



Location Based Services within a Converged Plantwide Ethernet Architecture

Rockwell Automation and Cisco Four Key Initiatives:

- **Common Technology View:**
A single scalable architecture, using open Ethernet IP standard networking technologies, is paramount to enable the Industrial Internet of Things for achieving the flexibility, visibility and efficiency required in a competitive manufacturing environment.
- **Converged Plantwide Ethernet Architectures:**
Collection of tested and validated architectures developed by subject matter authorities at Cisco and Rockwell Automation. The content of CPwE is relevant to both Operational Technology (OT) and Information Technology (IT) disciplines and consists of documented architectures, best practices, guidance and configuration settings to help manufacturers with design and deployment of a scalable, robust, secure and future-ready plant-wide industrial network infrastructure.
- **Joint Product Collaboration:**
Stratix 5950™ Industrial Firewall, Stratix 5100™ Wireless Access Point/Workgroup Bridge, and Stratix 5700™, Stratix 5400™ and Stratix 5410™ Industrial Ethernet Switches, incorporating the best of Cisco and the best of Rockwell Automation.
- **People and Process Optimization:**
Education and services to facilitate Operational Technology (OT) and Information Technology (IT) convergence, assist with successful architecture deployment, and enable efficient operations that allow critical resources to focus on increasing innovation and productivity.

White Paper

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Manufacturers are continually looking for ways to increase visibility into their plant's operating efficiency. As a part of workflow optimization within the plant, it is essential to have awareness about all factors of production, including personnel and assets and their movements and warehousing. Manufacturers can gain valuable insights for optimizing their production, workflows and people resources by knowing how people, products and assets move through a manufacturing facility. When the selection and distribution flow of products are optimized, business processes and safety practices can be improved, production compliance can be confirmed and scrap can be reduced.

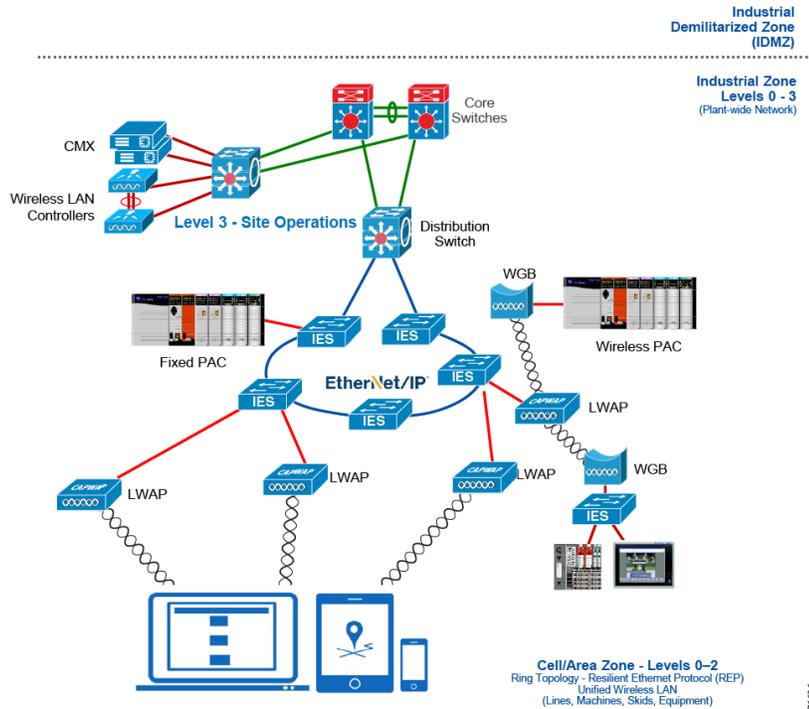
Customers can save on both capital expenditure and operating expenses when they have visibility through location data that can identify a product or asset's production path and location to within a meter's accuracy. Capital savings can also be realized by helping to reduce the need for unnecessary, under-utilized infrastructure. Operating expenses can be reduced through optimized production workflow across the plant floor and into warehousing facilities, up until the products are acquired by transportation services. Through enhanced production visibility, production scrap is reduced. Employee safety is also improved by knowing the exact location of individual employees during an emergency.

Converged Plantwide Ethernet's (CPwE) Location Based Services is a service that uses a manufacturing or warehouse facility's Unified Wireless LAN infrastructure. By combining the Unified Wireless LAN and the Cisco® Mobility Experience (CMX) Engine for frequent data processing, a powerful Location Based Services platform is created for the plant floor. Location Based Services can be customized to meet the needs of the business, or the plant floor operator. When used in conjunction with the Converged Plantwide Ethernet's Unified Wireless LAN architecture, it produces several benefits, including

- Maintained production flow visibility of products, assets and people throughout the industrial zone
- Context-driven information to help influence manufacturing and warehousing process improvements
- Reductions in the loss of capital expense production assets, including tools and machines, during shift changes and line changeovers
- Insight into traffic patterns, allowing for optimized Industrial Automation and Control System (IACS) machine placement and plant floor design
- Scrap reduction resulting from real-time tracking of a product's journey from manufacturing to the warehouse
- Real-time and historical visibility into environmental conditions that may impact product quality, integrity or compliance

The Converged Plantwide Ethernet Unified Access WLAN architecture, as illustrated in Figure 1, addresses large-scale plant-wide wireless infrastructure needs. The Unified Access architecture allows for centralized management and control of the Wireless Access Points distributed through the plant, and consolidates the Location Based Services traffic back to the Wireless LAN Controller (WLC) and CMX platform for analysis of IP-connected device location data. By using a centralized management model for all wireless services, the WLC and CMX work together to aggregate and analyze Wireless LAN traffic traversing the wireless architecture, for real-time information about the plant's wireless network and the IP-connected devices.

Figure 1 Unified Wireless LAN



CPwE is the underlying architecture that provides standard network services to the applications, devices and equipment found in modern IACS applications. The CPwE architecture provides design and implementation guidance to help achieve the real-time communication, scalability, reliability and resiliency requirements of the IACS. CPwE Location Based Services for the plant floor is brought to market through a strategic alliance between Cisco Systems and Rockwell Automation. The CPwE Location Based Services architecture details design and implementation considerations for the tracking of products, people and assets who use Wireless IP-connected devices for IACS applications via a Unified Wireless LAN infrastructure.

Converged Plantwide Ethernet Location Based Services

The Unified Wireless LAN architecture supports IP-connected device Location Based Services today. With the addition of the Hyperlocation Module and Hyperlocation antenna to Cisco Aironet 3600 and 3700 series access points and the Cisco CMX platform, IP-connected device tracking includes laptops, tablets and smart phones. Manufacturers will capitalize on faster, more accurate location data to help achieve improved business outcomes. The Hyperlocation module plugs into the socket on the back of the Aironet 3600 and 3700 access point, enabling advanced location and security features, including Cisco's FastLocate technologies. The Hyperlocation Antenna plugs into the Hyperlocation Module and wraps around the edges of the 3600 or 3700 access points for full 360-degree coverage. The addition of the antenna introduces an enhanced benefit: Angle-of-Arrival (AoA) determination. Cisco's CMX and its FastLocate technology boosts the location

refresh rate helping to enable the Cisco CMX to capture more location data points across the plant warehouse space and improving accuracy to as close as one meter via AoA capabilities. Manufacturing and warehousing operational practices can be better-refined based upon the improved accuracy gained from the granular analytics data learned from the Wireless LAN-connected IP devices.

For customers who have already invested in Cisco's Unified Wireless LAN architecture, existing access points can be upgraded in the field. These include the Cisco AP3602i and AP3602e and Cisco AP3702i and AP3702e Series Access Point Modules, which support both the Hyperlocation Module and Hyperlocation Antenna. Along with the Hyperlocation Module, the Cisco Hyperlocation Antenna is required to provide the near 1-meter location accuracy of IP-connected devices. The antenna's design brings AoA capability on top of the existing Received Signal Strength Indication (RSSI)-based 5 to 10-meter solution, increasing location accuracy of IP-connected devices to nearly 1 meter. As with any location-based technology, a clear Line-of-Sight (LoS) between the IP-connected device and Hyperlocation Module will produce the best results.

When determining the position of an IP-connected device on the plant floor, the CPwE Location Based Services architecture allows for the optimization of results based upon the following fundamental categories:

- Cell of origin (nearest Cell/Area Zone)
- Distance (lateration)
- Angle (angulation)
- Location patterning (pattern recognition)

To establish improved accuracy, additional methods of determining location including use of multiple access points, identifying LoS obstacles (such as machines) and the building's structure itself are each critical to obtaining optimal Location Based Service performance. The Cisco Location Based Services architecture provides increased accuracy when three or more Hyperlocation-enabled access points are used for the location calculation process.

The most basic approach, estimating approximate location of an IP-connected device based upon association to a given access point, or the concept of Cell of Origin (CoO), occurs when the IP-connected device is within range of a single access point. A CoO establishes a general proximity to the access point. Next, using Received Signal Strength (RSS) in place of Time Difference of Arrival (TDoA), lateration occurs, where signal strength is measured by either the operator's IP-connected device or the receiving access point. Again, this establishes general proximity of the IP-connected device. Improving results further, the AoA will locate the operator's IP-connected device by determining the angle of incidence at which signals arrive at the access point's Hyperlocation sensors, at a minimum of two Hyperlocation-enabled access points. Location estimation is still general, identifying the IP-connected device as residing between two access points. Ideal results are provided when three or more Hyperlocation access points are used for the purposes of triangulation, which identifies an IP-connected device's specific location via three data points or more. Building atop the location capabilities of the Location Based Services architecture, the Cisco CMX tracks every IP-connected device's unique RF fingerprint for location or path patterning, enabling even more visibility into IP-connected device use and behavior.

**Note**

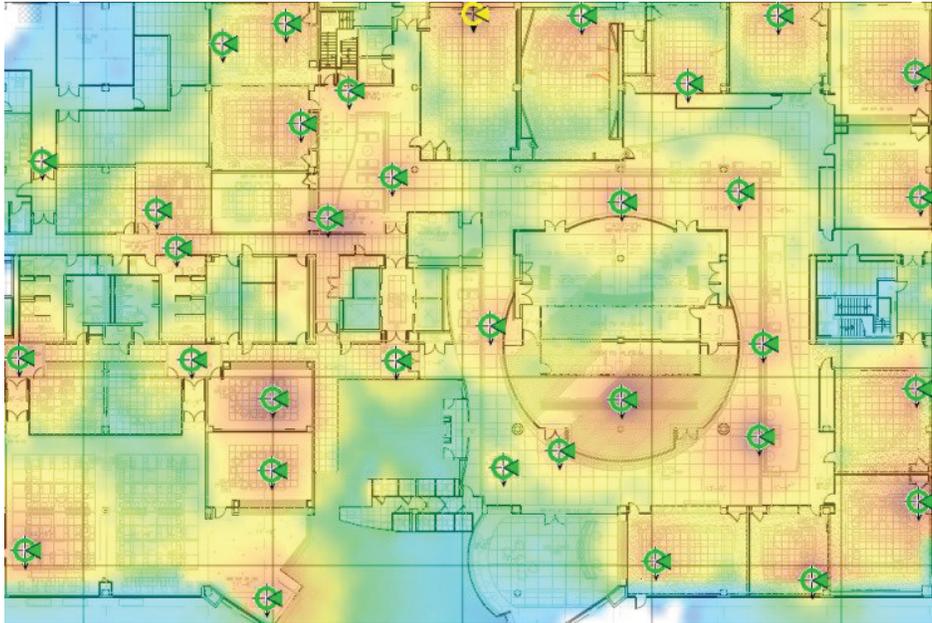
Location Based Services is not supported by autonomous AP configurations or workgroup bridges.

Device Path and Dwell Time

By integrating the Cisco CMX platform, an integrated report generator creates new visibility of operations on the plant floor. The CMX creates reports that are based upon an array of metrics that can help benefit the manufacturer and plant operator. Reports generated within the Location Based Services architecture create analytics-based value specific to the plant's needs. Default values available to the manufacturer or plant

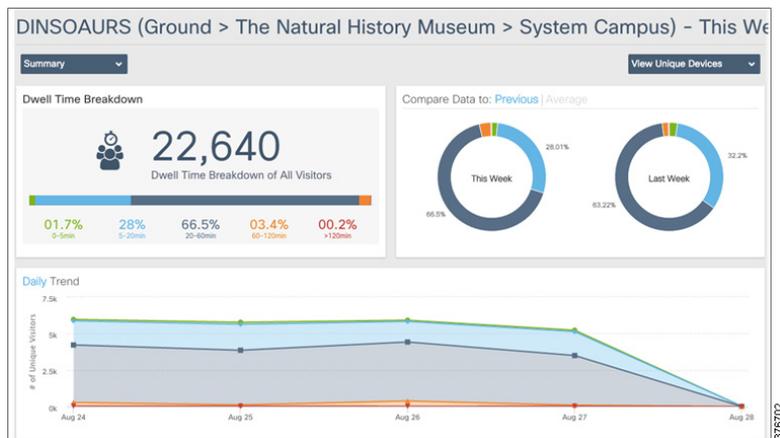
operator includes IP-connected device count, connected clients, average dwell time, location correlation, most popular zones and path analytics. Figure 2 is a simple representation of the path of three IP-connected devices traversing the plant floor.

Figure 2 Path Analytics



As shown in Figure 2, IP-connected wireless devices, such as hand held tools, are each shown as they traverse the plant floor. In addition to recording the route that each tool has taken, how long each device remained at a specific station is also recorded. As shown in Figure 3, a new data point referred to as *dwell time*, or how long the tool remained at a given station, provides validation of business decisions about the use of various assets that may drive investment into additional tools or assets.

Figure 3 Dwell Time Report



Summary

The Deploying Location Based Services within a Converged Plantwide Ethernet Architecture Design and Implementation Guide (DIG) provides design and implementation guidance for the deployment of a Cisco Unified Wireless LAN in conjunction with Cisco's Hyperlocation technologies for a 802.11 network-based location system that pinpoints an IP-connected device's path of travel and precise location within the plant. In almost every industry, location-based tracking services provide an invaluable view into overall plant-wide operating efficiency, resources utilization, production logistics and a platform for personnel safety. Based upon the best practices defined in the *Deploying 802.11 Wireless LAN Technology within a Converged Plantwide Ethernet Architecture DIG*, implanting a Location Based Services service provides special context in support of Industrial Automation applications that can now help to produce better business outcomes through the optimization of people, processes and assets.

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