Traffic signal basics

A traffic signal has the primary task of assigning right-of-way to the different movements at an intersection in a safe and efficient manner. Today's modern signalized intersections are complex, but this diagram outlines a few of the basics.

Controllers

Besides the poles, mast-arms, signal heads and signs there is also a cabinet present at each intersection containing various electrical components, including a traffic signal controller. This is the brains of the intersection — a small field-hardened computer that can take various inputs, make decisions on right-of-way and output appropriate signals that tell drivers and other users what to do.

MUTCD

Many of the settings and behaviors of traffic signals are governed by the Manual on Uniform Traffic Control Devices, the national standard developed by the Federal Highway Administration (FHWA), and adopted by local agencies. Beyond these constraints, many settings at an intersection are determined by engineering studies and engineering judgment by the owning agency and/or its contractors and consulting firms.

Preemption

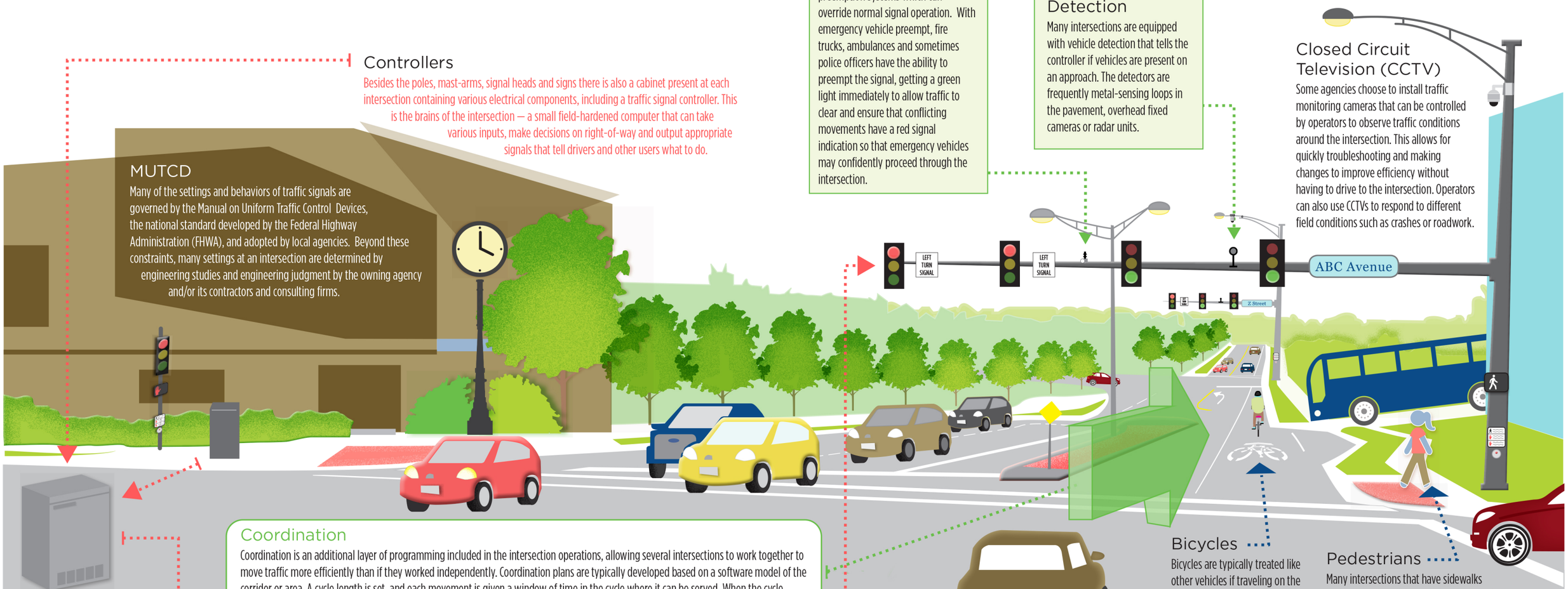
Many municipalities have installed railroad or emergency vehicle preemption systems which can override normal signal operation. With emergency vehicle preempt, fire trucks, ambulances and sometimes police officers have the ability to preempt the signal, getting a green light immediately to allow traffic to clear and ensure that conflicting movements have a red signal indication so that emergency vehicles may confidently proceed through the intersection.

Detection

Many intersections are equipped with vehicle detection that tells the controller if vehicles are present on an approach. The detectors are frequently metal-sensing loops in the pavement, overhead fixed cameras or radar units.

Closed Circuit Television (CCTV)

Some agencies choose to install traffic monitoring cameras that can be controlled by operators to observe traffic conditions around the intersection. This allows for quickly troubleshooting and making changes to improve efficiency without having to drive to the intersection. Operators can also use CCTVs to respond to different field conditions such as crashes or roadwork.



Coordination

Coordination is an additional layer of programming included in the intersection operations, allowing several intersections to work together to move traffic more efficiently than if they worked independently. Coordination plans are typically developed based on a software model of the corridor or area. A cycle length is set, and each movement is given a window of time in the cycle where it can be served. When the cycle lengths match across multiple intersections, the departure and arrival of vehicles can be better controlled and thereby made more efficient.

Bicycles

Bicycles are typically treated like other vehicles if traveling on the roadway. Some agencies install detector zones at intersections specifically for bicycles in bike lanes.

Pedestrians

Many intersections that have sidewalks and crosswalks will have pedestrian crossing signals. Pedestrian detection, typically a push-button, tells the controller of a person's presence and desire to cross the street. The signal may include a countdown timer to tell pedestrians how much time they have left to cross. During the steady Don't Walk signal, pedestrians should wait for the Walk indication, since conflicting vehicle movements may have the right of way at that time. More advanced pedestrian crossing systems can provide additional feedback to pedestrians including visual, audible and tactile signals to prompt persons to cross.

Conflict monitors

Signal controllers must not give right of way to two conflicting movements simultaneously. To protect against controller malfunction and provide a fail-safe operation, an additional piece of hardware is present at all intersections called a Conflict Monitor or Malfunction Management Unit. If this monitor detects an unsafe condition, it will override and all signal heads will go to flash mode.

Varying Control Strategies

Typically, the controller will have a schedule so that it can run different coordination plans or run free (no coordination) for different traffic conditions. In some areas, operators in a Traffic Management Center can command different plans to run based on real-time field conditions, such as an accident or roadwork event. More advanced systems can have a computer make decisions on traffic control based on the data available from certain vehicle detectors in strategic locations.

Source: marc.org/Transportation/Programs