Wireless Timing Barriers

all wireless is not created equal

Timing systems require precision response from each component in order to maintain high levels of accuracy and reliability. Using wireless technology to link components together and transfer precision high speed digital signals is a difficult task due to the innate delays of wireless communications.

Problem 1 – Timing Accuracy

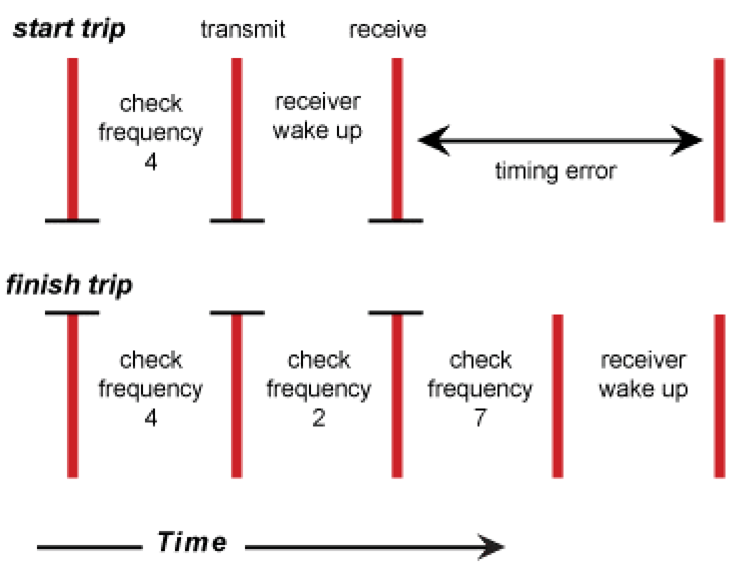
When a sensor on a race track is tripped, the signal is sent to the timer to start or stop a measurement of speed or time. Elapsed Time is the time between the start trigger and the stop trigger. If the start trigger signal is delayed getting to the timer, the resultant time is smaller indicating a faster run. If the finish trigger signal is delayed getting to the timer, the time appears to be larger indicating a slower run. Either of these scenarios effect the accuracy of the time measured by the timer. On the other hand, if the start trigger is delayed and the finish trigger is delayed by the exact same amount, the resultant ET would be accurate.

Problem 2 – Interference and False or Missed Trips

If electrical or radio interference occurs, the receiver may temporarily lose contact with the transmitter. If the loss of signal occurs when the trigger occurs, the receiver will never receive the trigger. If, on the other hand, the receiver is continuously listening to the transmitter waiting for an interruption in the transmission, a loss of signal due to interference will cause the receiver to process a false trip.

Wireless - Channel Hopping Technology

Consider today's channel hopping highly sophisticated wireless communications. The start sensor trips and the wireless start line transmitter has something to send to the timer.



The wireless unit picks a transmission frequency or channel and checks if it is clear for a transmission. If not, it 'hops' to a different channel and checks for availability. The transmitter continues to hop between channels looking for an unused frequency until it finds one. The transmitter sends information to alert the wireless unit connected to the timer, then sends the trigger. The receiver 'wakes up' and receives the signal, decodes it, ensures the data is valid and processes the trigger.

The finish sensor triggers and the finish line wireless unit follows the same channel hopping process. If both wireless units hop the same number of times, the ET should be pretty close assuming the receiver was able to response the same to both transmissions. Obviously, this will not work unless a few hundredths of a second accuracy at best is acceptable. The timing system may be displaying thousandths of a second, but the accuracy is most likely a lot less.

Wireless – Dedicated Continuous Transmitters

Another method is to enable the wireless units at the start and finish lines to pick a frequency and continuously transmit until their sensor is triggered. If the wireless unit immediately interrupts the transmission, the receiver will know immediately of the trip. If two transmitters are continuously transmitting, two receivers would be required each assigned a frequency associated with each transmitter. The problem here is the transmitters are continuously transmitting and consumes a lot of battery power during a 12 hour event. All is well here as long as two receivers can be integrated to one timer and the receivers react to a loss-of-signal in the same way and timeframe.

The Wireless Timing Challenge

To ensure a wireless link is robust enough to maintain accuracy and deliver reliable signals to the timer, the wireless link must be capable of a number of key factors:

1) RF DISTANCES - If you need 300 feet between the wireless transmitter and the receiver, the wireless link must be capable of at least twice that as a minimum rule of thumb. Most manufacturers will state the best possible performance of their wireless and it will fall short of a best scenario for actual working distances. Plan on using a wireless link capable of at least twice your desired installation distances.

2) ANTENNA PLACEMENT - When working with longer distances (farther than the 2x distance rule of thumb), antenna height is a key factor as well as how good the line-of-sight is between the transmitter and the receiver. Due to the nature of wireless communications, placement of the wireless units can be a critical factor and moving around small distances can sometimes make the difference. It will be a lot easier on the setup when the installed distance is much shorter than the advertised RF maximum distance. The wireless system should allow for antenna extension cables and alternate antenna solutions like Yagi antennas where needed.

3) MEASURING LINK INTEGRITY - How well the wireless link defends against RF interference or compensates for RF interference will determine how reliable an installation will be during a day long event. The wireless system should be capable of indicating the level of interference or the inverse, the integrity level of the wireless link. RF interference is not easily detected without sophisticated equipment, so the wireless link must provide some insight when problems occur.

4) DESIGNED FOR INTERFERENCE - When a sensor trip is transmitted and RF interference occurs at the same time, how well the wireless can detect this problem and work around it is key to eliminating false and missed trips. If the wireless system does

not detect the loss of signal by the receiver or the receipt of a garbled transmission, the timing will be erratic.

Most low end and inexpensive wireless solutions are not designed to handle the unexpected RF interference to the wireless link. When RF interference is present, shortening the distances between transmitter and receiver is about the only way to resolve the problem. With good tools to help guide the wireless installation, the wireless link's reliability can be optimized otherwise the wireless effectiveness will be equal to the environment making for a long race day.