

Using Diverse Path Mesh technology to implement a Wireless Synchronized Clock System

Based in Huntingdon Valley, Pennsylvania, Sapling, Inc. (www.sapling-inc.com) is a company that specializes in manufacturing state-of-the-art timepieces. Sapling is always on the cutting edge of technology and offers analog clocks, digital clocks, master clocks, GPS receivers, wireless transmitters and repeaters, as well as a plethora of related accessories.

Markets for time control systems have traditionally been schools, hospitals, transit facilities, industrial plants and retail and commercial complexes. These users require synchronous operation between all clocks within a building complex, with no late or early times shown. In short, all clocks have to always show exactly the same time. Time correctness is a key for smooth operation: all classes should end on time; all trains depart as planned etc. Time changes such as daylight savings time should be reflected immediately.

In general, clock synchronicity requires the use of a master clock, with a reliable mechanism to ensure its operation. Secondary clocks all work with the same principle: they can only have three conditions with reference to their master clock. Each clock can be either on time, fast or slow. At some point a control signal transmitted from the master clock corrects all the secondary clocks.

When Sapling decided to develop a line of master and secondary clocks it had a list of requirements:

1. A wireless system to require very little power yet be very robust, as most clocks are battery powered and a wasteful wireless protocol would dramatically shorten battery life.
2. The clocks operation and connectivity to the wireless network should be a 'no brainer', to be set up by untrained personnel. No repeaters, no measurement of the distance from a central unit, no pre-configuration.
3. Clocks should work and synchronize the first time around, in order to avoid product returns from customers who can't 'make them work'.
4. Clocks should use the cost-free unlicensed 902–928 MHz frequency band.
5. All clocks should have a set up capability so that the system can update all clocks simultaneously - especially important for daylight savings setting.

After checking many solutions, Sapling chose Virtual Extension as its supplier of the wireless modules for its systems. Since then, Sapling has installed tens of thousands of units based on Virtual Extension solution, to its and its customers' satisfaction.

Key solution system information:

- Operates at 902-928 MHz
- Units can be added or removed at any time by untrained personal
- Frequency Hopping Spread spectrum (FHSS)
- Wireless RS 232/485
- 8 mW output power.



Figure 1: *Wireless Synchronized Clock from Sapling*

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