WHITE PAPER

# Wireless Technologies in Industrial Markets

## Addressing the Container Ports Market with Mesh Technologies

## Executive Summary:

Ports represent a vital part of the international trade infrastructure for many countries around the globe. Global transportation has become an increasingly competitive marketplace and in order for ports to differentiate themselves they must offer cutting edge services that are predicated on advanced technologies. These technologies must provide the terminal with a competitive edge while at the same time increase the efficiency and productivity of the operations of the port.

Standards-based 802.11 a/b/g/n WiFi is often the wireless technology of choice for businesses, but sometimes extreme harsh RF environments or critical applications require other wireless options such as Motorola's industrial strength MEA (Mobility Enabled Access) technology. Motorola's flexible Wireless Broadband Mesh portfolio offers both 802.11-based solutions as well as purpose built MEA products. These solutions may differ in many aspects; however, one key element they share is Motorola's advanced MeshConnex™ routing algorithm. MeshConnex combines proactive and reactive algorithms, resulting in ultra-fast and scalable networks that provide robust connectivity for a business, campus or even an entire city. .

In this second paper in a series of solution papers addressing mesh technologies in industrial markets, the best solution or combination of solutions for the ports environment will be covered. This paper will describe how MEA as well as 802.11 technologies can be used in an environment that presents extraordinarily difficult radio frequency issues with scores of steel-walled containers stacked up seven high, placed in rows and rows over acres of land. Each of the wireless technologies' unique strengths and capabilities will be examined and discussed in real world scenarios. It will also demonstrate how wireless mesh networks are improving efficiency through a variety of applications that provide an excellent Return on Investment (ROI).


## WiFi and MEA – Access Solutions

For a container terminal environment two different broadband wireless communications can be considered – WiFi and MEA. These are two very distinct access technologies. WiFi is based on the 802.11 standards and off-the-shelf client devices are used to access the network. On the other hand, MEA is a purpose built industrial strength technology that was designed specifically to perform in the most challenging environments around the world.

### The Origin of WiFi

The WiFi or 802.11 standard was originally developed by the Institute of Electrical and Electronics Engineers (IEEE) with the purpose of wirelessly extending the link between the LAN port in the wall and the desktop computer. It has evolved over the years and now the generic WiFi term not only covers the 2.4 GHz 802.11b standard, but also includes products based on any of the 802.11 standards. WiFi is commonly used in enterprises to provide wireless high speed connectivity to the network for access to the Internet, email and other office applications.

### The Beginning of MEA

The purpose-built MEA technology was originally developed for the US Department of Defense, Defense Advanced Research Projects Agency (DARPA) for battlefield communications. Through its client meshing, MEA enables each client device to act as a router to and from every other device. Therefore, signals do not have to try to penetrate difficult environments, but they simply use other client devices to pass the signal along while bypassing interference-causing barriers. MEA is also built to handle strong multi-path signals and high RF interference without significant degradation. MEA meshing works with the environment and not against it, resulting in communications that are fast, reliable, and mobile.

## Considering the WiFi and MEA Technologies

Both WiFi and MEA can be used in wireless mesh networks because they are complimentary technologies that are only differentiated by the applications and the types of environments they support best. For customers in the industrial sectors that are considering both indoor and outdoor wireless connectivity it is critical that the right technology or combination of technologies are deployed for key applications such as video surveillance, remote monitoring of equipment or data access.

Previously 802.11a/b/g networks were the selected technology for communicating short distances in unlicensed radio bands. However, this is changing with the advent of high powered 802.11b/g/n solutions that offer increased bandwidth and easily enable advanced applications such as video surveillance. If indoor/outdoor connectivity is key 802.11b/g/n can also be deployed to enable standards-based outdoor networks to communicate with indoor WLANs.

However, in the harsh outdoor environment of a port, Motorola's Solo (6300 series) product with MEA technology is often the solution of choice for critical applications. MEA's strength lies in its ability to offer consistent throughput with exceptional interference mitigation. Motorola's Solo wireless mesh networks with MEA technology are able to evaluate the entire 2.4 GHz band, choosing the best channel for communications on a packet-by-packet basis. This enables the network to dynamically avoid other radio transmissions or interference. Motorola's MEA radios all feature client meshing as well, wirelessly extending and strengthening the network as the radios move throughout the terminal. This can be especially effective for reaching into the "canyons" created by parallel stacks of containers – typically very difficult to cover using only fixed infrastructure. MEA's "bullet proof" reliability ensures there is no loss in connectivity so communications are not missed and revenue is not lost.

When considering the different wireless technology choices in a port environment, the type of physical network and the types of applications that are being used will be the key determining factors. Sometimes instead of deploying a WiFi or MEA specific network, a hybrid network is implemented to leverage the strengths of both technologies. WiFi's ability to support off-the-shelf clients and higher throughputs may be important in certain areas of the network while the range, mobility and reliability of MEA technology in other parts can provide the optimal connectivity, cost-efficiency and performance for a port operator.

***Solo (6300 series)***

Motorola's Mesh Wide Area Network Solo solution is powered by a purpose-built equipment portfolio that offers an exceptional combination of cost-effectiveness, ruggedness and reliability in challenging RF environments.

The product line includes:

IAP6300 Intelligent Access Point serves as a transition point from the wireless network to the wired world or provides the functions of an enhanced wireless router by providing wireless network access to one or more IP devices via built-in Ethernet.

MWR6300 Mesh Wireless Router provides extended network mobility and coverage in the 2.4 GHz frequency band.

WSM6300 Wireless Serial Modem consists of a small compact router with a serial interface for machine-to-machine operations such as remote sensor, controller or signal connectivity.

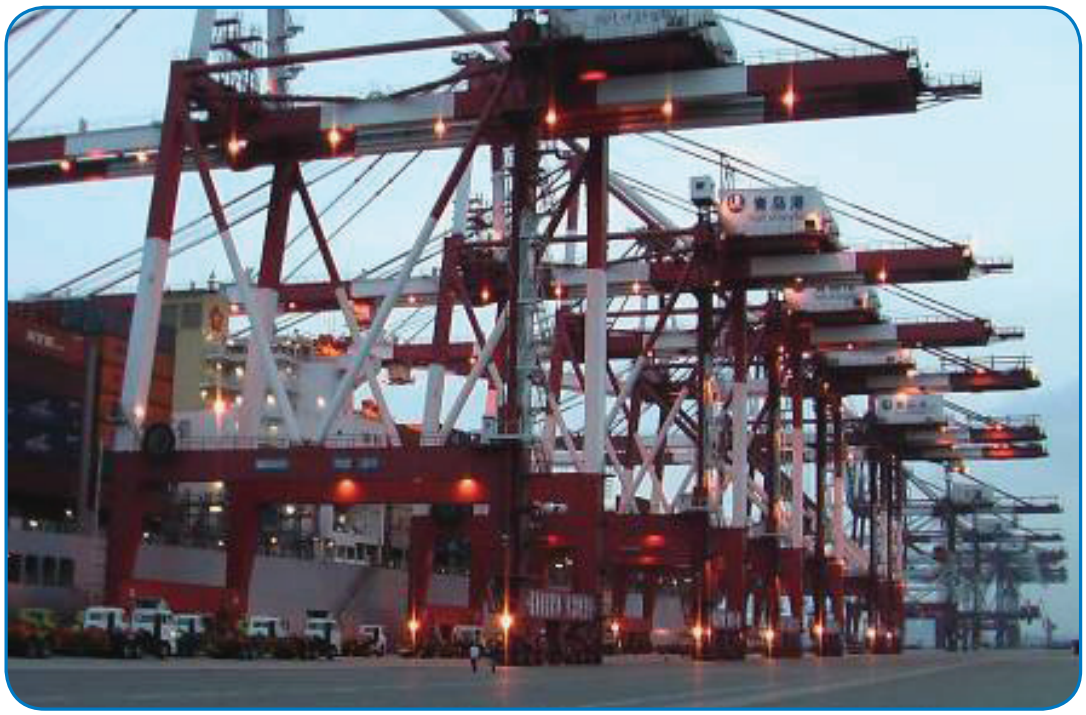
VMM6300 Vehicle Mounted Modem supports 6 Mbps burst data rates at speeds in excess of 200 mph.

WMC6300 Wireless Modem Card enables high bandwidth data and video, position location and voice services from most devices with a PCMCIA card slot.

# The Adoption of Mesh Wireless Networks in Ports

## Deploying Meshing Technologies at a Container Terminal

Port operations are looking at ways to meet operational goals and efficiencies through wireless technologies, building a consistent indoor and outdoor wireless strategy. However, a port environment presents extraordinarily difficult radio frequency challenges that can easily turn what should be a symphony into a cacophony if not deployed carefully. Therefore, it is essential to match the knowledge of the environment with the correct technology or combination of technologies, and applications.



Port operators are using mesh wireless technologies to solve a variety of challenges, including:

**Challenge:**
With increasingly larger ships coming into ports reliable communications are needed to enable Automated Guided Vehicles (AGVs) to offload containers around the clock.

**Solution:**
By selecting the best 2.4 GHz channel available the MEA technology ensures drop off and pick up information is communicated to the AGV for smooth operations making a ship's turn around time faster and guaranteeing the safety of port personnel.

**Challenge:**
Ports need to monitor the health and diagnostics of the multi-million dollar quay cranes and rubber tired gantries (RTGs) lifting the containers off of the ships and stacking them throughout the site. These large machines are critical for smooth day-to-day operations. A breakdown can slow the unloading process, reducing revenue and profitability.

**Solution:**
A MEA network provides reliable communications to monitor equipment diagnostic data and health in real-time to ensure the equipment remains in peak operating condition. Even with a port's high RF interference the multi-path capability of MEA enables secure, mobile handoffs for data communication.

**Challenge:**
With the concerns regarding terrorism and other criminal activity it is necessary to provide video surveillance of the terminal facility to prevent unauthorized access or other activities.

**Solution:**
Motorola's Duo solution with WiFi enables full motion video using standard 802.11e QoS (Quality of Service) built into the access points. 802.11e provides prioritization of video signals to ensure consistent video quality.

**Challenge:**
Dock workers, railroad operators, trucking yards, and shipboard personnel may require access to the network using standards-based WiFi clients.

**Solution:**
With 802.11b/g, connectivity is possible with the Motorola Duo mesh network using standard off-the-shelf devices. Many different parties can easily communicate to ensure operations at the port run smoothly.

***Duo (4300 series)***
Motorola's Mesh Wide Area Network Duo solution is a small, lightweight two radio WiFi meshed network.

IAP4300 Intelligent Access Point / Mesh Wireless Router serves as a transition point from the wireless network to the wired world or extends network mobility.

It supports enterprise as well as public safety networks with a 2.4 GHz WiFi radio (802.11b/g) and an additional 5.8 GHz, 5.4 GHz or 4.9 GHz (802.11a) radio.

## The Hybrid Network Option May Be Viable as Well

Port operators are now increasingly looking at multi-use networks creating a need for a hybrid network consisting of WiFi solutions such as Duo and MEA solutions such as Solo. WiFi mesh solutions such as the Duo (4300 series) would enable a port to outfit the outlying business areas with automation capabilities as well. Port operators are deploying WiFi mesh solutions in and around gate operations to enable video surveillance for tracking and monitoring the movements of containers, reading ID and chassis numbers for verification purposes, and to prevent un-authorized movements. Equally ports want to extend the office from the indoor to the outdoor for operations purposes. Standards-based client access in work yards

is necessary as well as developing applications that cross both meshing technologies for voice applications.

Hybrid networks also allow multi agency cooperation in port environments, whether it be rail operations or government security requirements. By having a combination of standard and purpose built mesh technologies ports are able to extend the network to reach other transportation or security access requirements. Rail operators and port operators are working together to enable tracking and traceability of containers beyond the confines of the dockside and a hybrid approach is taking place to enable this strategy.

## Real World Scenarios in Ports

### Upgrading Port Communications in Rotterdam

A new port in Rotterdam, was built from the ground up to offer advanced communication and automation capabilities. The port needed to control Automated Guided Vehicles in an environment with high levels of radio interference. The AGVs required instructions be sent multiple times each second in order for the vehicles to continue operating and not come to a halt. For these critical communications, a Solo MEA network was deployed providing complete coverage of the facility. Each AGV is equipped with a vehicular modem providing communications to the guidance system. MEA's highly reliable communications easily handles the simultaneous operation of dozens of AGVs unloading large vessels. Its RF interference mitigation capability ensures the AGVs remain operational at all times. Plus MEA's channel agility ensures that ship-based WiFi networks do not interfere with port operations.

### Overcoming Interference Issues in Nanjing, China

A multi-acre port in Nanjing China needed to overcome interference issues that hampered the effectiveness of their installed WiFi network. Therefore, the port operator deployed the Motorola Solo mesh network throughout the terminal. Utilizing the MEA technology, Solo was able to overcome multi-path issues and support the most important application, automatic dispatching.

## Conclusion

In summary, Motorola is the industry leader in wireless broadband solutions providing outdoor-indoor connectivity using a robust portfolio consisting of MEA and WiFi alternatives. Each technology serves different purposes. The container transportation industry is implementing broadband wireless solutions to stay competitive, and they are increasingly turning to Motorola for these solutions. Motorola can offer multiple network solutions that can enhance employee productivity and efficiency, minimize downtime and increase profitability.

motorola.com/mesh