Extricom

White Paper

The Extricom LS-3000

Channel Blanket™ WLAN Technology for Very Large-scale Deployments

Satisfying Warehousing & Logistics Wireless Needs

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Introduction

Extricom's Channel Blanket™ has earned a reputation in the enterprise WLAN industry as the 'go-to' solution for organizations that want to realize the dream of true wireless mobility, along with wire-like connectivity and throughput, even in the most challenging RF environments. Those close to the WLAN industry know that in such environments, traditional WLAN architectures struggle to deliver the goods.

The LS-3000 makes the Channel Blanket available to a new range of customers: those with potentially very large-scale WLAN deployments, such as are common in logistics hubs, regional medical centers, and hospitality applications.

This white paper reviews the unique challenges that must be overcome to achieve "true" wireless connectivity in large warehouses and logistics centers, and what makes Extricom LS-3000 the preferred wireless deployment solution for this environment.

Logistics - A Tough Wireless Environment

In large warehouses and logistics sites, the requirement for seamless and reliable wireless connectivity presents a difficult challenge for WLAN. The reason is that logistics centers are large buildings filled with metal structures, moving vehicles, and changing inventory, all of which contribute to a dynamic RF environment that can be a classic WLAN's 'worst enemy'. We will elaborate on this below.

Figure 1 Typical Logistics Center

The Top Challenges for WLAN Deployment in Logistics Sites

A logistics centre is typically a large area filled with metal structures, racks and corridors. As shown in figure one, this results in 'RF canyons' that are challenging for effective wireless coverage.

Second, RF conditions change frequently and drastically, due to movement of goods, which can undo the tedious and expensive cell planning that is a prerequisite for deployment of traditional wireless LAN's.

Third, co-channel interference (bleeding of strong RF signals into distant cells running on the same channel) is particularly common in microcell deployments, due to metal walls, which create a high degree of RF reflections and consequent multipath interference. This results in slow performance.

Fourth, in a microcell environment, the productivity of a highly mobile workforce can be negatively impacted by roaming and re-authentication issues, as WLAN clients move from cell to cell.

In logistics sites where seamless mobility is critical, during handoff (disassociation & re-association), no service is available to the client in either direction. Furthermore, the handoff is even more complex if standard security (such as WPA2) is enabled. WPA2, for example, can require complex log-in procedures

which can easily consume ten or more seconds. Adding all of the above factors together, the requirement for reliable wireless connectivity becomes a tough challenge.

Wireless Requirements for Warehousing & Logistics

The harsh RF-environment that logistics centers present, coupled with the mission critical nature of wireless deployment for logistics, leads to a difficult set of requirements for WLAN providers:

- Reliable, comprehensive communications: The WLAN must be highly resilient. Otherwise, connectivity outages will directly impact operational efficiency.
- Support a highly mobile workforce: The WLAN must meet performance needs of continuously moving wireless clients without roaming and re-authentication issues.
- Noise immunity: Logistics centres, with their metal walls and ceilings can be a nightmare for noise sensitive systems. The WLAN must be relatively noise-immune or wireless communications will slow to a crawl.
- Wire-like VoWLAN (Voice over WLAN): VoWLAN is an increasingly critical tool, and must operate flawlessly. System administrators and end-users expect toll-quality calls that are not dropped as the user moves.
- Ease of Use: The ability to handle a dynamic RF environment without requiring additional cycles of cell planning.
- User Security: Privacy of customer information is of paramount importance.

Wireless Warehousing & Logistics Applications

Competitive pressures and the resulting drive towards higher efficiency, are leading more and more logistics operators to deploy mission-critical applications that require a WLAN. A few examples of these applications are:

- Wireless bar-code readers
- AGV's (Automated Guided Vehicles): The top fulfillment centers around the world are beginning to deploy AGVs. The sheer volume of transactions and low time to ship means that AGV's are always in motion and there is no time for stoppages or other WLAN problems. Every minute counts. Smooth, zero-handoff mobility, is critical for the smooth operations of AGV's.
- RFID/Asset Tracking: A key component providing significant gains in inventory management.
- Infrastructure Build-outs: WLANs allow enterprises to quickly expand or modify logistics center space in response to changing operational demands.
- Communication - Voice over WLAN (VoWLAN) promises dramatically improved employee accessibility in large logistics centers.

Extricom LS-3000: Built For Large-Scale Deployments

As wireless operation became an essential part of logistics centers, the frequent handoffs and co-channel interference problems of traditional wireless LANs, became less and less tolerable to logistics center operators. As a result, over the last several years, many logistics centers have turned to the Extricom's Channel Blanket™ WLAN, which provides seamless roaming, and wire-like reliability to mission-critical, 100%-mobile environments.

In response to market demand, Extricom has been constantly expanding the maximum size of a channel blanket. In 2010, Extricom released the Switch Cascade, which enabled a channel blanket seamless coverage of a logistics area of up to 27,000 m^2, while supporting up to Extricom 32 AP's.

While this size of channel blanket is sufficient for medium-sized logistics centers, large and very large logistics centers needed to be covered with two or three channel blankets. The resulting solution was 'almost seamless': a wireless AGV (Automated Guided Vehicle) or a wireless enabled forklift truck, would experience one or two handoffs as it travelled from one side of the logistics center to the other. This was still far superior to the 10-15 handoffs that would be required if a microcell WLAN was deployed, but it was not totally seamless.

The LS-3000 changes the paradigm. One LS-3000 can cover an area of up to approximately 100,000 m^2, with a single blanket, due to its ability to control up to 128 Extricom AP's. Such an area is the equivalent of about 20 soccer fields and puts the vast majority of logistics centers within the reach of a totally seamless Extricom wireless LAN.

The Extricom LS-3000 Architecture

The Extricom LS-3000 is a large-scale switch that drives up to eight MS-1000 Extricom edge switches. The architecture of an LS-3000 installation is shown below:

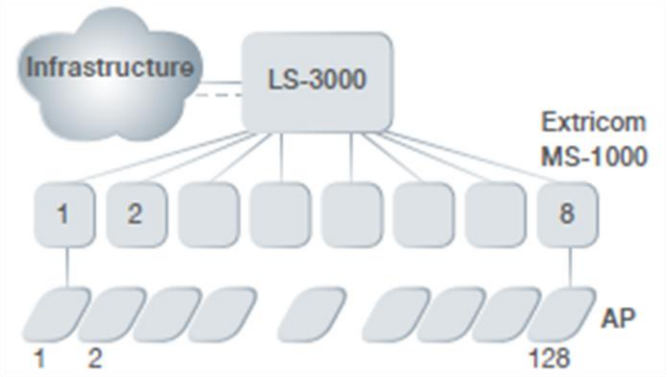

Figure 2 LS-3000 Architecture

Each MS-1000 edge switch supports up to 16 Extricom UltraThin AP's, so an LS-3000 can support up to 128 UltraThin AP's.

In order to ensure zero-handoff, seamless roaming, mobile clients associate directly with the LS-3000 switch. Network configuration details such as SSID's, security profile, blanket channel selection, and VLAN assignments are maintained in the LS-3000.

The Channel Blanket

A Channel Blanket is an area of wireless coverage that is created by several access points operating on the same channel, controlled by a central switch. A Channel Blanket is created by assigning the same basic network ID (BSSID) and same channel to one of the radios in each of the access points in the service area. Because the access points are controlled and coordinated by a central switch, AP transmission is tightly coordinated and there is no co-channel interference within the channel blanket.

In order to multiply system bandwidth, Extricom AP's have 2 or 3 radios, depending on the model, allowing the deployment of 2 or 3 channel blankets in any given area, as illustrated in the diagram below:

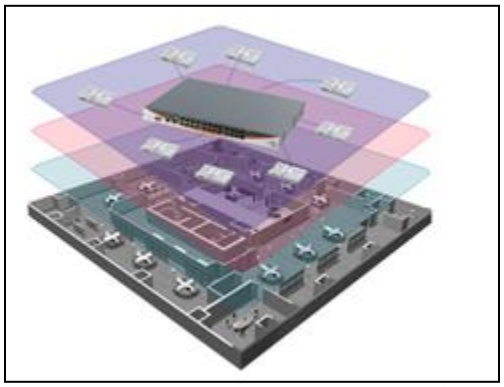

Figure 3 Channel Blanket Deployment

Each channel blanket is operating on a different channel, so there is no co-channel interference between the blankets.

The LS-3000 brings all of the channel blanket characteristics and benefits to a large-scale environment.

High Capacity

As mentioned above, Extricom AP's typically have 2 or 3 radios, allowing the deployment of up to 3 channel blankets in any given area, to multiply bandwidth.

Since each channel blanket is operating on a different channel, there is no co-channel interference between the blankets.

Because there is no co-channel interference to worry about, Extricom AP's can be located closer to each other than in standard microcell WLAN's. When AP's are located closer together, the result is that clients are always closer to the nearest AP which means the wireless client-AP link operates at a much higher data rate. The net result: average system throughput is significantly higher.

Another capacity-raising technique that is easy to achieve with the Channel Blanket architecture, is to run 802.11n channel blankets in HT (High Throughput) mode. In this mode, all clients are forced to use the faster 802.11n to communicate with AP's. Legacy 802.11a/b/g clients that cannot communicate on 802.11n, are relegated to one of the other channel blankets.

Unique In the Industry: TrueReuse™

A 4th way that Extricom increases system capacity even further, is its unique, patented TrueReuse™ technology, which enables up to three simultaneous downlinks on the same channel blanket.

TrueReuse raises system spectral efficiency to a level that is unmatched in the wireless LAN industry.

Looking Ahead: 802.11ac

802.11ac, when it reaches the market in 2013, will increase channel blanket capacity even further. In fact, Extricom's WLAN is the only one that will be able to implement all of the 802.11ac channel widths, including the ultra-high speed 160 MHz channel width, whereas microcell solutions will be practically limited to 80 MHz-wide channels.

Microcell WLAN and Logistics Centers: A Stormy Marriage

The Intrinsic Co-channel Interference of Microcell WLAN's

Microcell WLAN's have an architecture that looks like this:

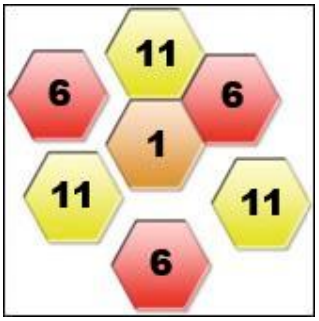

Figure 4 Microcell WLAN

This architecture is very susceptible to co-channel interference, because the channels need to be separated far enough that AP's on the same channel do not hear each other, yet the radio emission of an AP can easily 'bleed' into the coverage area of another AP that uses the same channel.

In large-scale deployments there are typically over 100 AP's, yet in the 2.4 GHz band there are only three channels. Channel reuse is a must, as shown in the diagram above.

The 2.4 GHz band is still critical today because there are many devices that do not support the 5 GHz band. Extricom's unique architecture turns the 2.4 GHZ band from a liability to a prime source of additional bandwidth. This is in contrast to competing WLAN's that cannot leverage the 2.4 GHz band effectively.

WLAN's 5 GHz band presents many more channels, at least in theory. There are 21 available channels @ 20MHz channel width. This is a big improvement over the 3 channels available at 2.4 GHz, but there is still channel repetition once the number of AP's in the deployment climbs above 21. Furthermore, if the organization wants to benefit from the faster 40 MHz wide channel width, then the number of available channels drops to 10. If the site is near radar, then DFS (Dynamic Frequency Selection) becomes an issue and the number of useable 40 MHz channels drops to just 4 (!).

Metal Walls Make It Even Worse

Co-channel interference is especially severe in logistics centers, where the metal walls and roofs reflect RF in many directions. Significant co-channel interference has a heavy price: it slows system throughput to a fraction of capacity. This plays havoc with microcell WLAN's.

One of the ways that microcell WLAN solution providers try to reduce this severe problem in logistics centers is through use of relatively expensive YAGI antennas, which are highly directional.

The problem with the microcell + YAGI solution is that the client must still switch channels every time it moves to a different aisle, which puts a damper on mobility. YAGI antennas also add an additional expense to wireless deployments.

Microcell WLAN Architecture vs. Extricom Channel Blanket – Meeting the Logistics Challenges

The table below compares the microcell WLAN architecture to the Channel Blanket architecture on key issues:

Microcell WLAN Architecture	Extricom LS-3000 Channel Blanket Architecture
Built-in Link Redundancy	
In the microcell architecture, the client is associated with one AP only. As the client moves, the AP may be suddenly obscured by some object, so the link transmission stops, resulting in performance degradation.	Built-in link redundancy. Unique in the industry is the fact that any AP on the same blanket that hears the transmission by the client transmits it to the switch (the switch removes any duplication before forwarding the transmission). The client is not associated with a single AP. It is associated with the channel blanket. The result is that several AP's are likely to hear the transmission and the likelihood of at least one flawless client-AP transmission is high.
Seamless mobility	
Microcell WLAN architecture will cause a client to handoff multiple times as it moves across a large logistics center.	Provides zero-handoff capability while covering an area of up to 100,000 m^2
Support for varied wireless application types	
Different services have to share a single radio	Different services can be *physically* separated by leveraging separate channel blankets
Easy Deployment	
• Complex design and deployment (cell-planning) • Changing RF environment may require additional cell-planning cycles	• Simple design, deployment and maintenance • Adding additional APs is simple (no cell-planning , just plug & play)

Wire-Like VoWLAN	
Limited, no differentiation between types of wireless application devices, average support rate is lower. • 802.11e protocol less powerful with data interruptions	LS-3000 Channel Blanket enables multiple separate layers of service. Voice and data can be separated in dedicated blankets. • Minimizes protocol interaction between voice and data traffic • 802.11e protocol does a better job without data interruptions • Allows better QoS and more calls per channel
Co-channel Interference	
In microcell WLANs, transmissions must be contained to a particular area, yet they inevitably 'bleed' into other cells operating on the same channel, causing co-channel interference and drastically reducing throughput.	The very nature of the Channel Blanket architecture means there is no co-channel interference.

Table 1 Microcell vs. Channel Blanket

Summary

Wireless network deployment in large warehouses and logistics centers imposes a unique challenge: the need to provide true and seamless wireless connectivity throughout huge areas of hostile RF environments.

Extricom's Channel Blanket technology is ideal for meeting this challenge. The LS-3000 brings the Channel Blanket to areas of up to 100,000m^2. This puts the vast majority of logistics centers within the reach of an Extricom wireless solution.

That is good news for the largest mission-critical logistics centers, that are now able to leverage the wireless LAN that behaves like a wired LAN: the Extricom Channel Blanket.