dB Performance

Using CCX with
Wi-Fi Alliance Passpoint® and
Cisco CMX Location Services

List of Acronyms

API   Application Programming Interface
AP   Access Point
ASD   Application Specific Device
BYOD   Bring Your Own Device
CCKM   Cisco Centralized Key Management
CCX   Cisco Compatible eXtensions
CMX   Connected Mobile eXperiences
GUI   Graphical User Interface
IE   Information Element
IEEE   Institute of Electrical and Electronics Engineers
IP   Internet Protocol
OS   Operating System
QoS   Quality of Service
RRM   Radio Resource Management
STA   Station
UI   User Interface
VoIP   Voice over IP
WFA   Wi-Fi Alliance

Introduction

Passpoint and Cisco CMX are several recent Wi-Fi enhancements that provide the user with improved connectivity and services - but there are some functional limitations. This whitepaper describes how a CCX-enabled mobile device can address these functionality gaps.

Passpoint

Originally known as Hotspot 2.0, Passpoint was introduced by the Wi-Fi Alliance in 2012. The first release of Passpoint allowed mobile devices to automatically detect and connect to secure public hotspot networks. Since then, the Passpoint specification has evolved to include automatic hotspot credential provisioning on the mobile device – making the initial public hotspot connection a seamless user experience.

While Passpoint automates the initial hotspot connection for the user, it does not provide a mechanism for the mobile device to roam without interruption (fast roam) between access points of a larger hotspot venue, such as an airport or office. In addition, Passpoint does not provide a mechanism for load balancing in congested environments, or allowing priority Wi-Fi access in emergency situations.

Cisco CMX

Cisco CMX is a powerful platform for venues or enterprises to manage and engage users using location-based services. A key component of CMX is the ability to locate the user using Wi-Fi.

While CMX works with all Wi-Fi enabled BYOD devices, location accuracy is not optimal because most mobile devices do not provide radio measurements for the wireless infrastructure - which significantly limits the accuracy of the location measurement.

What is CCX?

CCX is a group of Cisco proprietary Wi-Fi extensions designed to address functional gaps in the current Wi-Fi Alliance WPA specification, such as fast roaming performance, load balancing, and location accuracy.

CCX is already available today on nearly all Cisco access points. However, CCX functionality is also required on the mobile device in order to leverage the powerful features of CCX.

CCX-enabled access points and CCX-enabled mobile devices are backwards-compatible with legacy 802.11 networks and forward-compatible with newer 802.11 standards such as 802.11ac.

The following table summarizes the full list of CCX features (with the features discussed in this whitepaper shown in **blue**):

CCX Feature	Description
AP control of client transmit power	Minimize interference in dense AP networks
AP-assisted roaming	STA receives information from AP to make intelligent roaming decisions
Fast re-authentication	**Expedited WPA key handshake to reduce roaming time to 125 milliseconds or less**
Radio measurement requests	**STA submits radio signal/bandwidth data to AP to optimize network performance and location accuracy**
L2 Roaming enhancements	Dynamic updates of AP roaming information to improve network edge performance
Call admission control	Maintains VoIP call quality during network congestion
Voice and traffic stream metrics	Detect and correct packet latency/loss problems in the wireless network
Location-based services	STA location reporting to enable location-specific services
Link test support	Tests the quality of the wireless link
Diagnostic channel	Support for a separate channel for diagnostic support
Client reporting	STA provides detailed hardware, capability and network statistics information to the AP
Roaming and real-time diagnostics	STA provides diagnostic information to AP to fix performance or connection problems
Expedited bandwidth request	**Provides priority for VoIP or emergency wireless traffic**
Status and result code support	Specific AP requests that are performed by the STA to address network security or performance
Performance	**Additional enhancements for load balancing and fast-roaming**

Passpoint with CCX

Network operators can leverage CCX "carrier-grade" features to offer Wi-Fi based calling and media extensions, along with E911 and location-based advertising. Offices and industrial facilities can use CCX to extend location coverage where GPS is not available.

CCKM Fast Roaming

When a CCX-enabled mobile device associates with a CCX-enabled access point, CCKM Fast Roaming is used to reduce the access point roaming time to 125 milliseconds or less. This allows a user to maintain a VoIP call or streaming media session without noticeable interruption.

While the IEEE 802.11r fast-roaming specification provides similar functionality to CCKM fast roaming and has been available since 2008, it has not been widely adopted due to the lack of a comprehensive interoperability test plan and guaranteed performance test plan. In contrast, the CCX specification includes a full test plan for CCKM fast roaming performance.

Directed Roam Frames

In congested environments, CCX can also direct a CCX-enabled mobile device to roam to an under-utilized nearby access point to provide more bandwidth if the current access point is at capacity. This provides a more consistent user experience in venues with varying usage densities.

There is currently no published IEEE or WFA specification that provides the above functionality.

Expedited Bandwidth Request

In emergency situations, CCX also has the ability to prioritize a VoIP call (e.g. a 911 emergency call) over all other traffic. This feature, along with enhanced location accuracy discussed in the next section, can be extremely valuable for locating the user for emergency applications.

There is currently no published IEEE or WFA specification that provides the above functionality.

CMX with CCX

CCX provides the mobile device with unprecedented accuracy and flexibility in location measurements, using technology available today.

CCX Radio Resource Management (RRM)

With CCX, a mobile device can perform additional radio and path loss measurements that can be submitted to the WLAN infrastructure for further analysis. With CCX, the WLAN infrastructure can analyze the nearby access point signal levels as seen from the wireless device itself, rather than relying only on measurements of the mobile device signal received by nearby access points. The result is a much more accurate location measurement.

A CCX-enabled mobile device also improves the location measurement latency. The WLAN infrastructure can request measurements on-demand and at regular intervals while the device is moving. With a non-CCX enabled device, the access point must wait for the device to send an 802.11 probe request before it can capture the signal strength of the device – which may take 10 seconds or longer to occur - and could result in significant location error.

While the IEEE 802.11k Radio Resource Management specification provides similar functionality to CCX RRM, it does not define a mechanism for delivering the radio measurements from the mobile device to the access point. As a result, 802.11k is typically implemented only for the benefit of the mobile device. In contrast, the CCX specification includes the protocol capability for the wireless infrastructure to receive the radio measurements, and a full test plan to verify compliance.

Location Calibration

A CCX-enabled mobile device can also be configured to receive unicast measurement requests from the WLAN infrastructure at frequent intervals for calibration or site survey purposes. This allows the WLAN infrastructure to target a specific device without affecting other devices on the network.

Summary

CCX-enabled mobile devices provide an enhanced Passpoint and CMX user experience. Users can roam seamlessly and reliably within a hotspot venue using CCKM Fast Roaming and CCX load balancing. Network operators with CCX-enabled smartphones can unlock new Wi-Fi offloading opportunities and location services.

Greater location accuracy, coupled with CCX expedited bandwidth capabilities, allows factories and industrial environments to provide their employees with a higher level of safety and emergency response.

CCX allows mobile device makers to differentiate their products by providing premium performance and tangible value for their customers, using existing Cisco WLAN infrastructure and wireless standards.

For more information on implementing CCX for mobile devices, contact sales@dbperformance.com or visit our website at www.dbperformance.com.