



SOLUTION BRIEF

Xirrus Positioning System: Location Service

Indoor Location Services

When it comes to location services, global positioning systems (GPS) represent probably the most commonly known technology. Today, GPS gets widely used for driver assistance and general location applications (such as maps and directions), as well as government and industrial purposes (military, agriculture, etc.). While GPS comprises a very accurate and a highly-used technology, it works best outdoors where you can triangulate position based on line of sight with overhead satellites. Buildings tend to block and distort GPS signals, and buildings with multiple floors make calculating altitude difficult.

A better solution for indoor location typically uses pervasive in-building connectivity technology such as Wi-Fi.

Since its introduction, the 802.11 wireless protocol has grown spectacularly in the last decade, moving from what was once a productivity enhancement technology to one used in most aspects of daily life. The widespread adoption of Wi-Fi by everyday users has led to its deployment in offices, homes, public venues, government buildings and throughout metropolitan areas in general.

Wi-Fi's pervasiveness and growth in quality have engendered new uses for indoor location information. Thanks to its versatility, Wi-Fi now represents the de-facto connectivity standard inside buildings. A Wi-Fi network can maintain constant visibility of any asset, from the very moment a user or a device enters a building until the point the device exits. With their extensive user and device location insights, enterprise Wi-Fi networks have quickly emerged as an untapped wealth of real-time user knowledge. This remains especially true in today's highly competitive marketplace, where an otherwise well-positioned enterprise can fail to keep up with their peers in delivering differentiated contextual service and optimizing company resources.

XPS Features Overview

- Locate both associated and unassociated Wi-Fi devices in seconds
 - Track up to 100,000 devices simultaneously
 - Powerful distributed processors in each AP calculate device location
 - Identify devices on the map with Xirrus Management System (XMS)
 - Standards-based RESTful JSON API
 - Virtual server requires no dedicated hardware
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An Enterprise Necessity

Access to real-time location information has given businesses the ability to create a whole new category of customer and guest-facing services, such as helping people find their way within an indoor venue, providing self-guided tours at a museum, attracting customers to a store within a mall, understanding the flow of people through an entrance or exit, notifying resort staff of the arrival of a VIP guest and more. Accurate indoor Wi-Fi location services have become critical to the success of businesses which aim to provide patrons such amenities as augmented reality, social networking, healthcare monitoring, personal tracking, inventory control and other indoor location-aware applications.



Enhance Guest Experience

In large venues that provide services and facilities to patrons, the ability to track Wi-Fi devices (i.e., phones and tablets) allows the venue operators to provide information to customers that enhance their experience. For example, determining which bathroom or concessions stand has the shortest line.

Tailoring Customer Offerings

Retail stores and restaurants are finding that Wi-Fi location services can better entice their customers to engage in more purchasing activities. For instance, if someone at a mall moves toward the exit, Wi-Fi location services could detect this and push an offer for 20% off in-mall dining to encourage that person to remain. Casinos, hotels, stadiums or any other public venues can offer zone-based triggers to engage guests at an opportune time.

Retail

Naturally, a great deal of focus for these applications has centered on retail, where location and analytics provide powerful insights into shopper behavior, including shopper flow patterns, time spent in stores, how often buyers return and similar data points.

Hospitality

When people stay at hotels or attend conferences at hotel facilities, they often have trouble locating meeting rooms or other areas they wish to visit (e.g. restaurants, bars, fitness areas). Guests could use Wi-Fi location services to map or navigate routes to these areas.

Customer Service

There's a huge premium on customer service, where you can tie location services to customer management systems: personalized greetings for loyalty members, notify staff of VIP arrival and other guest offerings.

Tracking Personnel Location

Tracking a person's location represents another primary use of Wi-Fi location services. For example, hospitals can instantly locate nurses in case of an emergency or use a signaling application to call for assistance. Wi-Fi monitoring can also locate patients within a hospital or students on a campus.

Locating Equipment

Most tracking solutions have the basic function of monitoring equipment. For example, hospitals can use Wi-Fi to keep up with medical equipment such as infusion pumps, crash carts and nursing carts. By using Wi-Fi monitoring, staff can easily find the equipment they need when they need it.

Network Troubleshooting

Organizations can also use Wi-Fi location services to improve network functionality. When wireless network users report problems, the help desk can locate the user physically and get a better comprehension of the issue by evaluating the location and infrastructure directly in use.

Analytics

Finally, all of these scenarios generate data on movement, traffic levels, habits and general use. Wi-Fi operators can use and analyze this data to improve user experience and create new opportunities for monetization of services.

Key Attributes of an Indoor Location System

For location services to become truly useful to both the customer and the Wi-Fi operator, they must have specific characteristics.

Fast Response

First and foremost, and rather obviously, a good Wi-Fi location system must track Wi-Fi devices. However, tracking must take place in real time, and on associated and unassociated devices. In other words, the tracking system must have the ability to provide position information quickly and as close to real time as possible. It must also be able to follow not just devices that are currently logged into the Wi-Fi, but any devices currently within the Wi-Fi sphere of influence (whether logged in or not).

Scalable

One of the biggest concerns for location systems lies with scalability. With the prevalence of Wi-Fi-enabled devices, a reasonably sized office or venue can expect hundreds to thousands of devices at any given moment. A good Wi-Fi tracking system should have the ability to quickly accommodate and incorporate such growth without adversely affecting its performance and accuracy.

Accurate

As a Wi-Fi location system tracks more and more devices, it must maintain accuracy as to the location of all devices in the Wi-Fi sphere of influence. Wi-Fi location accuracy depends on many factors such as Wi-Fi deployment design, equipment quality and the system's ability to scale as more devices get added to the mix. The granularity of accuracy needed depends on specific uses – tracking items on a shelf for store inventory requires more accuracy than locating a meeting room in a hotel, for example.



Extensible

The value of location information becomes truly realized through various applications such as way-finding, alerting systems and others. These applications must effectively communicate with the location service, access relevant data and use it to implement services.

Secure

When it comes to the collection of location data, and to interactions between third party applications, it is essential that the information gathered gets transported and maintained in a secure fashion.

Cost effective

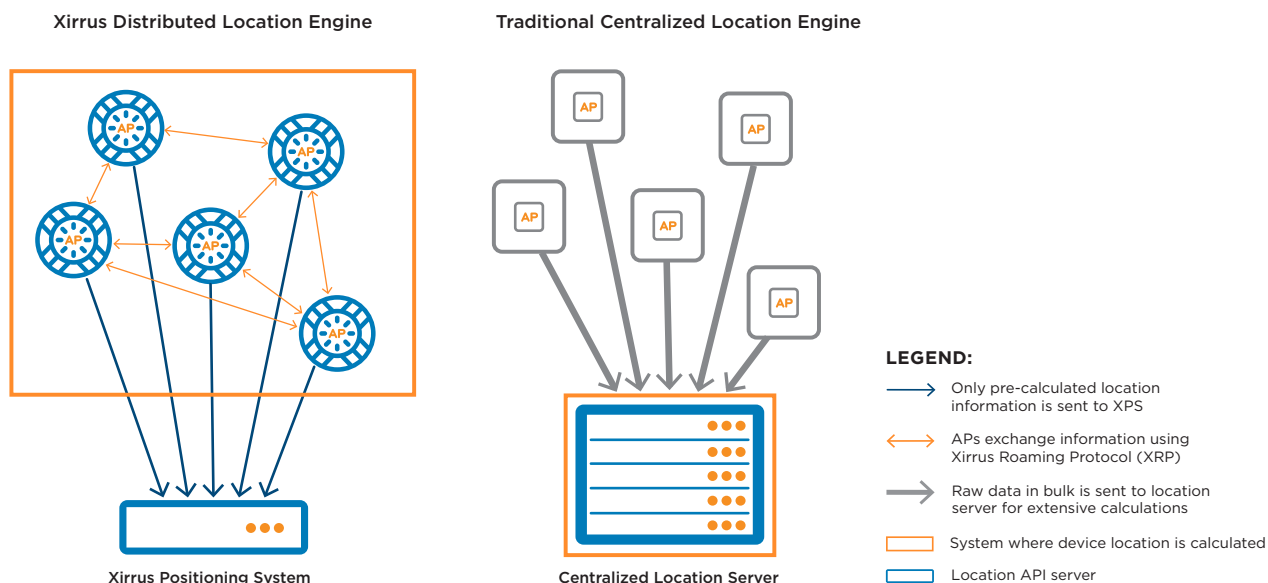
The location platform should easily integrate with existing infrastructure. In other words, having to add a completely separate system can pose just as many problems as it solves — adding both more cost and more complexity to IT operations.

Xirrus Positioning System

The Xirrus Positioning System (XPS) is a groundbreaking location system which integrates with Xirrus Wi-Fi infrastructure. Each integrated Xirrus Wi-Fi network is built on distributed architecture, with controllers embedded in every access point (AP). Unique in the industry, Xirrus APs provide 2-8 radios in each AP to deliver high Wi-Fi capacity, and 2-4 core processors to deliver the Wi-Fi performance demanded by today's 802.11ac standards. This means that Xirrus Wi-Fi supports 100s to 1000s of devices on a single AP. Using these compute cycles, XPS can easily support even the most extreme density environments.

Xirrus Unique Architecture

The XPS is the only solution in the marketplace that distributes highly intensive client location calculations among all the access points in a network. A traditional location system often requires a powerful (and expensive) hardware platform in order to handle the location computation of tens of thousands of devices — all of which gets performed in one single server. XPS, on the other hand, uniquely harnesses the computing power of the entire network, for a faster and more scalable system.



Track 100,000 Devices Simultaneously

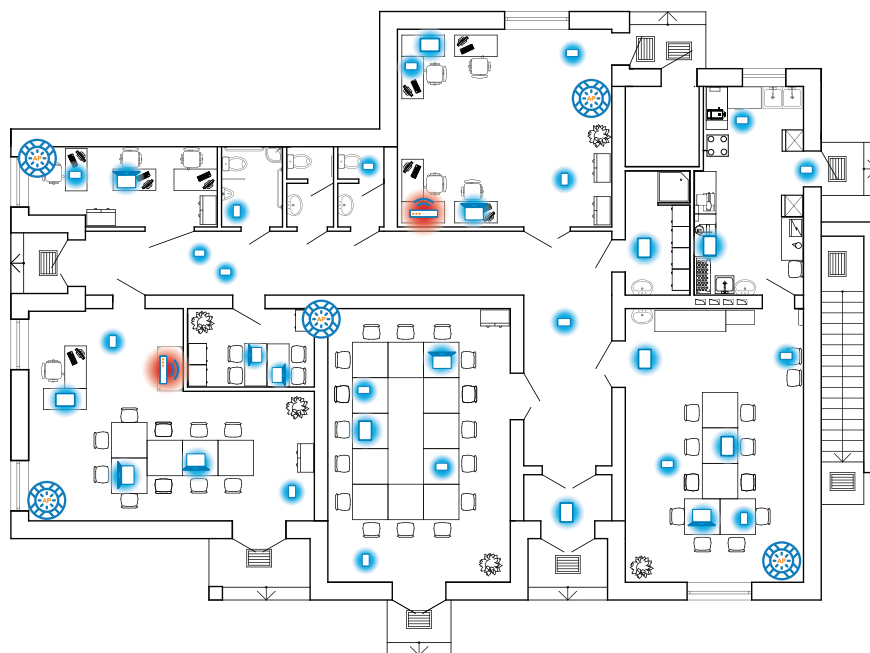
Xirrus APs in a Wi-Fi network directly communicate with each other to compute the relative location of devices using the Xirrus Roaming Protocol (XRP). Users do not have to log into the Wi-Fi network to get tracked, as the intelligent Xirrus APs recognize all Wi-Fi devices within range by analyzing the beacons they emit. As result, XPS can track associated devices as well as unassociated objects that haven't yet joined the network.

XPS provides a holistic view of the entire Wi-Fi network. The system calculates a device's location using multiple parameters (including RSSI values) and calibrates results for accuracy, before securely uploading the data from each AP into the XPS server.

With location pre-calculated among all APs and maintained by the XPS, a single XPS instance running on a VMware virtual server can achieve massive scale — up to 100,000 devices.

Locate Devices Within Seconds

With 2-4 core processors in every Xirrus AP, the distributed XPS location system leverages significant compute resources throughout the network to quickly deliver location information, at a rate that can reach orders of magnitude faster than centralized systems. Pre-computation of X/Y coordinates within APs enables real-time monitoring of clients as they move around within a physical area. The XPS uses very low bandwidth for data transmission between APs. And since the XPS server itself does not compute the location of client devices, it can dedicate its complete compute power to servicing location queries from 3rd party applications or from the network management system. Upon receiving a query for an individual client or bulk list, the XPS scans its information repository and sends back the information within seconds.

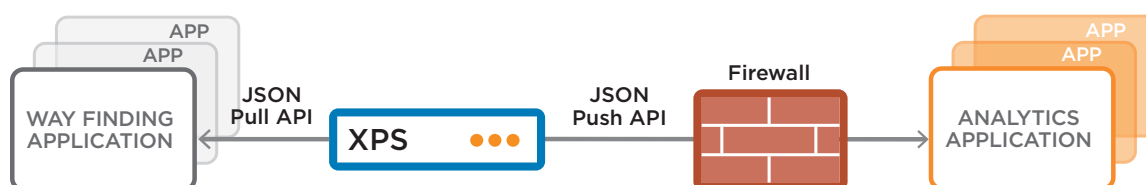


XPS determines location for Wi-Fi clients (blue) and rogue APs (red) directly on floor plans of your deployment.

Easily Integrate With Application Ecosystem

XPS easily integrates with other applications, including 3rd party industry-specific platforms. The solution's application programming interfaces (APIs) are built on a standards-based RESTful JSON API. This approach simplifies the integration with other applications and reduces the time needed to realize location information's value.

The platform supports both the pull and push methods of delivering location information through the APIs. Providing the ability to either push the information periodically to external systems, or pull the information periodically from XPS, this flexibility simplifies application integration efforts. To ensure tight security, many firewalls do not allow external applications to pull information from the internal system. In such instances, XPS can push the data to the external systems without compromising firewall integrity.



Single Dashboard to Configure and Deploy

Since XPS is integrated with the Xirrus Management System (XMS) for Wi-Fi network management, it takes only minutes to configure. From a single management dashboard, IT staff can locate clients in real-time on floor plans imported into the system. XMS provides a graphical user interface to visualize the location of each Wi-Fi device. When queried for a client's data, XMS pulls that information from XPS and presents it to the IT operations staff — with devices placed on the imported floor maps for easy physical location tracking. The solution can track all types of Wi-Fi-enabled devices — including BYOD devices, IoT sensors, rogue access points and more. Further, XPS runs on VMware virtual servers and requires no dedicated hardware appliance. Instead, using a highly-efficient data format, the solution requires only minimal bandwidth to send data from the APs to XPS.

Best Practices to Deploy XPS

While XPS provides all the fundamental requirements of an outstanding Wi-Fi location service, Wi-Fi operators should still follow certain configuration guidelines to maximize the solution's effectiveness. The following covers what Xirrus recommends when deploying XPS to ensure a high-performing and highly-scalable implementation.

- **AP Configurations:** In order to guarantee effectiveness, make sure to run all APs on the latest version of the AOS software. Configure and set the Xirrus Roaming Protocol (XRP) to “broadcast tunneled” or “tunneled in range.” Finally, if you plan to locate and track unassociated devices, make sure you have one radio enabled for radio frequency (RF) scanning of all channels.
- **Designing for Higher Accuracy:** Achieving high accuracy in locating devices requires some considerations in network design. To achieve accuracy of 3-10 meters for any device, set up your Wi-Fi network so that any and all clients remain visible to at least three APs when in the network coverage area.
- **Tracking in High Density Environments:** High-density environments may require special tuning for better accuracy. Specifically, do not use the “tunneled in range” setting for a high-density deployment. Ideally, you should instead set the Xirrus Roaming Protocol (XRP) to “broadcast tunneled” for these high-density environments.
- **Network Port Configuration:** Xirrus APs upload location information to XPS using the standard HTTP protocol, meaning the LAN should allow port 80 traffic to ensure optimal connectivity. Finally, if you use a firewall in your environment, make sure to unblock port 443 (https) to allow encrypted traffic from XPS and 3rd party applications.
- **Location for Outdoors:** The high gain of external antennas causes an adverse impact on AP location calculations. Do not deploy XPS using Xirrus outdoor APs that have high-gain external antennas. Xirrus has a wide selection of omni-directional antennas as well as indoor APs that can be used with outdoor enclosures.

Conclusion

In this highly-mobile, always-connected age, we expect Wi-Fi to provide more than just Internet access. Users look for site-specific value-added services, applications and features that provide an enhanced experience. Wi-Fi location services can greatly facilitate these offerings with solutions that meet critical user and site demands, including real-time device tracking of associated and unassociated devices, scalability to thousands of users with no performance degradation and easy extensibility to other applications. Meeting all these demands can pose a challenge — but when it's done right, both users and network operators gain significant value.

The Xirrus XPS was expressly designed to overcome these challenges. The XPS represents the industry's fastest location engine, featuring a unique distributed processing engine that allows for the real-time tracking of up to 100,000 devices. It integrates seamlessly with the XMS system, and provides the necessary scalability, flexibility, low latency and security for any enterprise scenario.

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