
Also, **Default Signalization will use the timing parameters defined in Global Settings**. Furthermore, the Major and Minor street Priority Scheme determines how to allocate the NEMA traffic signal phasing convention. This is also customizable in Global Settings. The first method of local optimization is to just click on Default Signalization. Local optimization from *Default signalization* behaves differently from the initial setup:

- The 1st time this is clicked, the splits and cycle length are locally optimized.
- The 2nd time this is clicked, **only the splits are optimized**. The Cycle length will stay the same.

Figure 3-2: Default Signalization sets up your traffic signals
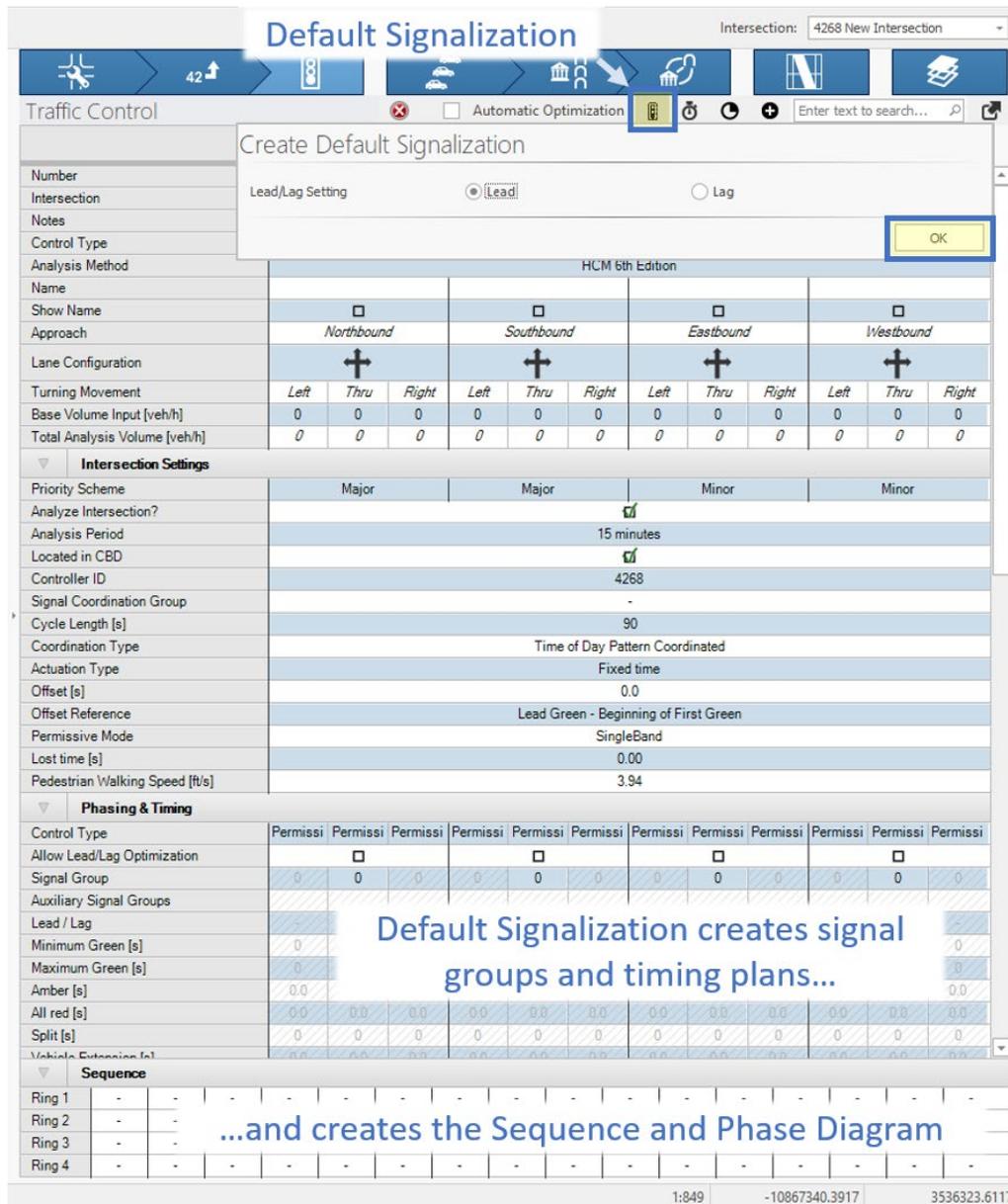
4.1.1   Pedestrian Clearance (Flashing Don't Walk) Estimation

Default Signalization estimates pedestrian clearance or the flashing don't walk (FDW) interval. First, the calculation uses the pedestrian walking speed entered in the Intersection Settings section of the Traffic Control workflow. These speeds are based on your agency's recommendations and engineering judgment.

If the Crosswalk Length is not set in the Intersection Setup workflow, PTV Vistro will automatically estimate the length using the roadway cross-sectional width. This feature is extremely useful for planning situations.

Warning messages indicate missing crosswalk length values or if the entered crosswalk value is less than the minim lane widths of the leg.

Figure 3-3: A sample of crosswalk warning messages

In some cases, these can be ignored; however, FDW calculated estimates should be placed with engineering-based pedestrian clearance calculations. And, crosswalk lengths should be verified and replaced based on new lane configuration modifications, as-built designs, field measurements, and/or measurements conducted in PTV Vistro using the measuring tool.

Figure 3-4: Using the measuring tool to determine the crosswalk length for pedestrian clearance calculations.

Back to top

Example 3-1: Understanding Pedestrian Clearance Calculations

Impacts of crosswalk lengths can be simply tested and comparing 2 basic intersections with traffic signals setup using default signalization.

1. Create intersection 1 and then leave the crosswalk lengths as 0 in the Intersection Setup Workflow. Then click default signalization.
2. Create intersection 2 and then enter a crosswalk length, perhaps 2x greater than the approach leg width, in the Intersection Setup Workflow. Then click default signalization.
3. Notice the difference in pedestrian clearance and interval calculations.
4. Note the warnings on intersection 1 indicated that the crosswalk length is not entered and the values are less than the graphical width of the approach leg.

Figure 3-5: Pedestrian Clearance Calculation Example
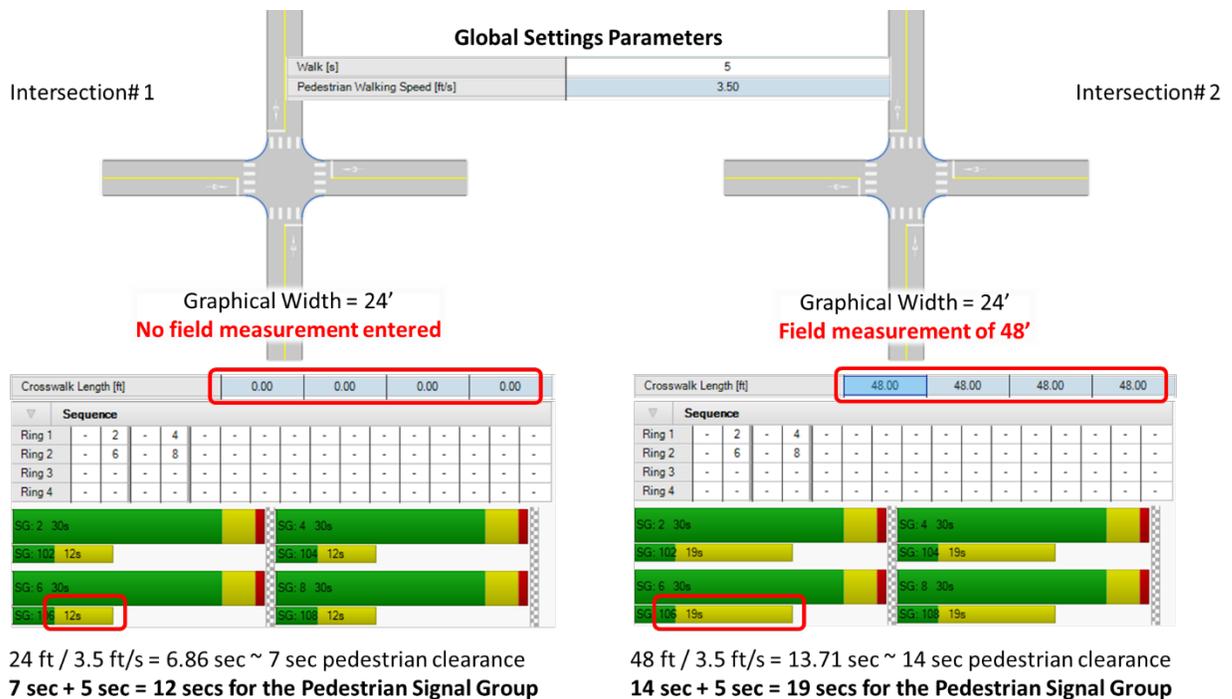
Back to top

4.2 Manual Signalization setups

For non-standard 3- or 4-legged intersections configurations, intersections with more than 4 legs, intersections sharing traffic signal controllers, or requiring special signal groups, manual setup of signals may be required.

4.2.1   *Assigning signal groups*

In cases where signal groups need set manually, at new intersections, a "0" signal group will be displayed. After setting the control types for all movements, as needed, simply enter the desired signal group number for each movement. Entering signal groups per NEMA Phasing schemes is not required, and you can enter any number combination.

Once the signal group is entered, the timing and advanced parameters are unlocked for further modifications.

Back to top

4.2.2   *Signal Groups Window*

In the main Traffic control workflow, only 1 signal group can be used per movement along with a combination of non-conflicting overlaps using auxiliary signal groups. However, in special cases, such as a Texas Tight Diamond interchange functioning with 2 intersections on 1 controller (see **Section 3.3.1**), or a hold phase for passive transit signal priority you may need extra signal groups to work with. These extra signal groups have a split time, can be assigned to auxiliary signal groups, added to the sequence, and shown in the phase diagram.

To create an extra signal group, open the Signal Groups window with the Plus Icon on the Traffic Control Toolbar ⊕.   This window list all of the Signal groups assigned to the controller and indicates which SGs are in use. Once the signal groups setup and OK is clicked, they are accessible in the Traffic Control Workflow drop-down menus for Auxiliary Signal Groups and Sequence.

Figure 3-6: Using the signal groups window.
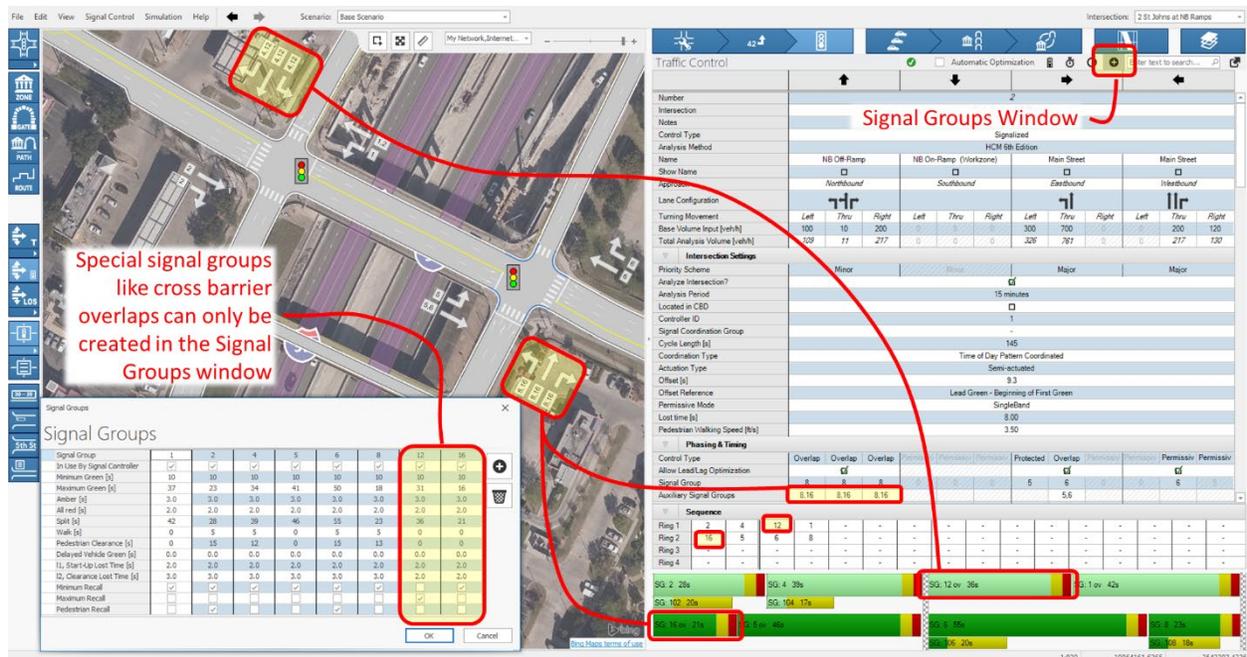
Back to top

The phase diagram graphically reflects the Signal Groups listed in the Phasing & Timing section and listed in the Signal Window, but also added to the Sequence. The phase diagram lists the signal group numbers, green, yellow, red, delayed vehicle green, pedestrian interval timing, and split information. When hovering over a Signal Group, this information is summarized in a pop-up. Also, in this pop-up, the Actual Green Time, and Green Time Start is displayed.

Signal Group information can be displayed in the network editor when toggling the **Show Signal Groups** graphical display to visually show what signal group belongs to what approach.

Also, the signal group bars represent the total splits for both vehicle and pedestrian signal groups and can slide to adjust the total split time.

When the green color of the bars is lighter in color, this means that the signal group is added in the sequence, but not used locally at the active intersection. This is can because the signal group may be used at another intersection using the same controller (creating a *clustered* controller case, see **Section 3.3.1**) or because the signal group serves as a placeholder to reserve signal time (*hold phase*). See **Figure 3-6**.

Back to top

Example 3-2: Create a Passive Transit Signal Priority Signal Group (Hold Phase)

In this example, create a basic intersection with signal groups 2, 4, 6, and 8 – and then a special transit signal group (SG 10) to account for a pre-timed placeholder on barrier 3 of the sequence phase diagram.

1. Create intersection 1, set the intersection to fixed time actuation, and then click default signalization.
2. Open the Signal Groups Window, click the "Plus" button and create Signal Group 10.
3. In Signal Group 10, enter min and max green = 3, amber = 3, all red = 1, split = 7, walk and ped clearance = 0, and check max recall.
   Note: With Fixed Time actuation, max recall is not needed; however, it is good practice to check this if the actuation method is updated later.
4. Click Ok.
5. In the sequence, enter SG 10 in Ring 1, Barrier 3.
6. In the Phasing & Timings section of the Traffic Control Workflow, adjust the splits of SG 2, 4, 6, 8 to fit SG 10 within the cycle length, or utilize the Phase diagram.

Figure 3-7: Creating a Hold Phase Example

4.3 Advanced Settings

### 4.3.1   *2 or More Intersections on 1 Traffic Signal Controller*

Placing 2 or more intersections under 1 controller (clustered traffic signal control) can simply be achieved by using the **Controller ID** drop-down list in the **Intersection Setting** section of the **Traffic Controller Workflow** and then selecting another controller. This practice is often used with closely spaced intersections (see Intersections 225 and 228 sharing Controller ID 225 in the **Austin Texas Example** in the **Help->Open Examples Directory->Signal Optimization Folder**, or for a Texas Tight Diamond, as shown in the **->Signal Controller Folder -> Tight_Diamond_Core_Overlaps** for Intersections 1 and 2 sharing Controller ID 1. Additionally, many of the Examples in the ->**Alternative Intersections** folder applications of this practice.

Often, the Signals Group Window will have to be utilized to set up additional Signal Groups on an approach represented at an adjacent intersection, for example, Minor Street SG 4 at one intersection and SG 8 at another intersection (see **Section 0**).

Also, the same sequence and phase diagram are utilized at each intersection location reusing the controller. All Signal Groups must be placed in the sequence (from any intersection reusing the controller) for the signal group to be visible in the Phase Diagram. When the green color of the bars in the Phase Diagram are lighter in color, this means that the signal group is added in the sequence, but not used locally at the active intersection. This is can because the signal group may be used at another intersection using the same controller. This is very useful when setting up multiple intersections on the same controller.

Tip#1: Utilizing the Graphic Parameter **Show Intersection Info -> Controller Number** will confirm which intersections share the same traffic signal controller.

Tip#2: Turning on the **Show Signal Groups** Graphic Parameter will show the signal group numbers per movement in the network editor. This is very useful when setting up multiple intersections on the same controller.
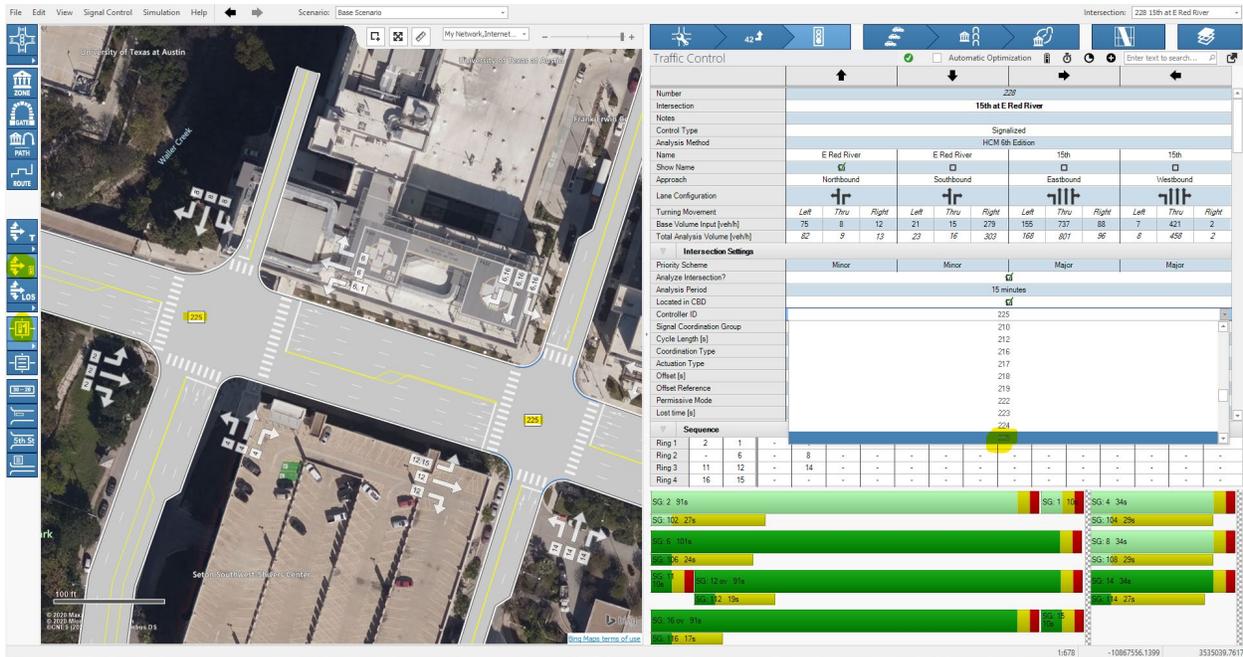
4.3.2   Pedestrian fixed-time, recall, and push-button settings

Pedestrian crossing signal group in Vistro can be configured in several ways and depends on fixed-time or actuated control types. Ultimately, utilizing the **Vissim Preview** under **Help** will confirm if the configuration is correct.

Fixed Time: Under this configuration, pedestrian signal groups will automatically be set to recall and pedestrians will be served.

Semi-actuated: Under this configuration, the major street pedestrian signal groups will recall automatically; however, you may choose to manually click Ped Recall for clarity. The minor street pedestrian signal groups may operate pushbutton-stye or under recall. This choice is selected in the **Pedestrian Recall Checkbox** in the **Phasing and Timing** section of the **Traffic Control Workflow**.

If left unchecked, the pedestrian signal group will be pushbutton controlled and only be called when a pedestrian is present via a pedestrian probability calculation based on the HCM. In PTV Vissim a detector will be created to simulate the pushbutton. If this checkbox is checked, the pedestrian phase

will recall every cycle and the signal vehicle group cannot gap out before the ped phase is complete, or the vehicle phase cannot be skipped.

Fully-actuated: Under this configuration, all pedestrian signal groups must be reviewed, requiring a choice is in the Pedestrian Recall Checkbox in the Phasing and Timing section of the Traffic Control Workflow.

If left unchecked, the pedestrian signal group will be pushbutton controlled and only be called when a pedestrian is present via a pedestrian probability calculation based on the HCM. In PTV Vissim a detector will be created to simulate the pushbutton. If this checkbox is checked, the pedestrian phase will recall every cycle and the signal vehicle group cannot gap out before the ped phase is complete, or the vehicle phase cannot be skipped.

Back to top

Example 3-3: Pedestrian Push button and Recall Settings

The Chapel Hill Small Corridor example under **Help -> Open Examples Director -> Signal Optimization** explains showcases the pedestrian push button or recall configuration. In this example, Intersection #1 and #2 are set to semi-actuated with pushbuttons on the north and south approach (not checked for the Pedestrian Recall parameter). Intersection #3 is fully-actuated, and all approaches operate with a pushbutton.

For Intersection #1 in this example Reviewing Signal Groups 4 and 8's **Actual Green Time** results in the **Lane Group Calculations** section of the Traffic Control Workflow, it is apparent that the green time is less than the Green time under a Fixed time Configuration.

1. Observe the northbound and southbound **Actual Green Time** approach results with pedestrian recall unchecked (push button). The result is 14 seconds. This means that due to the pedestrian probability influences of a push button, some cycles truncate the green time as expected. The extra 5 seconds of green time is given to the major street.
2. Next, On the **Volume Workflow**, change the pedestrians to 50 for northbound and southbound approaches under pedestrians (v_do and v_di inputs). Back on the **Traffic Control Workflow** observe that the **Actual Green Time** results are now 18 seconds for both northbound and southbound approaches, meaning that the vast majority of Cycles will receive a pedestrian push button call.
3. Finally, check the pedestrian recall box (no push button) for both the northbound and southbound approaches. Now, the **Actual Green Time** results are 19 seconds, meaning that the signal group is recalled to the maximum green every cycle.

Figure 3-8: Example of Pedestrian Push Button's influence on serviced Actual Green Time
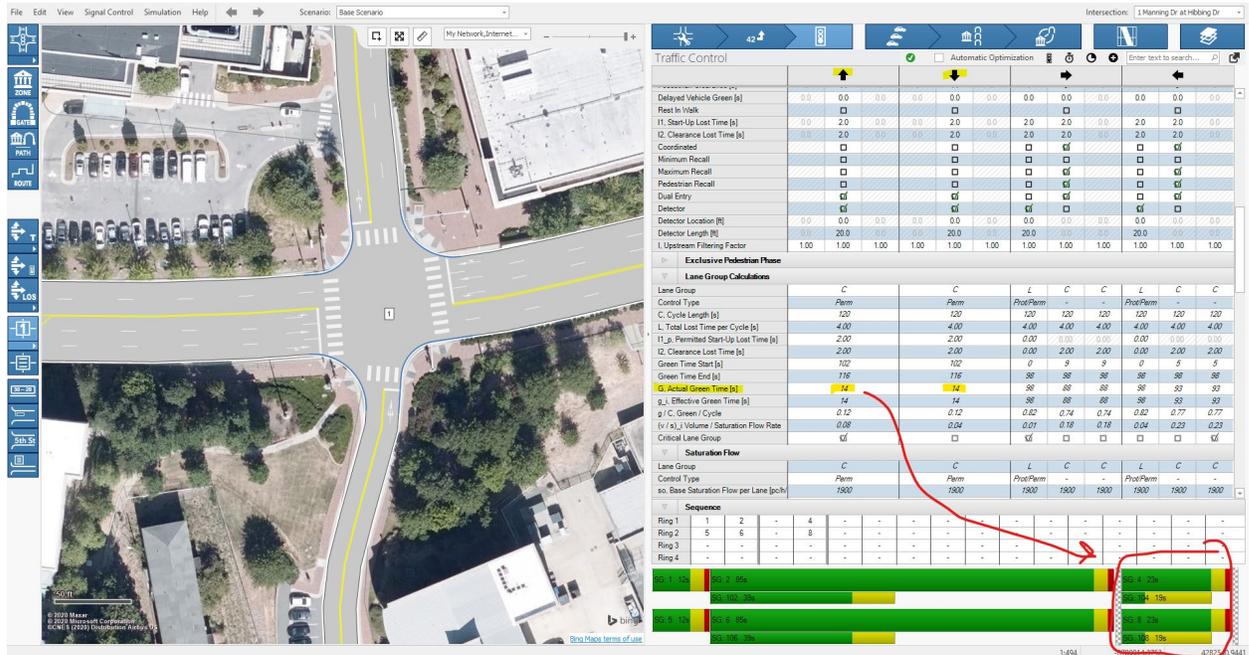
4.3.3   Exclusive Pedestrian Phase

PTV Vistro also includes build-in functionality to analyze exclusive pedestrian phases. Some local names for such a phase are the Barnes Dance or Pedestrian Scramble. These phases allow *all pedestrians* to cross on one pedestrian phase while vehicular traffic has all-red signals. Additionally, this safe and efficient crossing option is useful for intersections with high pedestrian crossing volumes and multiple transit stops requiring a multi-stage crossing. See **Scenario 2** in the **Signalize Midblock Crossing** example located under **Help -> Open Examples Director -> Pedestrian and Bicycles** and the supporting documentation.

To create this configuration, visit the **Exclusive Pedestrian Phase** section of the **Traffic Control Workflow**, create a pedestrian signal group, assign a pedestrian walk time and clearance, and then add the signal group into the sequence. Once added here, the **Phase Diagram** will display the Exclusive Pedestrian Phase.

Note: Once an exclusive pedestrian phase is added, all other pedestrian signal group bars will disappear and the data entry will be locked for the walk and clearance input from the **Phasing and Timing** section.

In some special cases, cities may need to utilize exclusive pedestrian phases along with additional traditional approach based pedestrian phases. In this case, create an intersection with regular pedestrian crossing phases. Then create a special "placeholder" phase (hold phase) using the **Signal Group Window**, as discussed in **Back to** top

Example 3-2 – then add this special signal group to the sequence. This will conservatively replicate the exclusive pedestrian phases along with traditional approached based pedestrian signal groups. With this method, all conflicting pedestrian volumes will still be allocated to the primary approach-based pedestrian signal groups and not allocated to the hold phase. This will lead to greater impacts on the vehicle results. Currently, no HCM guidance is available for combining exclusive pedestrian phases with the traditional approach based pedestrian phases, and **judgments should be made to interpret analysis results**.

Figure 3-9: Exclusive Pedestrian Phase Setup and Vissim Simulation
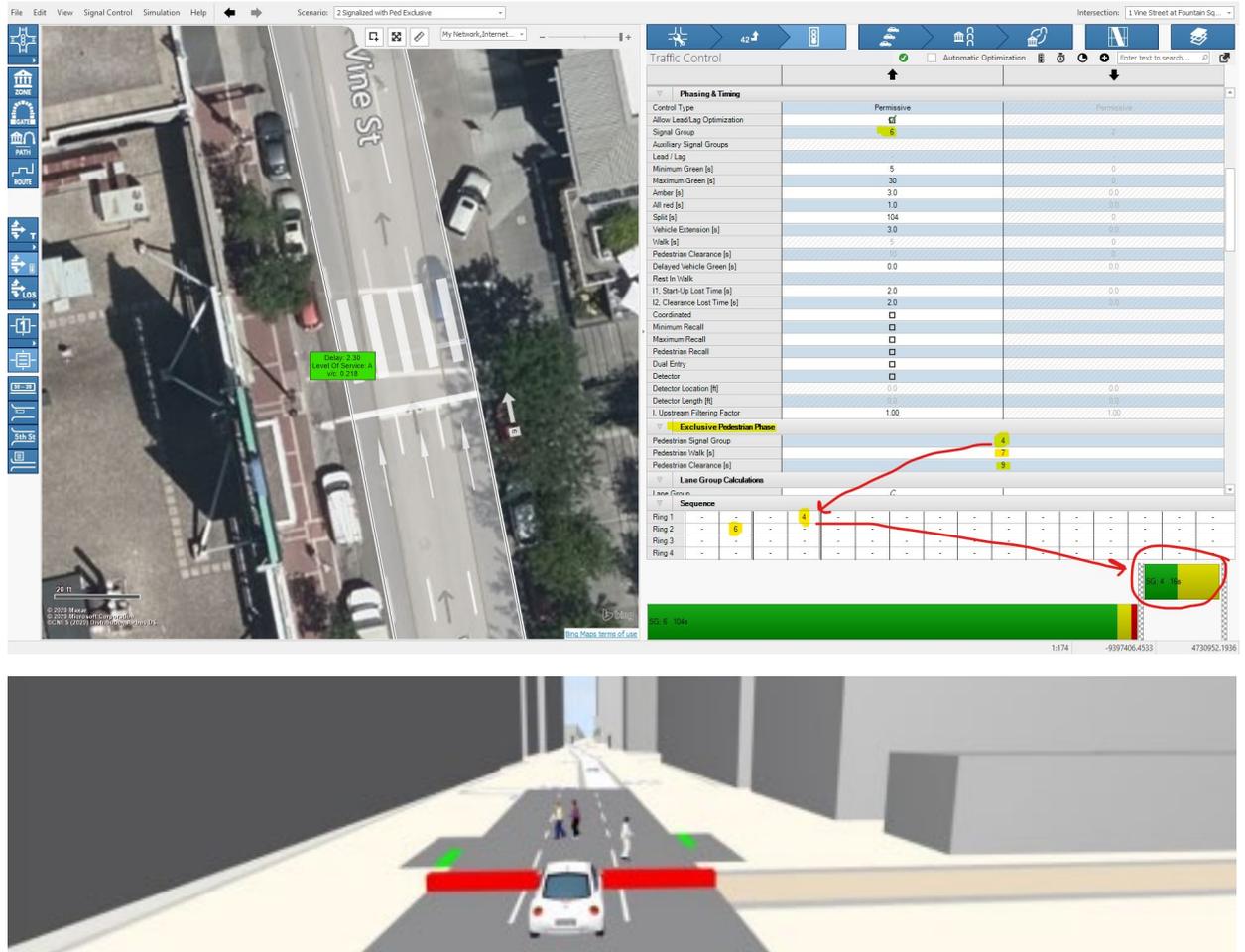
4.3.4   *Delayed Vehicle Green*

Leading pedestrian intervals (LPIs) at traffic signals are wide-spread active transportation plan features. LPIs can be achieved by requiring no additional signal phases and can utilize the Delay Vehicle Green Parameter.

The Delayed Vehicle Green parameter in the **Phasing & Timing section of the Traffic Control Workflow Panel**, inserts a red time at the start of the signal group split, as shown in the Phase Diagram. This delays the vehicular start of green, which can be observed in the **Lane Group**

Calculations section of the Traffic Control Workflow Panel. This delay time allows pedestrians and cyclists to lead.

Note: LPI modeling is setup for fixed-time controllers only. However, the delayed vehicle green parameter can be applied to actuated pedestrian approaches, but this will call the delayed vehicle green every cycle – even without pedestrian "calls". Currently, no HCM guidance is available for actuated leading pedestrian interval calculations and **judgments should be made to interpret analysis results**.

Furthermore, leading pedestrian intervals are exported to PTV Vissim automatically. See the example documentation in **Help->Open Examples Directory ->Pedestrians and Bicycles -> Lead Pedestrian Interval** for more detailed information on how this is coded in PTV Vissim's .RBC file via the ANM export.

The Delay Vehicle Green parameter has other advanced applications, such as to produce a Montreal Leading Thru or to emulate a stage-based controller in a ring-barrier environment.

Back to top

Example 3-4: Create and LPI with Delayed Vehicle Green

In this example, create an LPI utilizing the Delayed Vehicle Green Parameter.

1. Create a basic intersection 3 leg intersection. Set 200 vehicles on each approach, on 100 pedestrians on each crosswalk.
2. Set the intersection to fixed-time and create default signalization
3. Set the Delayed Vehicle Green parameter for 10 seconds on each approach and adjust the max green timing to compensate.
4. Under the **Lane Group Calculations** observe the Green Time Start results and compare them to the Phase Diagram.
5. Finally, under **Simulation->Preview in Vissim** observe the Leading Pedestrian Interval in Vissim.

Figure 3-10: Delayed Vehicle Green Settings.

Figure 3-11: PTV Vissim Leading Pedestrian Interval Simulation
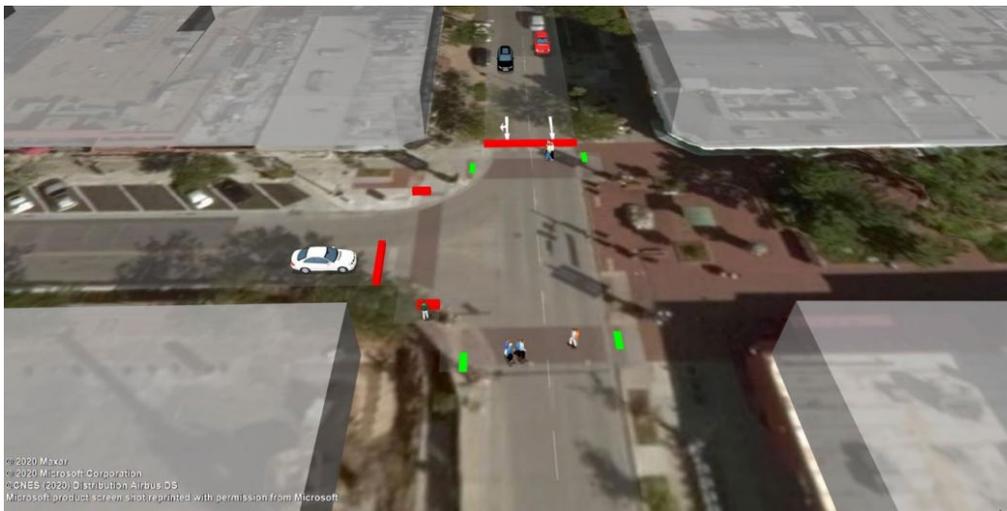
Back to top

4.3.5   Overlaps

Overlaps can be selected under the Signal Group's control time for all movements. This links the signal timing together of the *parent* signal group and the overlapping auxiliary signal group.

A common configuration is overlapping a protected left-turn signal group with a non-conflicting right-turn signal group.

Additionally, overlapping signal groups provide an opportunity to create a special or custom configuration like that shown in the Texas Tight Diamond in Figure 3-6 (also shown in **Help->Open Examples Directory ->Signal Controller -> Tight Diamond Core Overlaps** and described in the documentation).

Back to top

4.3.6   Montreal's Leading Thru Configuration with Overlaps

Also, Overlaps can be used to create leading thru phases on shared lane groups, commonly utilized in Montreal, Canada. Typically, in this case, shared-lane turns with thru movement would have the same Permissive signal group. However, in Montreal, the thru will receive a green indication first, and the shared left and right turning vehicles are required to wait until their green indication. This is often intended to protect crossing pedestrians, thus providing a *leading pedestrian interval* under this situation.

To achieve this in Vistro, the **Overlap** Control Type can be assigned to the left and right movements on the shared lanes. This unlocks the usage of Signal groups for left and right turn movements. Then, by utilizing the Delay Vehicle Green parameter, the turns can be held in 1 signal group, while the thru leads first in another signal group. See the following figure and example.

Note: This configuration does result in an ICA check error since the application is not conventional. The message indicates the more than 1 signal groups control the same shared lane; however, that is exactly what needs to be achieved in this configuration. Importantly, interpretation of the results is needed, as green time will only be calculated for the lane groups, not for each movement per HCM. Due to this, the thru green time prevails in the lane group, as it is the highest, and the results of the turning movements are calculated with a higher green time than represented in the field conditions.
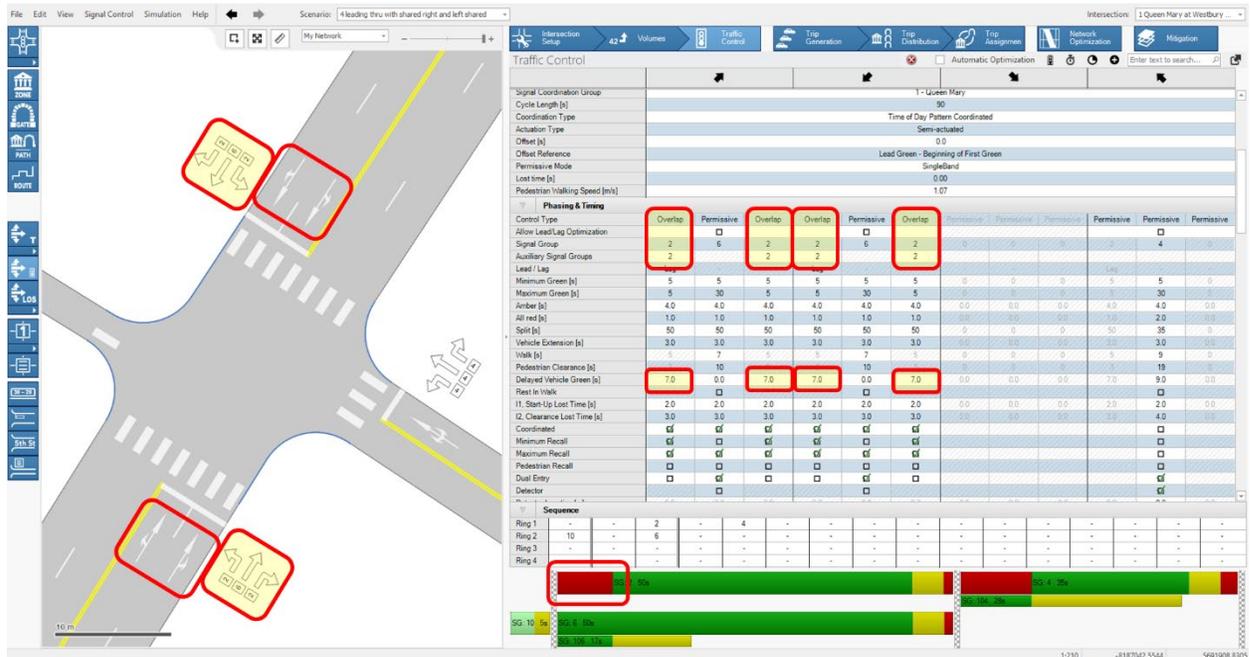
Back to top

Example 3-5: Creating Montreal's Leading Thru Configuration with Overlaps and Delayed Vehicle Green

In this example, create an intersection utilizing Montreal's leading thru configuration with Overlaps and shared turning lanes. The thru signal groups are set to 6, and the turning signal groups are set to 2 with a delayed vehicle green of 7 on each turn.

1. Create a basic intersection and set the Major Street lane configuration Shared Left/Thru and Shared Thru/Right.

2. Next, instead of creating default signalization, set the northbound and southbound movements to both signal group 6. Then on the northbound and southbound right and left movements, set the Control Type to Overlap.
3. Next, set the signal group for both the right and left turns to 2. Under the Auxiliary Signal Group settings, ensure that signal group 6 is NOT checked, thus resulting in both Signal group 2 as both the parent and auxiliary.
4. Then, set minimum and maximum green, amber, red, and split times for all signal groups.
5. Then, set the Delay Vehicle Green time to 7 seconds for both the left and right turns.
6. Finally, review the pedestrian timing, coordination, recalls, detectors, and dual entry settings as needed.

Figure 3-12: Create Montreal's Leading Thru Configuration with Overlaps and Delayed Vehicle Green

Back to top

4.4 Local and Automatic Optimization

After setting up the **intersection settings** in the **traffic control tab** it can be Local Optimized. Local optimization will optimize the intersections individually, and will not consider coordination.

The first method of local optimization is to just click on **Default Signalization** 🔳 on the **Traffic Control Workflows toolbar** (see **Figure 1-3**). Local optimization from *Default signalization* behaves differently from the initial setup:

- The 1st time this is clicked, the splits and cycle length are locally optimized.

- The 2nd time this is clicked, **only the splits are optimized**. The Cycle length will stay the same.

The second method for local optimization is to go to **Signal Control -> Local Optimization**. This can be conducted before or after default signalization. In this menu, the following can be set:

- **Objective function strategies** from "volume/Capacity balancing" or "minimizing the critical movement delay".
- Optimize splits only, or splits and cycle times.
  - Selecting **splits and cycle times** unlocks an option to select a **cycle length range** and **step size for each iteration**, as well as a **try set** if your intersection has a preferred cycle time array or a specific cycle length in mind.
- Locally optimize all intersections
- Save the settings for next time.

Figure 3-13: Local Optimization Menu
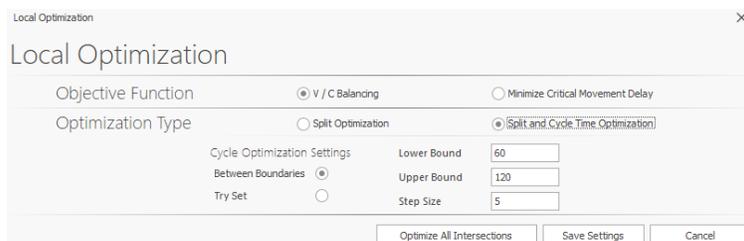
The third method is to click on the **Optimize Split and Cycle Time button** ⏱ on the **Traffic Control Workflows toolbar** (see **Figure 1-3**). Here the selection of parameters is similar to the previous method; however, you can't optimize all intersections.

Finally, the fourth way is to optimize locally is with the Automatic Optimization toggle ☐ Automatic Optimization on the Traffic Control Workflows toolbar (see Figure 1-3). This optimizes the splits only. When checked, updates to lane configurations, volumes, control types, or other timing settings will automatically optimize the signal. When unchecked the intersection won't optimize with each update made. This sets Vistro apart from other software, such as Synchro where changes automatically optimize the signal.

Back to top

4.5 Renumbering Controller IDs

Matching controller ID numbers to an agency number scheme or just organizing your traffic controller numbers is possible in PTV Vistro. In some cases, merging in a model from another network or importing an OpenStreetMap file may produce intersection numbers and traffic signal controller IDs that need to be revised. Or perhaps extra intersections were created and then deleted and the order of intersections and controller IDs need to be reordered. There are 2 methods to modify a traffic signal controller ID number.

The first method is to simply change the Intersection Number, which can only be achieved on the **Intersection Setup Workflow** in the **Number** field. If the revised number entered is an available Traffic Signal Controller ID number, then Vistro will automatically change the Controller ID to match the Intersection ID. If the Controller ID (and/or intersection number) is not available, the conflicting controller (and/or intersection) must be temporarily reassigned to a vacant number to avoid the conflict. Renumbering a Controller ID only requires method 2.

The second method is to go to **Signal Control -> Edit Controllers...** and renumber only the traffic signal controller ID. This window provides a list of all traffic signal controllers with numbers in the ID column which is editable to change the controller ID number. The only other editable field in this list is the controller Description. This field enables the entry of notes about the controller, just as inspection dates, controller manufactures, or classification types. Next, the intersection number shows where the traffic signal controller is applied. Multiple intersection numbers indicate that the traffic signal controller is used at multiple locations. If there are multiple locations, the intersection name will be displayed only for the first ID. Also, the Coordination Group is displayed to show what corridor or signal system the controller resides in. To learn more about Coordination Groups see **Section 4.1**. These columns can be filtered or sorted by clicking. To filter by value, enter the value, then hold down shift to select multiple controllers to show.

Figure 3-14: Edit Controllers Window with Location Filtering
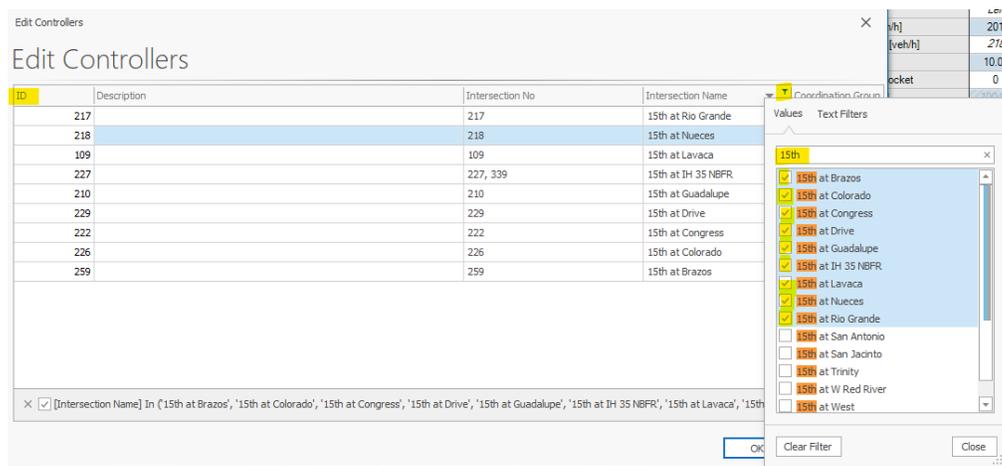
5 Network Optimization

PTV Vistro's powerful coordination tools can optimize entire districts, corridors, and precise routes with our user-friendly graphical-user interface, resulting in accurate and fast Green Wave optimizations. PTV Vistro provides you with two network optimization methods:

 Traditional zonal coordination using "Coordination Groups"; and

User-defined and flexible optimization corridors using "Routes".

5.1 Coordination Groups

In PTV Vistro, setting intersections to the same **Coordination Group** (similar to Zones in Synchro), optimizes the intersections' offsets, in addition to the cycles and splits, if desired. This *zonal* optimization calculates the Green Wave between intersections in that Coordination Group. Using multiple Coordination Groups can optimize a combination of districts and corridors as individual groups, or all at the same time using basic equal coordination to a City grid or straight-line corridors. By default, 1 Coordination Group is included in a new Vistro file; however, more can be added.

Note: A Coordination Group must be assigned to an intersection to be considered for Network Optimization. If a Coordination Group is not assigned, the intersection will not be recognized in the Network Optimization process.

Tip: To increase efficiency when modeling, it is best to have all signal coordination groups created if known ahead of time, then allocated Coordination Groups can be achieved while creating and modifying traffic signal controllers.
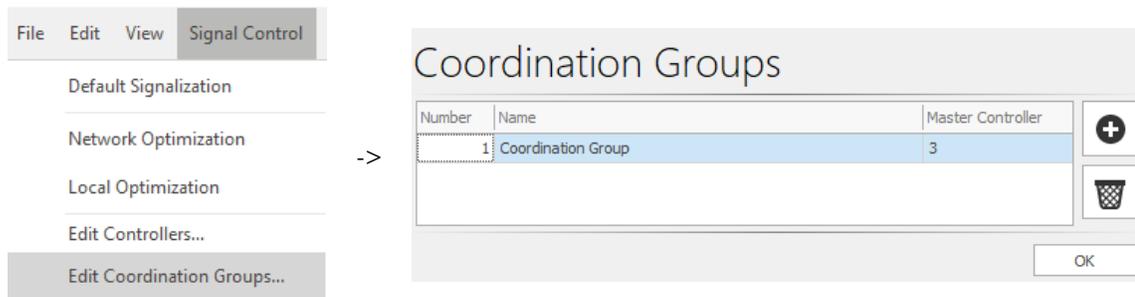
Back to top

5.1.1   Create a Coordination Group

To view, add, or modify the Coordination Groups, go to **Signal Control -> Edit Coordination groups.** In this menu:

- New Coordination Groups are added with the *plus* icon ⊕ ;
- Deleted with the *trash can* icon 🗑 ; and
- Renamed in the *Name* field.

Once a series of controllers are assigned a Coordination Group (see **Section 0**), such as along a corridor or in a city district grid, this menu can be revisited to assign a **Master Intersection Controller** (see **Section 0**).

Figure 4-1: Adding or Modifying Coordination Groups

Back to top

5.1.2   Assign Coordination Group

To assign a Coordination Group to each intersection, click on the intersection, navigate to the **Traffic Control Workflow**, and then select the drop-down list from the **Signal Coordination Group** parameter – and then select the desired Coordination Group.

Figure 4-2: Assigning a Coordination Group to an Intersection

Tip #1: To identify the Coordination Group set on each intersection in the network editor, click on the **Show Intersection Info** graphic parameter and select the **Coordination Group** option. This will display which intersections have been assigned a group and help provide a quick quality control check. If a group is not assigned to an intersection, the intersection will be blank.

Back to top

5.1.3   Selecting a Master Controller

Selecting a Master Controller in the Coordination Group is optional to network optimization; however, many agencies prefer to introduce a master controller clock within a series of coordinated signals. If an intersection is set to the **Master Controller**, the offset reference is locked to 0 seconds when set**.** All other controllers in the same **Coordination Group** will adjust relative to the **Master Controllers** 0 second offset automatically.

Tip #1: To identify the intersection controller number in the network editor, click on the **Show Intersection Info** graphic parameter and select the **Controller Number** option.

Tip #2: To identify the Coordination Group set on each intersection in the network editor, click on the **Show Intersection Info** graphic parameter and select the **Coordination Group** option.

Back to top

Example 4-1: Creating and Assigning a Coordination Group, and selecting a Master Controller

This example, will create a Coordination Group, assign it to a series of intersections, and select an intersection Master Controller.

1. First, go under **Signal Control -> Edit Coordination groups** to add a new coordination group. Click on the *plus* icon to create **Coordination Group 2**. Name the coordination group "Example". Then click "**OK**" to save the Coordination Group.
2. Next, Create 2 closely spaced intersections then connect adjacent Leg Handles.
3. Next, go under **Signal Control -> Default Signalization**. Then, click on "**Create Default Signalizations**" to create Signal Groups for each intersection simultaneously.

4. Notice at each intersection the Signal Coordination Group parameter shows a "**-**", indicating that no **Coordination Group** is defined. Define **Coordination Group 2** for each intersection.
5. Turn on the Graphic Parameter **Show Intersection Info -> Coordination Group** and confirm that both intersections are on **Coordination Group 2.**
6. Place a 3rd intersection, using **copy and paste** to the right of the right-most intersection (Right-click on the main Intersection Grip to open the context menu, select Copy Intersection, and then right-click on a location to Paste the Intersection using the context menu.
7. Notice that this intersection is already assigned **Coordination Group 2** when using copy and paste. This could be used as a shortcut when setting up intersections.
8. Connect the new intersection's Leg Grip with the middle intersection.
9. Turn on the Graphic Parameter **Show Intersection Info -> Controller Number** and determine the Controller ID of the right-side intersection**.** Renumber the signal controller ID numbers, as needed (see **Section 0**).
10. Click on each intersection and enter the **Offset** values of "5, 10, and 15" seconds from left to right, for each intersection under the **Intersection Settings** section in the **Traffic Control Workflow**. Leave the rightmost intersection active, with the Offset value viewable in the **Intersection Settings** section.
11. Go to **Signal Control -> Edit Coordination groups**, select **Coordination Group** #. Under the **Master Controller** drop-down list select the rightmost intersections Controller ID number. Before clicking "ok" to accept the changes, take note of the **Offset** value in the **Intersection Settings** section set for 15 seconds.

Figure 4-3: Assigning a Master Controller in a Coordination Group.
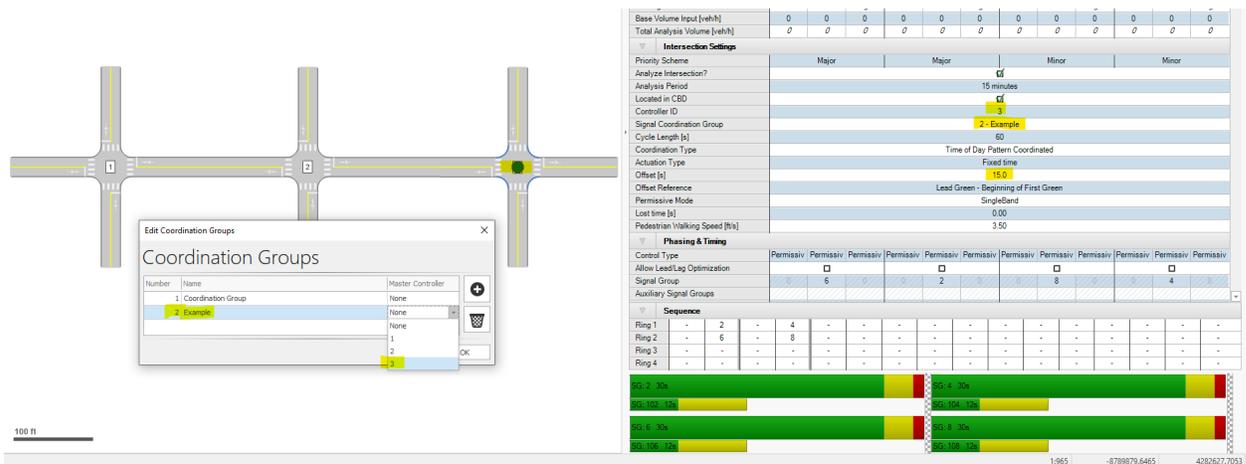
12. Then, click "**OK**". Notice that the **Offset** value change to 0 seconds. This value will be locked. Note: the new **Offset** values calculated for the other "non-master" intersections.
13. Go back to the rightmost intersection, and attempt to change the **Offset** value to something other than 0. Note, the error by hovering over the red "X". This value can not be updated since the controller is the master.
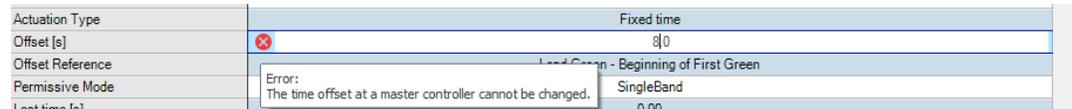
5.2 Network Optimization Settings and Running

After Coordination Groups are created, the network and be optimized Using the Network Optimization tools in PTV Vistro. Go to **Signal Control -> Network optimization**, to open the Network Optimization Settings menu. This menu has the following parameters with descriptions. More information can be found in the Vistro Help manual under the **Help** menu:

Table 4-1: Network Optimization Settings and Description

Parameter	Short Description
Objective function	In these fields, the weights for delays and stops can be defined The formula is used to determine the Performance Index for optimization. Generally, the stop weight is a low number because this is the total number of stops across the intersections being optimized.
Genetic method	This method is a more robust and customizable method that includes closing criteria The maximum number of iterations can be selected as well as Population Size. Generally speaking, the larger the population size the better the optimum solution. The number of runs without improvement and an improvement percentage threshold represent the closing criteria to the method.
Hill Climb method	This method is a simpler and faster method but the optimization may close without finding the optional solution if the number of runs is low. Here the hill climb defaults to only 10 starting solutions and genetic defaults to 100 iterations with the closing criteria.
Coordination Groups to Be Optimized	One, more, or All Coordination groups can be selected. To select a few groups hold down SHIFT and click.
Optimize Split and/or Cycle Time	Here, choose if to optimize, **Splits Only**, or **Splits and Cycle Time**. And if you only want to optimize offsets just leave the splits and cycles unchecked. When selecting **Splits and Cycle Time** and upper and lower bound, along with step size can be entered.
Use Offset Optimization	Choose if the **Offsets** between traffic signal controllers should be optimized and the precision of the optimization.
Allow Lead/Lag Optimization	Optimization will find the best solution for the left-turns in either a leading or lagging configuration. If your agency does not allow lags, then just leave it unchecked so all of your signal group control types on your left-turns will stay as Lead. **Note:** This setting is dependent on if the Allow Lead/Lag Optimization checkbox is checked in the **Phasing and Timing** Section of the **Traffic Control Workflow**. If the box is checked here, then the optimization is possible. If it is not checked, then Lead/Lag optimization for that intersection is not available.
Save Settings	After modifying the parameters on the Network Optimization Menu, click Save Settings to retain your preferences.

Run Optimization	After modifying the parameters on the Network Optimization Menu, click Run Optimization to start the Network Optimization Process.

*Figure 4-4: Network Optimization Menu*

Also, the **Network Optimization** window is accessible in the **Network Optimization Workflow's**, by clicking the **Network Optimization** button. This workflow is discussed in more detail in **Section 0**.

Network Optimization process begins after the **Run Optimization** is clicked. The **Optimization Progress** window will appear cycling through optimization calculations probing each specified cycle length. The **Best Score** will be displayed during the optimization process based on the objective function. The lowest Cycle length with the **Best Score** will be selected.

Note: Depending on the optimization settings, closing criteria, network size, and the number of Coordination Groups selected at 1 time, Network Optimization could be quick or take a few minutes to process. **It is recommended that you save your file (or a copy of your file) before running Network Optimization** in case you wish to exit the process. Occasionally, the screen will remain black

for a few moments or show as non-responsive. Be assured, optimization is working in the background, and your patients may be required for larger networks. Using the **Allow Reduction of Optimum Split and Minimum Improvement** parameters greatly increases processing time.

Figure 4-5: Network Optimization Progress Window
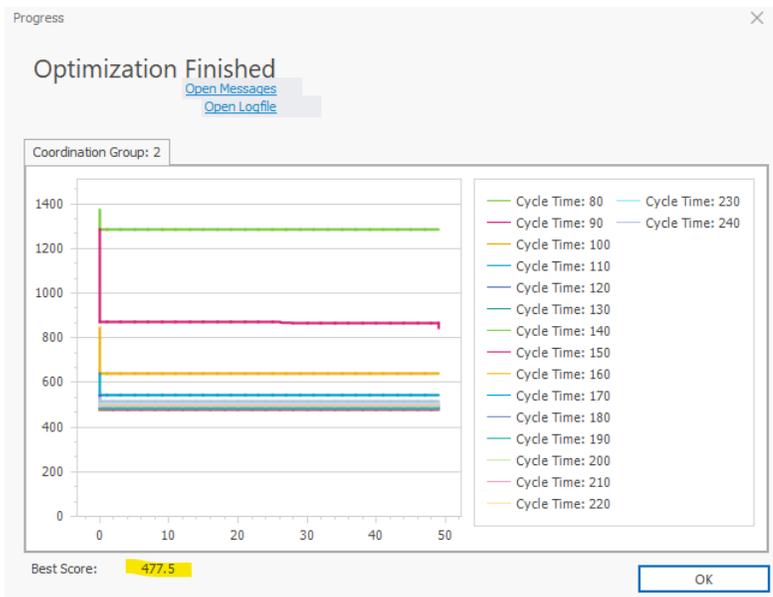
5.3 Routing

PTV Vistro's Traffic Signal Optimization Routes enhances a Coordination Group's Green Wave optimization by taking the traditional methodology further. With Routes, you can optimize a corridor that makes a turn or has a higher priority **Weight** over another route.

A typical application of Optimization Routes is identifying several corridors by drawing a Route object, and then optimizing it with or without assigned priority weights within a City grid or district Coordination Groups. This will establish key arterial corridors within the Coordination Group – and increased functionality over traditional zonal coordination, by tying a series of movements together.

Also, Routes are necessary to visualize the Time-Space Diagram shown on the Network Optimization Workflow (see **Section 0**).

To draw a route, left-click the **Route** button , and then start with the **Leg End** or **Intersection Grip** at one end of the network and drag to another **Leg End** or **Intersection Grip,** and double left-click to complete the **Route**. A route can also be manually defined by left-clicking once on each **Intersection Grip** until the last point, ending the **Route** with a double left-click.   Routes can also be redefined by dragging the intermediate points to another intersection with a left-click. More information on drawing routes can be found in the **Turning Routes 2-Way to 1-Way Conversion** example documentation located under **Help->Open Examples Directory ->Signal Optimization** folder**.** After the Route is created it will be displayed in the Network Optimization Workflow (see **Section 0**).

Additionally, the linked video indicates how the draw a route: Drawing a Route.

Figure 4-6: Drawing a Traffic Signal Optimization Route
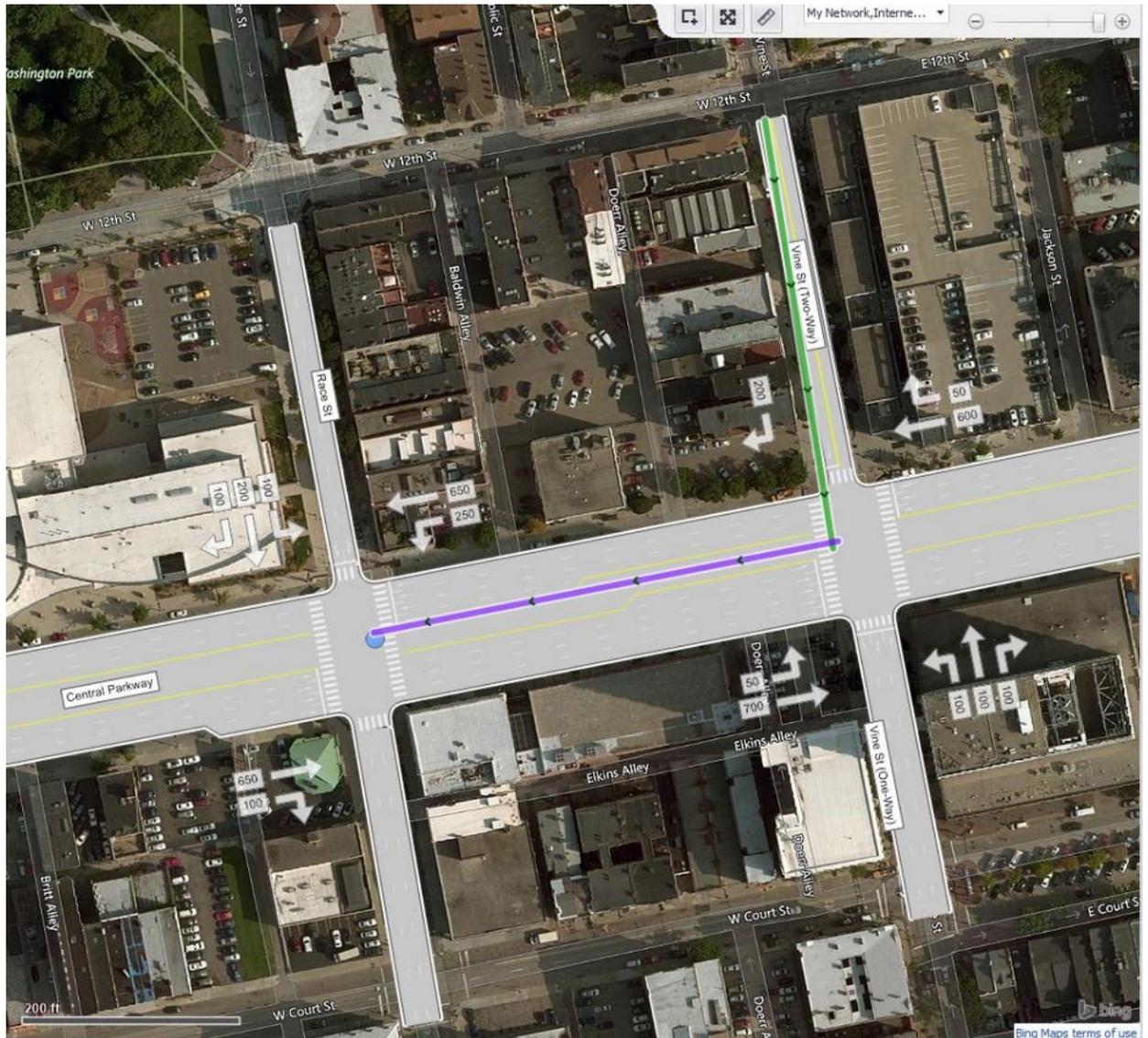
5.4 Network Optimization Workflow and Time-Space Diagrams

The Network Optimization Workflow [image] summarizes every **Route** in the network (see **Section 0**), and the **Time-Space Diagram** along that Route and/or Reverse Route. With at least 1 Route defined, the Network Optimization Route table will be populated. Here a **Name** can be given to the **Route**, typically indicating the direction as well as a **Weight**.   The weight is a factor that gives priority to the Routes movements at each intersection in **Network Optimization**. The higher the **Weight**, the higher the priority.

A **Routes Reverse Direction** can be quickly created by **right-clicking on the route** in the table to open the context menu. This will create an exact copy of the route. When creating a reverse direction, be aware of one-way roadways. Also, this context menu contains an option to **Delete** the **Route** or

Copy and **Paste** route text. **Copy** and **Paste** do not copy the **Route**. An example of Route Setup, Reverse Directions, and with Weights is shown in the Atlanta TIA Mitigate example under **Help->Open Examples Directory ->TIA.**

The following are additional parameters of the Network Optimization Workflow as shown with labels in **Figure 4-7**:

1. The **Time-Space Diagram** can be visualized using the **Maximum Flows** or **Arterial Bands** in the **Signal Time-Space Diagram Mode** drop-down menu.
2. The scale of the **Time-Space Diagram** can be set with the **Max Signal Time(s)** parameter.
3. The **Time-Space Diagram** can show the **Route** in the **Reverse Direction** if one is created by checking the **Show Reverse Direction** route.

The **Time-Space Diagram** also shows the following information.

4. Spacing between intersections along the **Route.**
5. **Intersection** and **Controller ID** numbers, and the
6. **Cycle Time, Offset,** and **Coordination Group** number

Figure 4-7: Time-Space Diagram on the Network Optimization Workflow
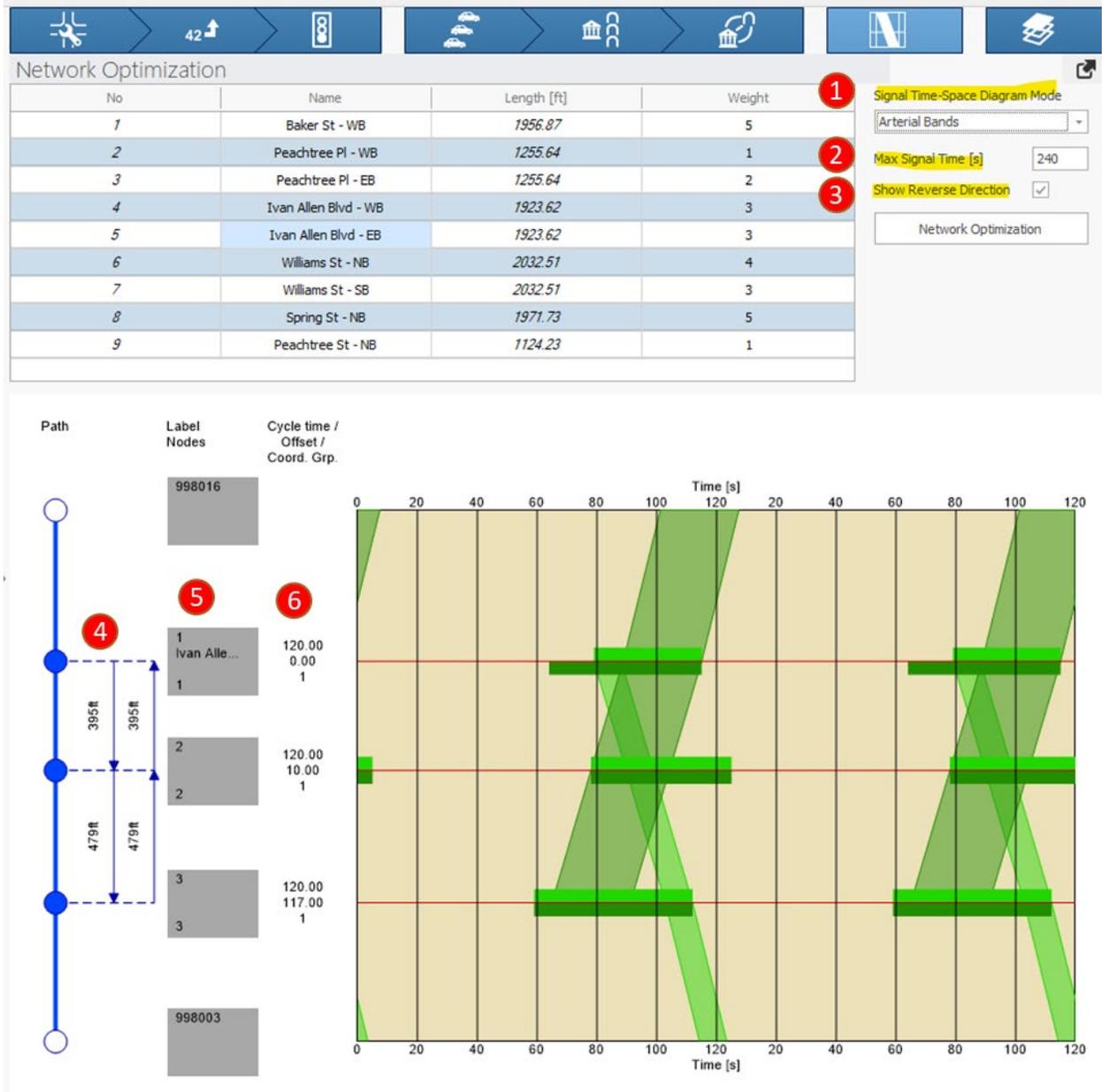
Additionally, Time-Space Diagrams can be printed by going to **File -> Print report**. On the "Select Report" tab, select the Time-Space Diagram report under the Graphical Reports section on the right side of the window.

Back to top

6 Additional Special Cases

6.1 Transit or Bicycle Active TSP

Transit queue-jumps utilize short, dedicated lanes. In these lanes, transit vehicles move to a priority position and bypass queued vehicles on the approach. Once in position, detection places a priority call to the transit signal group. Estimating active TSP in Vistro provides a general understanding of queue jump operations. This begins by adding a special transit leg to access traffic volumes and detection parameters.

Furthermore, importing PTV Vistro into PTV Vissim or Visum migrates your special transit leg, detection, and signal groups into an advanced transit planning tool. These advanced transit planning toolsets include TSP elements, such as phase omits, minor street truncations, and signal corridor coordination. The following video tutorial shows how to create active TSP in PTV Vistro, building from the passive TSP example:

Active TSP estimation in PTV Vistro

Figure 5-1: Transit or Bicycle Active TSP Self-Tutorial (click for video)

Back to top

7 Migration from Synchro

7.1 Global Settings

Make sure global settings are complete before Merging a Synchro file. See **Section 1.1** for recommendations. More Information Coming Soon

7.2 Importing a Combined .csv

Information Coming Soon

7.3 Merge

Information Coming Soon

7.4 Update

Information Coming Soon