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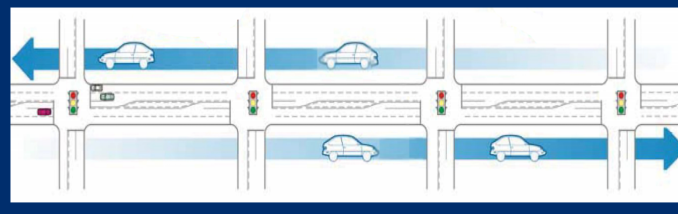
Who is responsible for traffic signal timing?

Why do I have to wait so long for a green light when there's no cross traffic, and how do I report a signal timing problem?

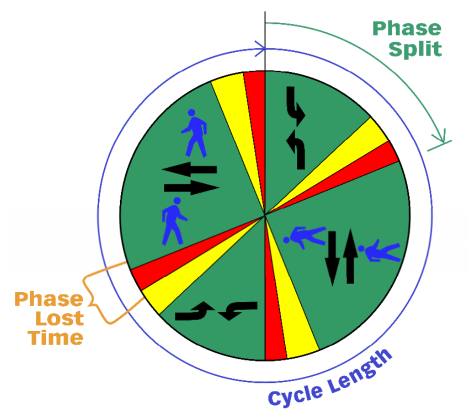


How are traffic signals timed, and are they coordinated with each other?

Most traffic signals along major arterial streets are coordinated with other nearby signals. There are several competing factors and considerations that go into the timing and coordination of traffic signals that make it a much more complicated task than one might assume. First let's define a few terms.

The time it takes a traffic signal to serve all the conflicting traffic movements at an intersection is called the **cycle length**. In other words, the cycle length is the length of time required for the signal indication for a given traffic movement to go from the onset of green to yellow, then to red, and then back to green again.

Each individual green indication for a traffic movement at a signalized intersection is a **phase**. The simplest of intersections may have two phases, one for each street, but many intersections have additional phases for left-turn movements. Traffic signal phases also include **pedestrian phases**, which typically run concurrent with vehicular phases, but can require less time or more time than the concurrent vehicular phase. The length of a phase, including its terminating yellow and all-red intervals is also called the phase **split**.



Traffic Signal Cycle Diagram

Traffic signals allocate the signal's cycle length to green phases serving the various conflicting traffic movements at the intersection, but unfortunately, not all of the cycle length can be allocated to green time. Each phase ends with a yellow change interval to warn drivers of the upcoming change in right-of-way, and there is a short all-red clearance interval to make sure traffic can clear before the next phase. The yellow and all-red intervals are needed to safely transition between phases, but they do take away effective green time. Furthermore, traffic does require time to get going, which is called start-up lost time. The total time lost to the clearance interval plus initial start-up is called **phase lost time** and is generally 4 to 6 seconds per phase.

Lost Time vs. Additional Phases: A signal with two phases, one for each street, will have 8 to 12 seconds of lost time per cycle. However, many intersections require additional phases for left-turn movements. If left-turns on both streets require separate left-turn phases, the lost time per cycle doubles to 16 to 24 seconds for the four phases being served. Separate left-turn phases are often needed for safety and capacity reasons, but their inclusion does have the adverse effect of increasing lost time. This needs to be balanced against the benefits of adding the additional phases.

Cycle Length Capacity and Delay Considerations: The percentage of the signal cycle that can be allocated as green time depends on the cycle length, since lost time per phase stays the same regardless of the cycle length. This means capacity can be increased by increasing the cycle length. Unfortunately, increasing the cycle length also increases motorists' delay, and the length of traffic queues that can create movement blockages and safety issues. So, the selection of an appropriate cycle length needs to balance higher capacity (good) vs. higher delays and queuing (bad), among other factors.

Pedestrian Phasing, Cycle Lengths, and Phase Splits: Another factor that affects the cycle length needed is the time it takes pedestrians to cross a wide arterial street. Required pedestrian phase lengths are often longer

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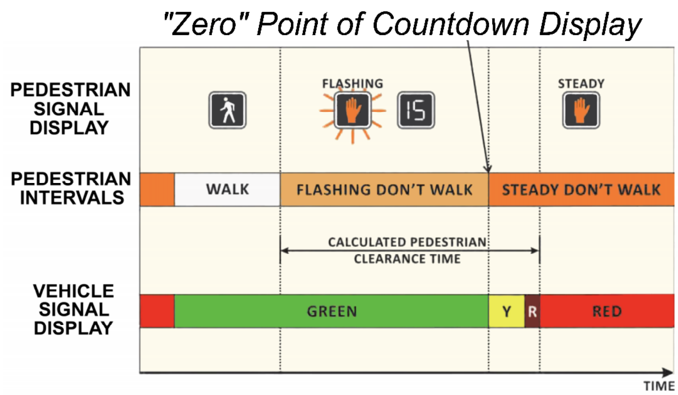
than what is needed for the vehicular phase they run concurrent with. Once required pedestrian phases are accounted for, the remainder of the cycle length must be sufficient to adequately serve other vehicular movements. On our many six-lane arterial streets, the minimum cycle length needed to accommodate both pedestrians and vehicular demands is typically 120 seconds or more.

If the phase split isn't dictated by pedestrian crossing time, the amount of green time allocated is generally based on the amount of traffic per lane that the phase serves. Traffic counts are collected on a regular basis to efficiently allocate green time to competing traffic signal phases. Non-coordinated phases have vehicle detection to end the phase early if traffic is not present.

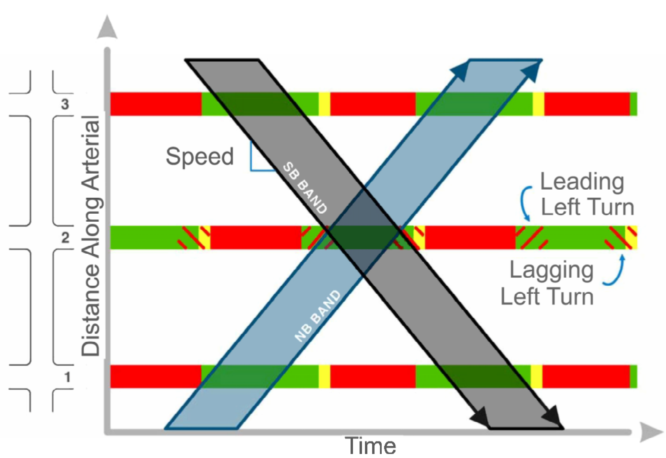


Concurrent Pedestrian and Vehicle Phases
(Source: FHWA Traffic Signal Timing Manual, 2nd Ed.)

Signal Coordination: Tightly spaced groups of vehicles departing from an intersection at the onset of green are called **platoons**. Traffic signals along major arterial streets are coordinated with each other so platoons of traffic moving from one intersection to another arrive on or near the onset of a green indication as much as possible. This is also called **signal progression** and has been found to reduce crash rates as well as motorist stops and delays. For signals to be coordinated they must run on the same **system cycle length**, or a multiple thereof. This means that the longest minimum cycle length needed within a group of signals along a corridor or in a coordinated grid, must be used as the system cycle length for coordination purposes.

A system cycle length that effectively provides for two-way signal progression also needs to be close to a multiple of the average travel time between major signalized intersections along the corridor or within the coordinated grid. Many of Las Vegas' signals are located on a grid of streets at approximately ½-mile intervals. Effective system cycle lengths in Las Vegas are typically 120 to 180 seconds in length.

Selecting Signal Offsets: Signal coordination **offsets** define the time relationships between coordinated phases of individual signals. Offsets are based on a master clock reference and are expressed in seconds or as a percent of cycle. Selecting offsets that "line up" green lights to provide a wide **green band** of signal progression in one direction is relatively easy. The task becomes much more challenging when the opposite direction is considered. Fairly good two-way signal progression can usually be achieved along a corridor as long as signals are evenly spaced, and the appropriate resonate cycle length relative to travel times is utilized. **Time-space diagrams** are used to develop effective coordinated timing plans, including strategic use of lead-lag left-turn phasing to provide wider green bands.



Time-Space Diagram
(Source: FHWA Traffic Signal Timing Manual, 2nd Ed.)

The signal coordination challenge is further complicated by cross street coordination considerations. Cross streets may not have the same ideal system cycle length, and trade-offs between different corridors in the coordinated grid become a complex balancing act. Computer modeling and Automated Traffic Signal Performance Measures (ATSPMs) are utilized to develop and regularly update grid-wide coordinated signal timing plans for Las Vegas' arterial streets.

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So, to summarize, developing and maintaining coordinated traffic signal timing plans is a complicated task that must consider and balance a number of factors that include:

- Determining the number of signal phases needed while considering lost time impacts.
- Selection of a cycle length that balances capacity needs and delay considerations.
- Selection of a cycle length that provides both adequate pedestrian crossing times and vehicular capacity.
- Selection of a cycle length that facilitates coordination with other traffic signals.
- Setting phase offsets that provide efficient two-way coordination with other traffic signals along the street.
- Setting cycle lengths and phase offsets that provide efficient coordination on a grid of streets.

Who is responsible for traffic signal timing?

The City is a member agency of the **Regional Transportation Commission of Southern Nevada (RTC)**, which is a regional entity that oversees public transportation, traffic management, roadway design and construction funding, transportation planning and regional planning efforts. RTC includes the ***Freeway & Arterial System of Transportation*** **(FAST)**, which is responsible for the day to day timing of traffic signals in the City of Las Vegas, as well as other member agencies (e.g., Clark County, City of North Las Vegas, and City of Henderson).

The City works collaboratively with RTC-FAST staff to ensure efficient signal timing is implemented and maintained on City streets. RTC-FAST, as a regional entity, is also able to effectively coordinate signals across jurisdictional boundaries where disruptive coordination breaks might otherwise occur.

Why do I have to wait so long for a green light when there is no cross traffic, and how do I report a signal timing problem?

Relative to uncoordinated operations, coordinated signal timing along Las Vegas' grid of major arterial streets often increases delays on minor side street approaches that are not part of the coordinated grid. However, overall system stops and delays are greatly reduced by signal coordination, and once a motorist turns from a minor side street to travel on the major street, they experience those benefits. There are a couple of reasons you may not observe cross traffic while you are waiting at a red signal indication:

- As noted previously, pedestrian phases often need to be longer than the vehicular phases they run concurrent with. Motorists sometimes have to wait for a conflicting pedestrian phase to finish while there is little vehicular traffic moving at the intersection. You may not see a pedestrian because they may have already crossed at a faster than average pace, or they may have decided not to cross after pressing the pedestrian signal button.

- Major street traffic platoons do arrive at different times during coordinated green phases, particularly those in opposite directions. There may be periods of light traffic on the major street in between the arrival of traffic platoons, but they are not long enough to serve minor street phases (and concurrent pedestrian phases) while reliably returning to the major street to serve arriving traffic platoons.

If you see a signal timing problem you can report it to RTC-FAST through Seeing Orange at https://www.seeingorangenv.com/, or to the City of Las Vegas at https://seeclickfix.com/las-vegas. Be as detailed as possible, and include the intersection, direction of travel, time of day, and date or day of the week.

Want More Information?

This flyer is for general purposes only. For more information, please contact the City of Las Vegas Department of Public Works, Transportation Engineering Division at (702) 229-6331 or https://seeclickfix.com/las-vegas

NOTE: The **Manual on Uniform Traffic Control Devices (MUTCD)** is used throughout the country as the standard by which traffic control decisions are made. Nevada Revised Statute 484A.430 requires its use for placement of all traffic control devices. Find the ***complete*** **MUTCD** at https://mutcd.fhwa.dot.gov/ or scan the QR code.

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